



**MONROE CARELL JR CHILDREN'S
HOSPITAL**
**TRAUMA ANNUAL
REPORT 2022**

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**THE
COMMITTEE
ON TRAUMA**

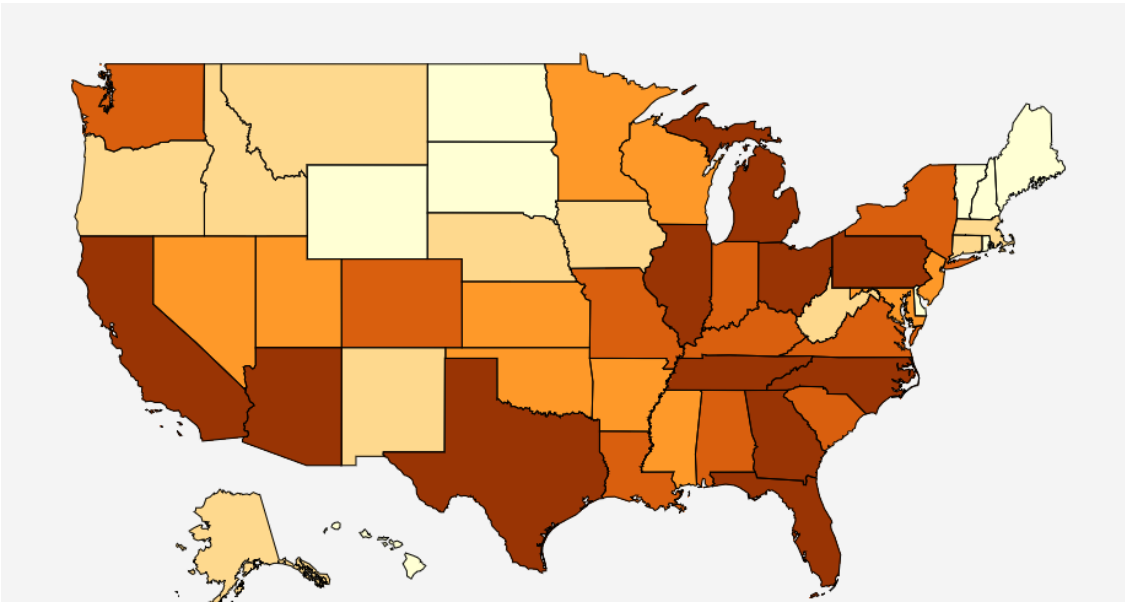


Trauma is the leading cause of pediatric deaths in the US, and other highly resourced countries, claiming the lives of >12,000 children in the US each year, more than all other causes of pediatric death combined. Roughly 150,000 injured children each year require hospitalization and most have long-term sequelae. According to the Centers for Disease Control (CDC), of the 12,402 deaths in 2020 of children ages 18 and below, 56.9% are attributed to unintentional injuries, 22.2% were homicides, and 17.6% were determined to be suicides. When looking at non-fatal injuries in 2020, the CDC reported an estimated 4,126,022 children ages 18 and below were seen and treated at hospitals across the country.

For more than 60 years, motor vehicle crashes were the leading cause of injury-related death among young people. Beginning in 2017, however, firearm-related injuries took their place to become the most common cause of death from injury. This shift demonstrates how a concerted approach to injury prevention can reduce injuries and deaths, while the lack of public attention allows the number of firearm-related deaths to rise.

When comparing the state of Tennessee (TN) to the neighboring state of Kentucky (KY), in 2020 TN had 354 deaths of children aged 18 and below while KY had 239. The number of homicides in TN were 85 versus KY's 45 and suicides in TN was 44 compared to KY's 31.

The below map reflects the rate of child deaths (≤18) across the country. With trauma being the leading cause of death of children in the United States, more attention needs to be given to how we can prevent these deaths from occurring through injury prevention, community education, and legislation focused on deterring future preventable deaths.



Monroe Carell Jr Children's Hospital at Vanderbilt

While the Trauma Service is led by Pediatric General Surgery who are pediatric-trained trauma experts, we could not provide the high level of care required by the American college of Surgeons without the expertise of every trauma team member highlighted in this document.

| Department of Pediatric Surgery | | | |
|---------------------------------|---------------------|----------------------|-----------------------|
| Attendings | | | |
| Martin Blakely, MD* | Melissa Danko, MD | Joseph Fusco, MD | Eunice Y. Huang, MD |
| Harold Lovvorn, MD | Monica E. Lopez, MD | Walter Morgan, MD | Jamie Robinson, MD |
| Jeff Upperman, MD | Irving Zamora, MD | | |
| Fellows | | | |
| | Laura Stafman, MD | Maren Shipe, MD | |
| APPs | | | |
| Kara Cole, PA | Jocelyn Gmerek, NP | Melissa Matthews, NP | Monica Milovancev, NP |
| Laura Pickel, PA | Lori Rahko, NP | Anne Ramsey, NP | Kelsie Townsend, NP |
| Whitney Wharton, NP | | | |

*No longer on the Trauma Call Panel

| Trauma Program Staff | | | |
|---------------------------|----------------------------|--------------------------|------------------|
| Amber Greeno, MSN | Stefani King, BSN | Haley Wiggins, MSN | Barb Shultz, MSN |
| Injury Prevention Program | | | |
| Stacey Pecenka, MPH, CPH | Emily Roberts, BS | Amber Sexton, BS | |
| Trauma Registrars | | | |
| Tricia Aaron, CPC | Kelly Collins, RHIA, CSTR | Kristina Rampersad, RHIT | |
| Erin Wilmore, BSN, CAISS | Bonnie Woodard, RHIT, CSTR | | |

The Trauma Program is extremely grateful for the investment of time and funds the organization has contributed to making our Program successful in providing high-quality care to the patients we serve. By funding new positions such as our Trauma Program Coordinators, Trauma Registrars, and Advanced Practice Providers, we have been able to improve patient care, increase research publications, and ensure our injury prevention efforts reflect the community's needs.

Pediatric Anesthesia

Attendings

| | | | |
|------------------------|----------------------|--------------------------------|---------------------|
| Clayton Adams, MD | Christy Crockett, MD | Brian Donahue, MD | Andrew Franklin, MD |
| Michael Kuntz, MD | James Kynes, MD | Bevan Londergan, MD | Hannah Lonsdale, MD |
| Amanda Lorinc, MD | Carrie Menser, MD | Katharina Modes, MD | Mark Newton, MD |
| Jonathan Niconchuk, MD | Srijaya Reddy, MD | David Roberts, MD | Trevor Robison, MD |
| Thomas Romanelli, MD | Heidi Smith, MD | Jenna Helmer Sobey, MD* | Brian Tinch, MD |
| Cori Van Gorkom, MD | | | |

Pediatric Critical Care

Attendings

| | | | |
|----------------------|-----------------------------|-------------------------|--------------------|
| Kristina Betters, MD | Katharine Boyle, MD | Brian Bridges, MD | William Cutrer, MD |
| Jennifer King, MD | Michael Miller, MD | Stephanie Patterson, MD | Ryan Stark, MD |
| Jessica Turnbull, MD | Richard Wendorf, MD* | Michael Wolf, MD | |

Fellows

| | | | |
|-------------------|------------------------|-------------------|---------------------|
| Subhendu De, MD | Emily Fretz, MD | Jennifer Laws, MD | Chi An Liu, MD |
| Alonso Marron, MD | Michael Santarelli, MD | Megan Shea, MD | Laura Smallcomb, MD |
| Chiara Velez, MD | Allison Weatherly, MD | | |

APPs

| | | | |
|--------------------|----------------------|---------------------|---------------------|
| Daniel Barrett, NP | Kelly Davis, NP | Courtney Hall, NP | Melissa Lashock, NP |
| Dani Ogg, NP | Herchel Portella, NP | Lindsey Riley, NP | Sidney Sloan, NP |
| Philip Thrust, NP | Jaimie Torres, NP | Cynthia Woodard, NP | |

Pediatric Neurosurgery

Attendings

| | | | |
|----------------------------------|-------------------|-------------------|-----------------|
| Christopher Bonfield, MD* | Michael Dewan, MD | Robert Naftel, MD | Jay Wellons, MD |
|----------------------------------|-------------------|-------------------|-----------------|

Fellow

Albert Isaacs, MD

APP

Haley Vance, DNP

* Trauma Program Liaison

Pediatric Emergency Medicine

Attendings

| | | | |
|----------------------|----------------------|----------------------------|----------------------|
| Tucker Anderson, MD | Donald Arnold, MD | Catherine Burger, MD | Leslie Burton, DO |
| Daisy Ciener, MD | Cristina Estrada, MD | Swathi Eyyunni, DO | Emily Fain, MD |
| Barron Frazier, MD | Holly Hanson, MD | Nicholas Higby, MD* | Mark Hincapie, MD |
| Michael Johnston, MD | Nicholas Jones, MD | Rebecca Kidd, MD | Marla Levine, MD |
| Megan Malik, MD | Jaime Otilio, MD | Clay Smith, MD | Kurt Smith, MD |
| Barbara Solomon, MD | Matthew Swarm, MD | Michele Walsh, MD | Caroline Watnick, MD |
| Valerie Whatley, MD | Saralyn Williams, MD | | |

Fellows

| | | | |
|---------------------|---------------------|---------------------|----------------|
| Taylor Anderson, MD | Claci Ayers, MD | Margaret Barton, MD | Liz Ebbens, MD |
| Tom Gilmartin, MD | Blake Gruenberg, MD | Britta Roach, MD | Jay Petosa, MD |
| Amelia Wong, MD | | | |

Pediatric Orthopaedics

Attendings

| | | | |
|--------------------|----------------------------|--------------------------|-----------------|
| Kevin Dale, MD | David Ebenezer, MD* | Nathaniel Lempert, MD | Craig Louer, MD |
| Jeffrey Martus, MD | Gregory Mencio, MD | Jonathan Schoenecker, MD | |

Fellow

Courtney Baker, MD

APP

Tracey War Hoover, NP

Pediatric Radiology

Attendings

| | | | |
|----------------------|-----------------------|------------------------|-------------------------------------|
| Kimberly Brennan, MD | Gabriella Crane, MD | Elton Greene, MD | Marta Hernanz- Schulman, MD* |
| Melissa Hilmes, MD | Lindsey Johnstone, MD | Rekha Krishnasarma, MD | Yu Luo, MD |
| Dann Martin, MD | Sumit Pruthi, MBBS | Asha Sarma, MD | Sudha Singh, MD, MBBS |
| Elizabeth Synder, MD | | | |

Interventional Radiology

Christopher Baron, MD

Radiology Fellow

Andrew Dhillip, MD

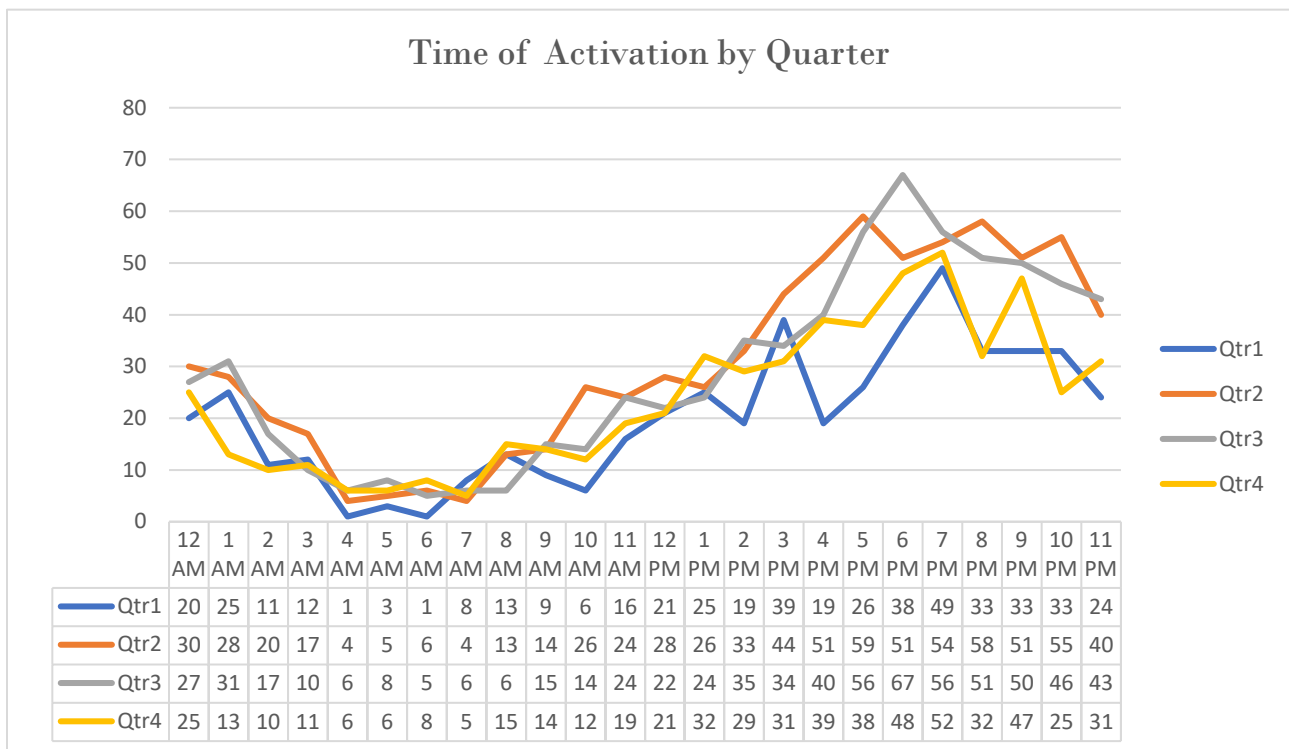
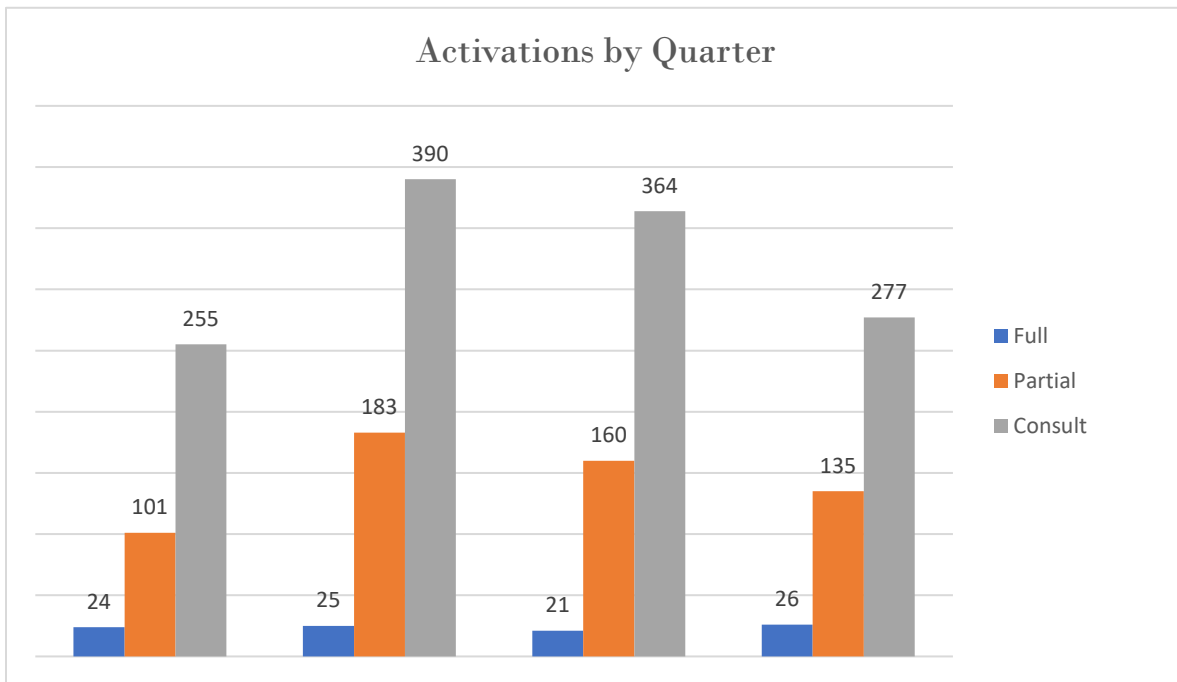
*Trauma Program Liaison

Trauma Registry Data

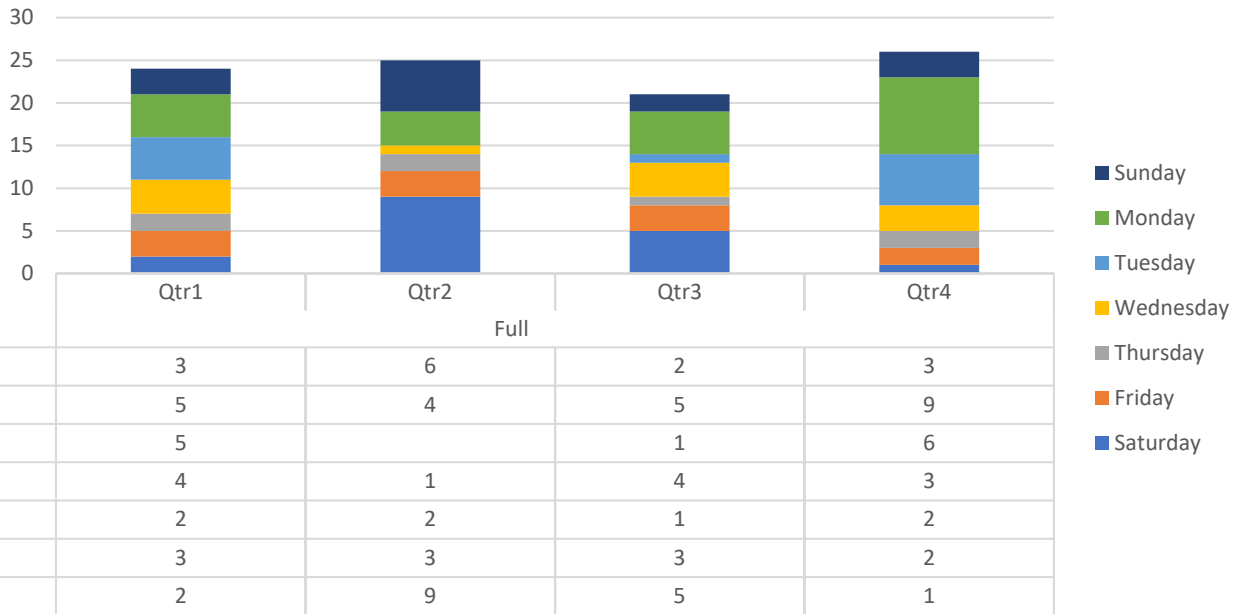
Calendar Year 2022

Trauma care is system care for pediatric patients. The data gathered in the trauma registry is extremely detailed and can be used as a snapshot of system areas of improvement that can apply to all children who enter our system and receive care.

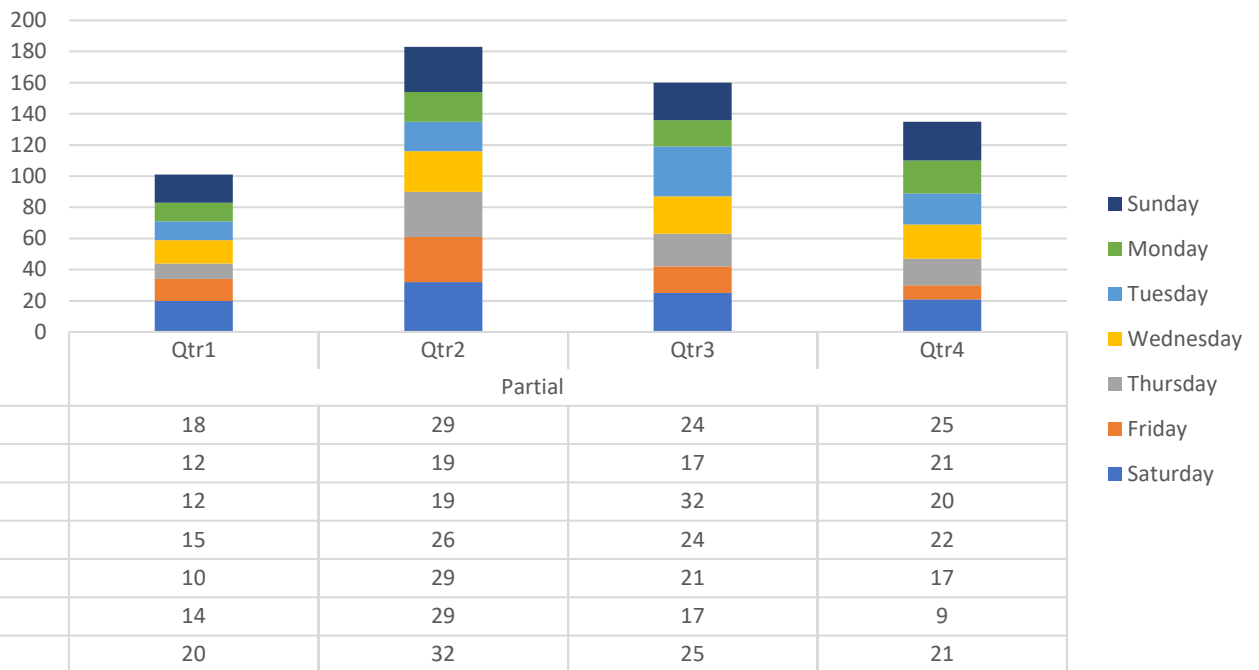
We have been identified as one of the busiest Pediatric Trauma Centers in the country and the below information reflects that.



Level I Activations by Day of the Week



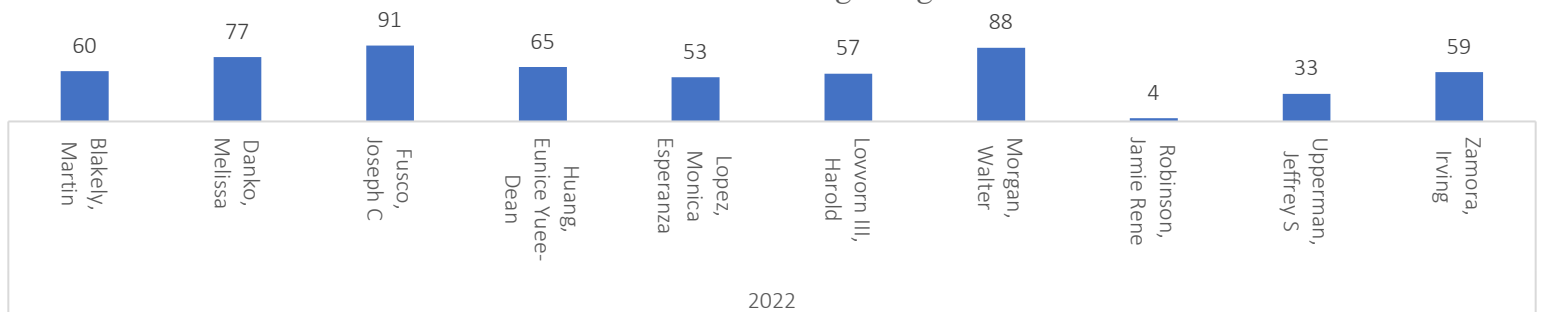
Level II Activations by Day of the Week



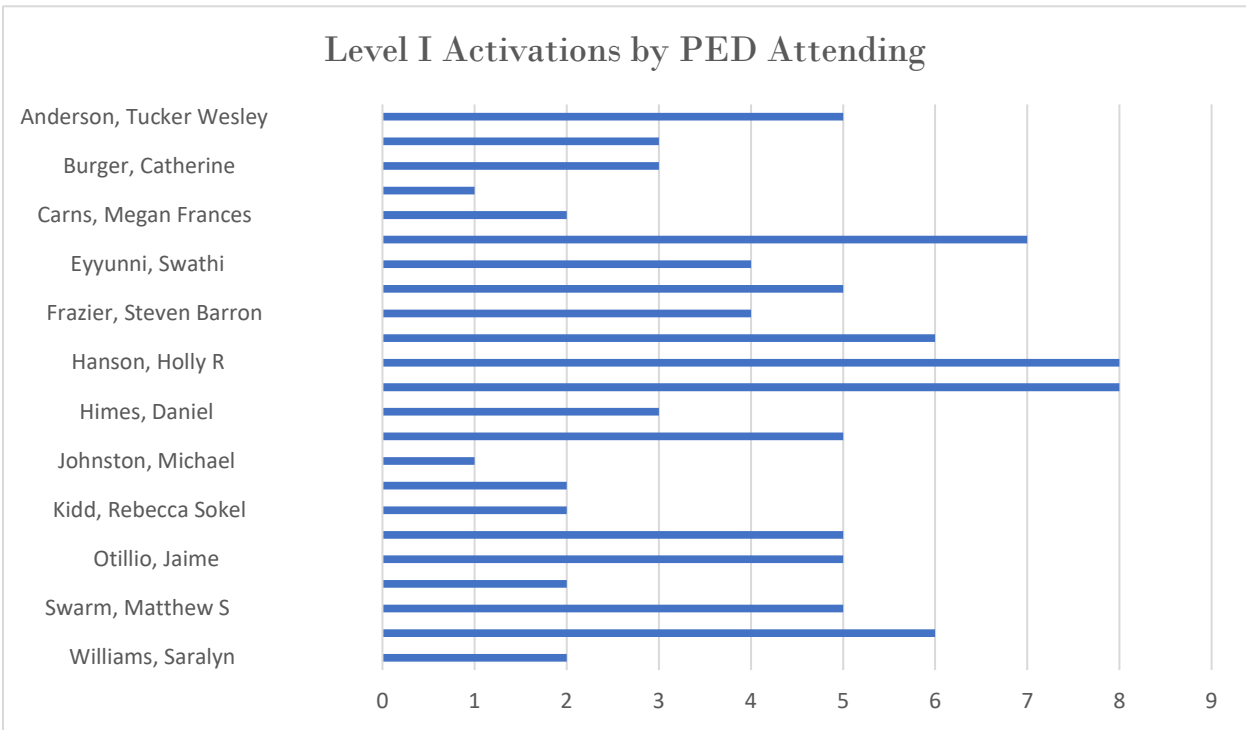
| 2022 Level I Responses | | | | | | | | | | | | | |
|---|------|-----|-----|------|------|-----|------|------|-----|-----|-----|-----|-----|
| (Some activations have more than 1 responder) | | | | | | | | | | | | | |
| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | YTD |
| Total | 9 | 6 | 11 | 7 | 16 | 6 | 5 | 11 | 8 | 16 | 10 | 2 | 107 |
| Blakely | 1 | 2 | 2 | | | | 1 | | 1 | | | | 7 |
| Danko | 2 | 1 | 1 | 4 | 2 | | | 5 | 1 | | | | 16 |
| Fusco | 2 | | | | | 2 | 1 | 1 | | 4 | 2 | | 12 |
| Huang | 1 | 1 | 1 | | 1 | | 1 | 3 | 2 | 3 | | | 13 |
| Lopez | 3 | | 1 | 2 | 3 | | | | | 2 | 2 | | 13 |
| Lovvorn | | 1 | | | 3 | 2 | | 1 | 1 | 3 | | | 10 |
| Morgan | | | | | 1 | | 1 | | | 1 | 2 | | 5 |
| Robinson | | | | | | | | | | | 1 | 1 | 2 |
| Upperman | | | 2 | | | 1 | | | 1 | 1 | | | 5 |
| Zamora | 1 | | 2 | | 3 | | | 1 | 1 | 2 | | | 10 |
| Olson | 4 | 1 | 4 | 3 | 4 | | 2 | | | | | | 18 |
| Stafman | 1 | 1 | 1 | 1 | 3 | | 1 | 2 | 1 | 5 | | | 16 |
| Shipe | | | | | | | | | 2 | 6 | 3 | | 11 |
| No Show | | 1 | 1 | | | | | | 1 | 1 | 1 | 1 | 6 |
| Past Time | | | | | | | | | | | | | 0 |
| No Documentation | | | | | | 1 | | | | | | | 1 |
| Percentage | 100% | 84% | 91% | 100% | 100% | 84% | 100% | 100% | 88% | 94% | 80% | 50% | 93% |

| 2022 Level II Responses | | | | | | | | | | | | | |
|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Total |
| Total | 29 | 38 | 40 | 57 | 77 | 59 | 51 | 54 | 56 | 56 | 36 | 33 | 586 |
| Present | 27 | 35 | 30 | 46 | 53 | 43 | 46 | 45 | 41 | 46 | 30 | 30 | 472 |
| No Show | 1 | 1 | 5 | 7 | 17 | 12 | 5 | 4 | 9 | 8 | 6 | 3 | 68 |
| Not Documented | 1 | | 4 | | 5 | 3 | 2 | 2 | 5 | 2 | 0 | | 21 |
| Past Time | | 2 | 1 | 4 | 2 | 1 | | 2 | 1 | 0 | 0 | | 13 |
| Percentage | 93% | 92% | 75% | 81% | 64% | 73% | 90% | 84% | 73% | 82% | 83% | 91% | 81% |

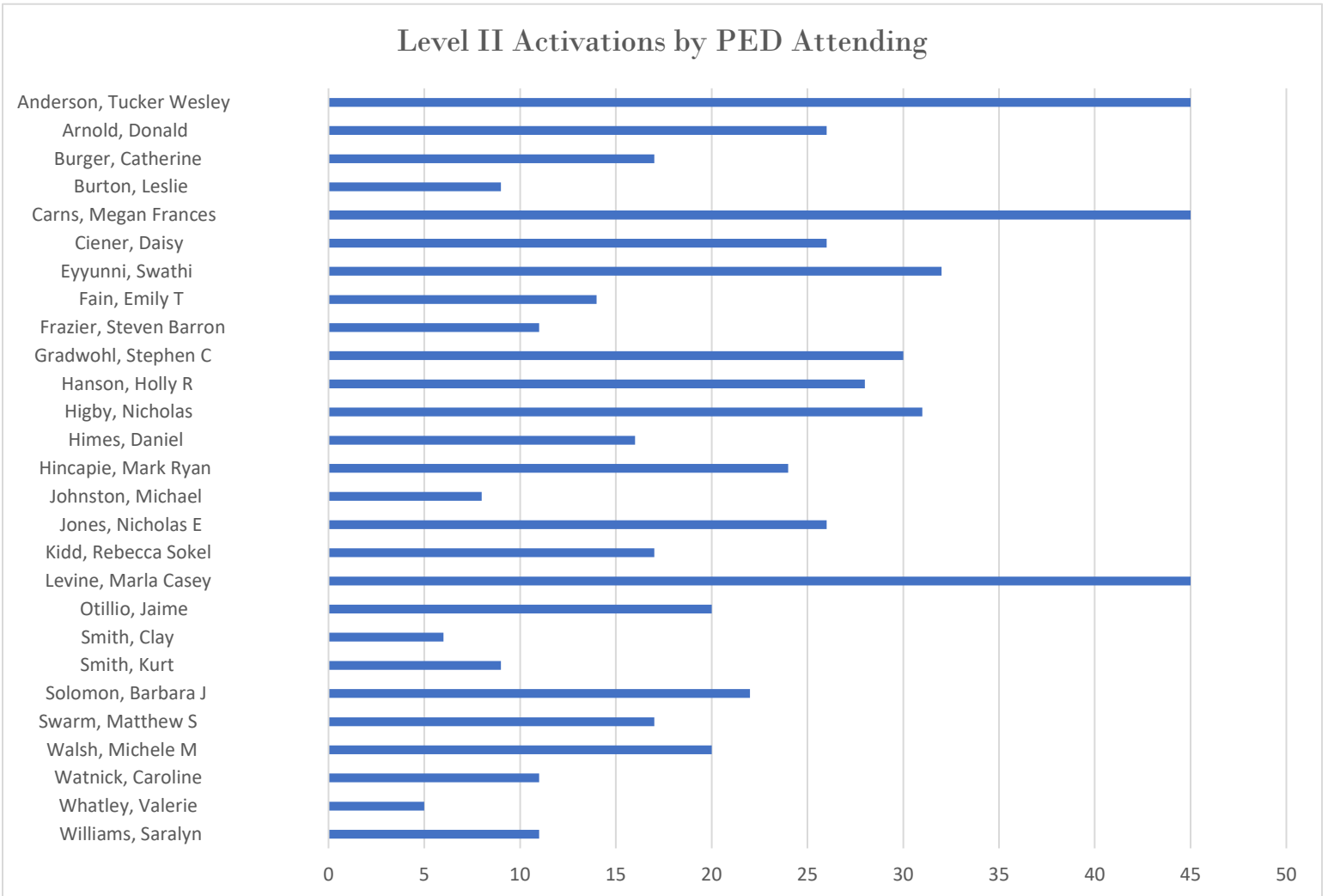
Trauma Admitting Surgeon



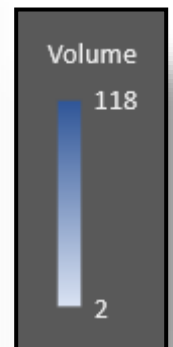
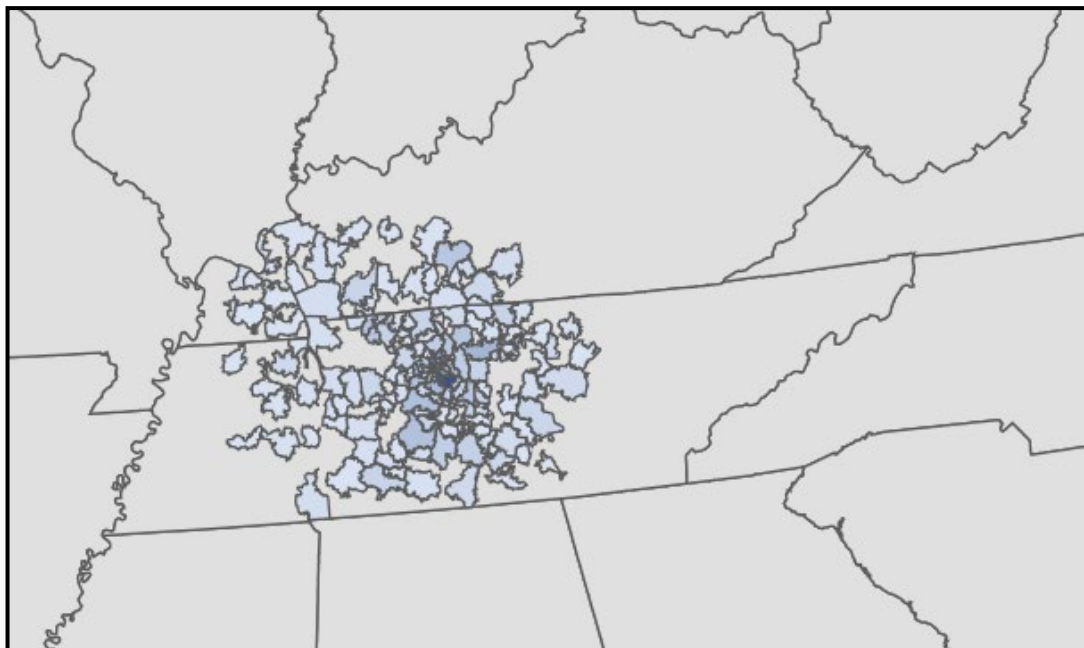
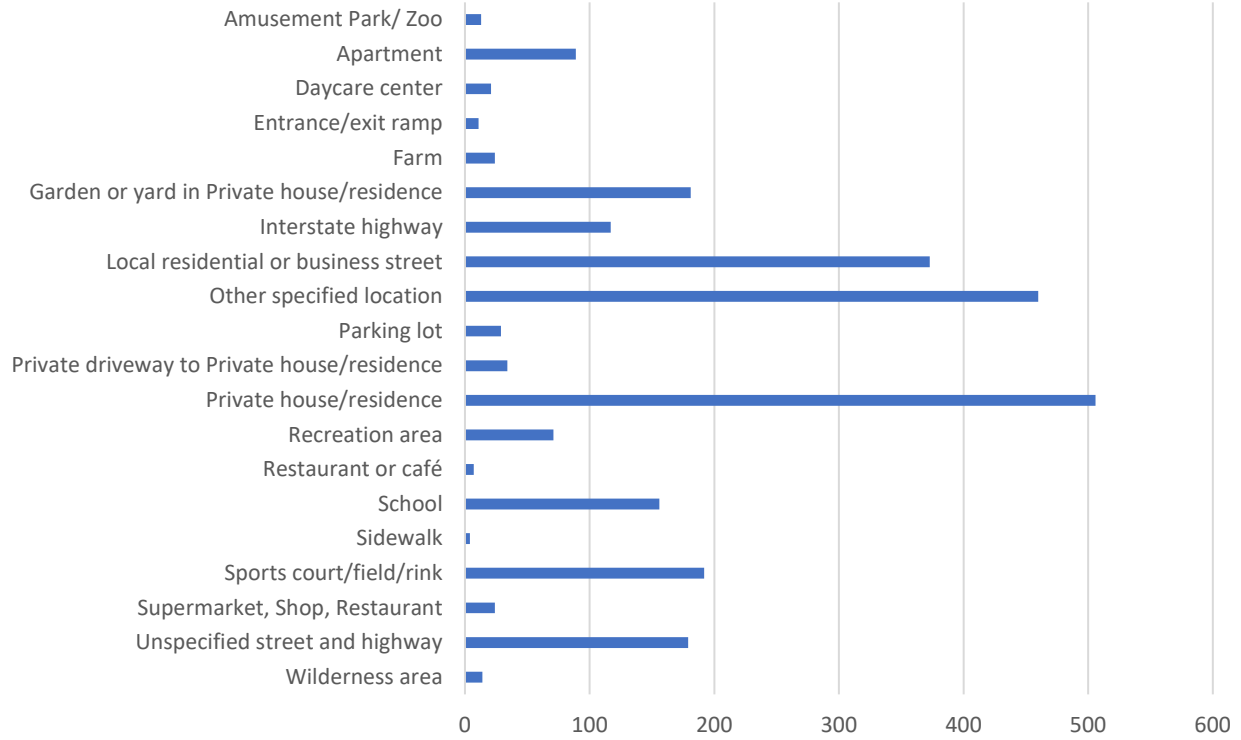
Level I Activations by PED Attending



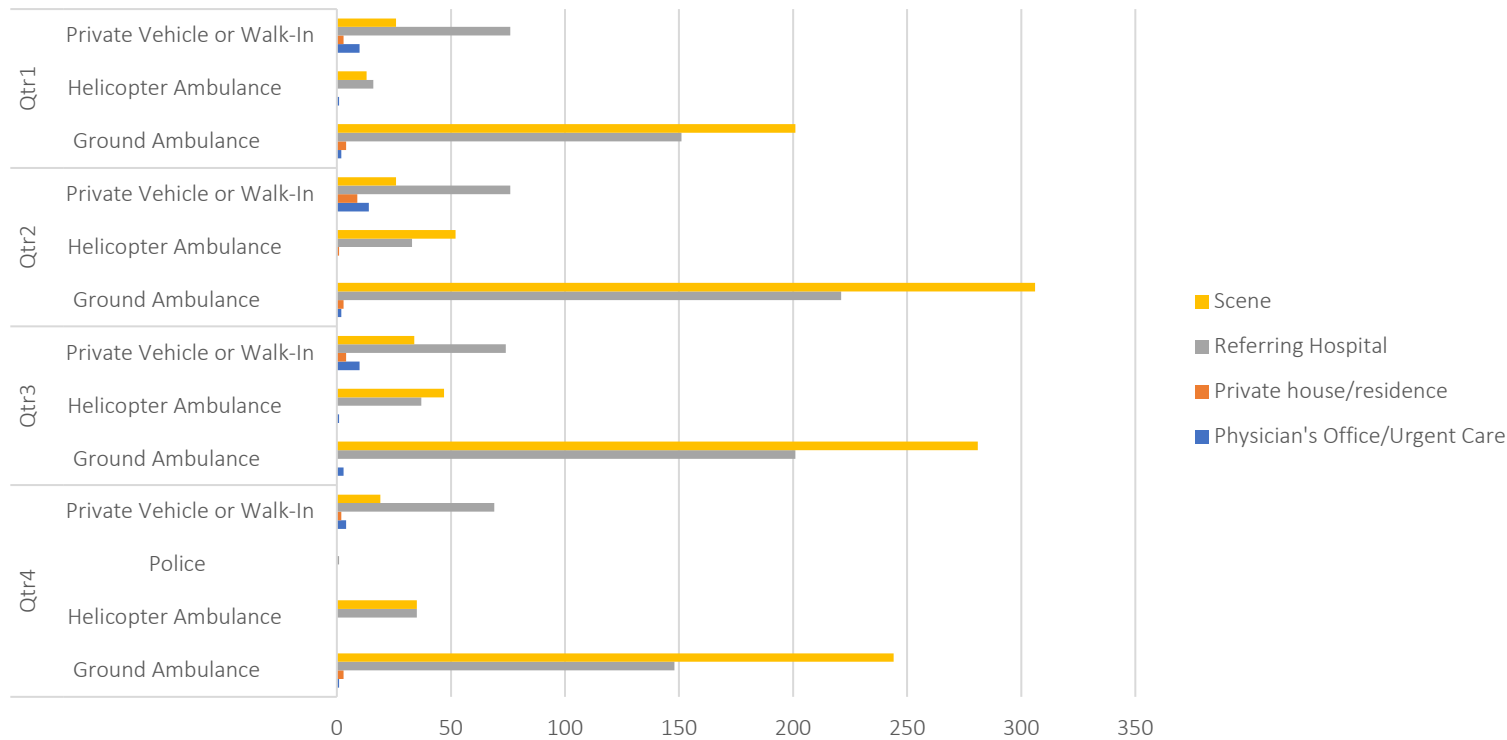
Level II Activations by PED Attending



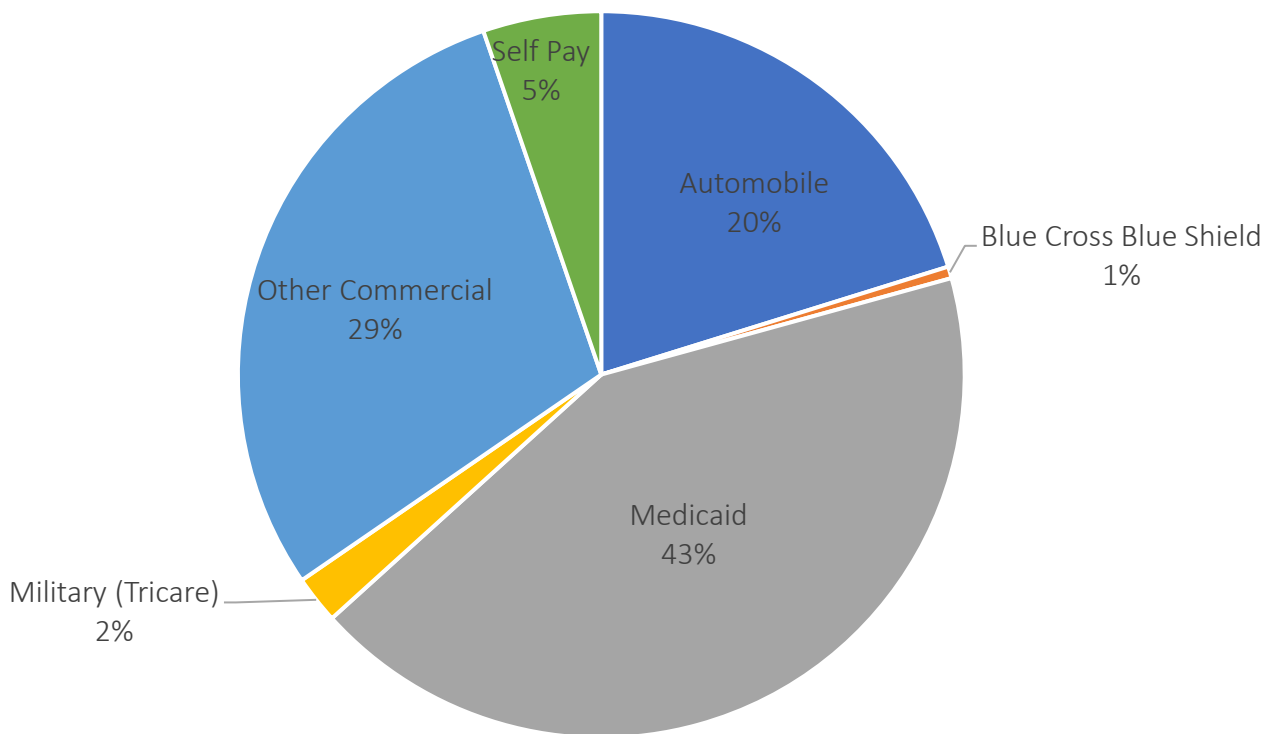
Injury Location



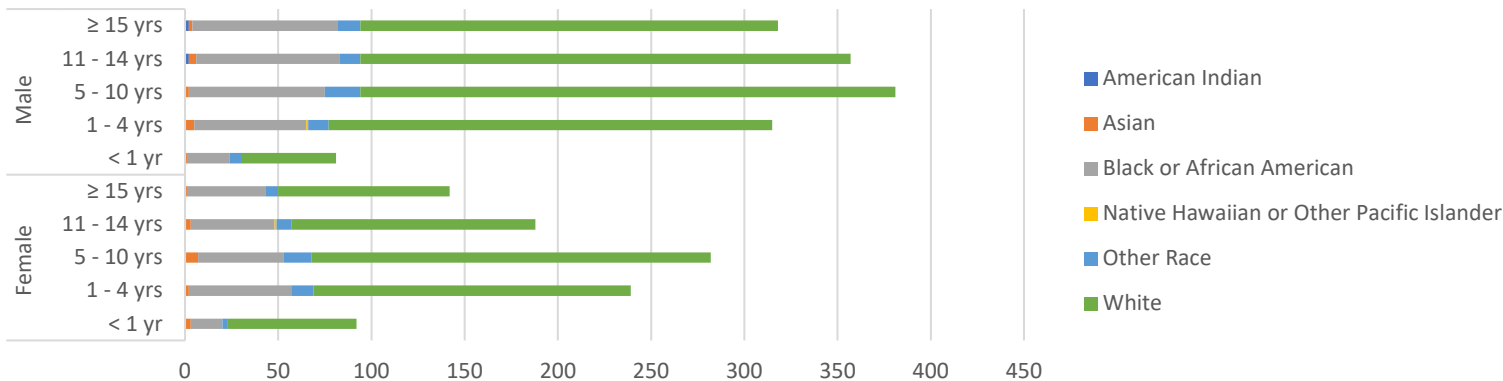
Transfer and Transport Type by Quarter



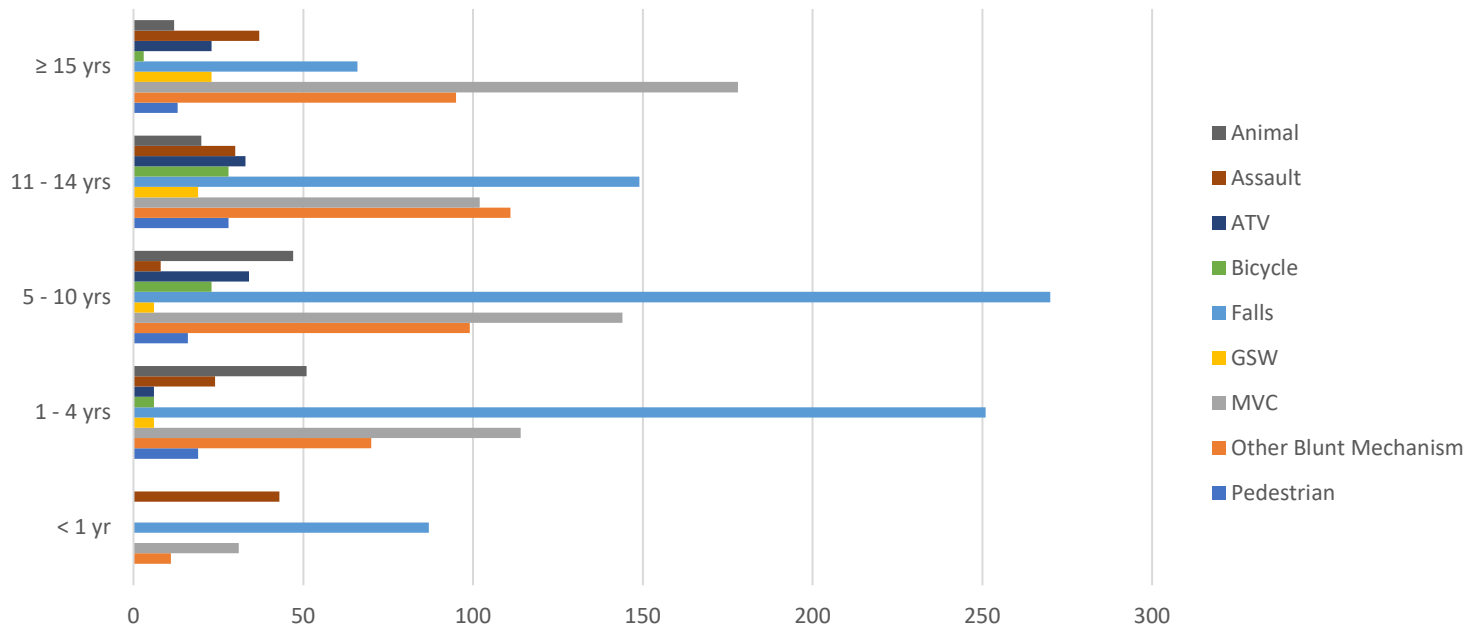
Primary Payor



Age Distribution by Sex and Race



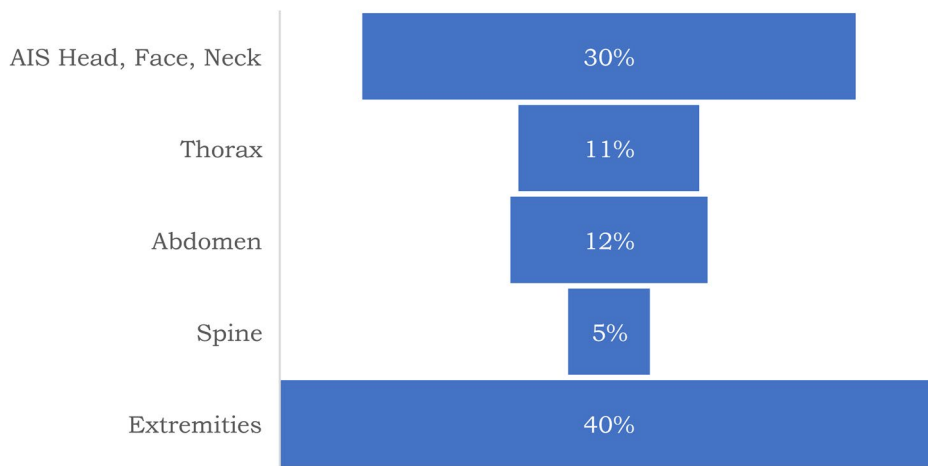
Mechanism of Injury by Age

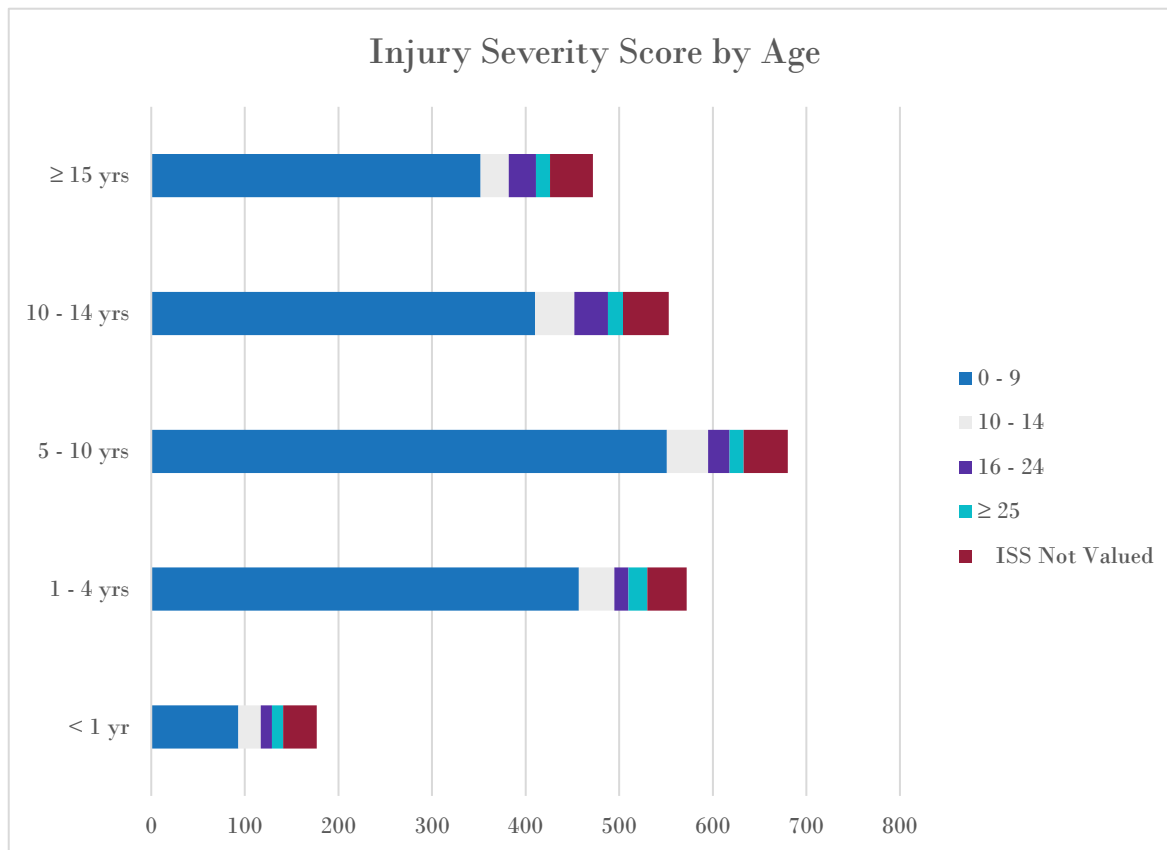
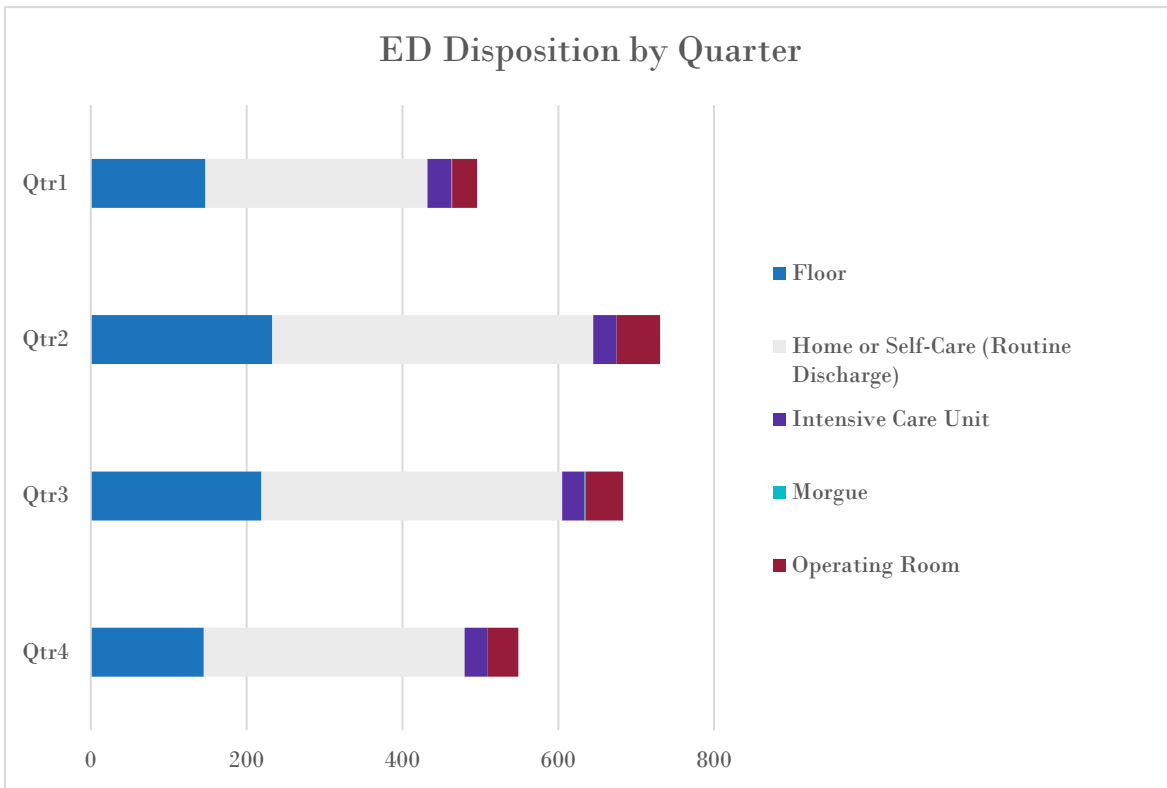


Currently, we have Injury Prevention Programs focusing on distracted driving, ATV safety, and car seats and booster seats.

Our Injury Prevention Program also provides inpatient education when safety equipment was not used or used improperly. Safety information such as the use of helmets, seatbelts, car seats, and protective gear is often not documented in the patient's chart, which could reflect limited resources such as PED RNs, SW, and others.

Percentage of Patients by Body Region





2022 Registry Filter Report (Top Filters)

| Pre- Hospital | | Hospital | |
|--------------------------|-----|---|-----|
| Delay in transfer | 72 | Blood pressure documented >30min of arrival | 310 |
| EMS failure to notify ED | 47 | COVID-19 | 26 |
| EMS scene time >20min | 226 | Cervical collar clearance not documented | 96 |
| Hypothermia | 6 | Delay in Trauma physician response | 87 |
| Missed intubation | 9 | Documentation error | 17 |
| No EMS form | 266 | Hypothermia | 12 |
| No/Incomplete OSH notes | 135 | Incomplete hospital record | 19 |
| No Trauma Activation | 19 | Missed procedures | 27 |
| Over-triage | 13 | SBIRT screening error | 152 |
| Under-triage | 25 | Temp documented >30min of arrival | 189 |
| Vascular access problems | 45 | Untimely Ortho response | 13 |
| | | Vascular access problems | 35 |

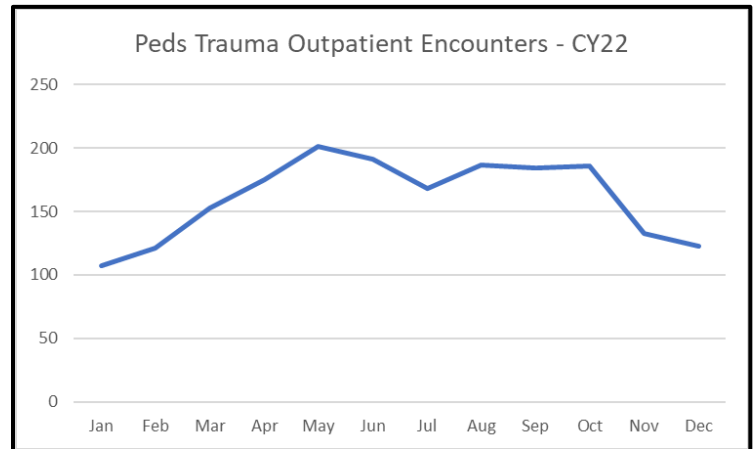
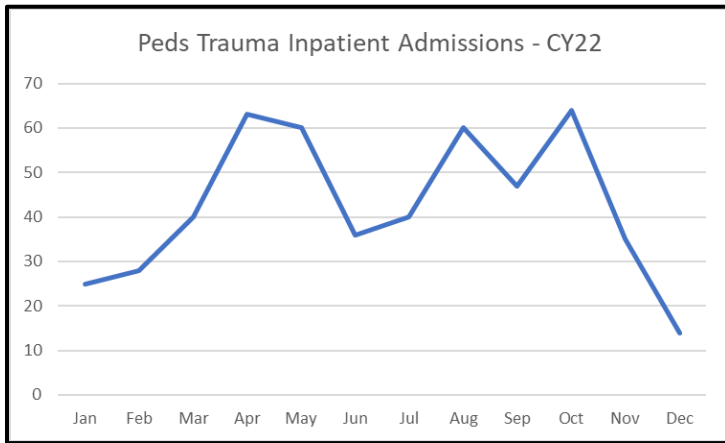
| Date Range: 4/1/2020 - 3/31/2022 | | |
|--|-----------|-------------------|
| Data Submission Deadline: June 3, 2022 | | |
| Data Quality Filter | Your Data | Outside Threshold |
| More than 10% of patients with an unknown Sex | 0.00% | No |
| Atypical percentage of records meeting the TQIP Patient Inclusion Criteria (Mean +/-2 STD (95%)) | 71.28% | No |
| Atypical percentage of records reported with Major Hospital Events (Adults <1% or >15%; Pediatrics > 4%; Level III > 7%) | 1.70% | No |
| More than 10% of patients with an unknown Initial ED/hospital Temperature | 8.83% | No |
| More than 10% of patients with an unknown Length of Stay (LOS) | 0.00% | No |
| More than 10% of patients with an unknown Initial ED/hospital Systolic Blood Pressure (SBP) | 11.65% | Yes |
| More than 10% of patients with an unknown Initial ED/hospital Pulse | 4.66% | No |
| More than 10% of patients with an unknown Initial ED/hospital GCS Motor | 0.68% | No |
| More than 10% of patients with unknown Pre-Existing Conditions | 0.00% | No |
| More than 1% of patients with unknown Hospital Events | 0.00% | No |

Fall 2022 Trauma Quality Improvement Program Report: Hospital Events

| | | | |
|---|----|---------------------------------|---|
| Acute Respiratory Distress Syndrome | 1 | Osteomyelitis | 1 |
| Cardiac arrest with CPR | 10 | Pressure Ulcer | 8 |
| Catheter-Associated Urinary Tract Infection | 2 | Severe Sepsis | 1 |
| Central Line-Associated Bloodstream Infection | 3 | Unplanned Admission to ICU | 6 |
| Deep Surgical Site Infection | 1 | Unplanned Intubation | 2 |
| Deep Vein Thrombosis | 6 | Unplanned Visit to OR | 4 |
| Delirium | 7 | Ventilator-Associated Pneumonia | 3 |
| Organ/Space Surgical Site Infection | 1 | | |

Pediatric Trauma Program Financial Overview Calendar Year 2022

Pediatric Trauma Encounters



| Type | Encounters | % of Total |
|--------------------|--------------|---------------|
| INPATIENT | 512 | 21.0% |
| OBSERVATION | 293 | 12.0% |
| SAME DAY PROCEDURE | 226 | 9.3% |
| EMERGENCY | 1,410 | 57.8% |
| Total | 2,441 | 100.0% |

| Surgeries | CY22 |
|----------------------|------------|
| Inpatient Surgeries | 331 |
| Outpatient Surgeries | 269 |
| Total | 600 |

| Measure | CY22 Total |
|------------------|------------|
| INPATIENT | |
| Encounters | 512 |
| ALOS | 3.45 |
| CMI | 2.17 |

- 21% of Trauma patients admitted as inpatient; additional 12% admitted as Observation.
- 600 Surgical cases for Trauma patients.

| Attending Service | CY22 Total |
|-----------------------------|------------|
| PEDIATRIC TRAUMA | 225 |
| PEDIATRIC ORTHOPEDICS | 170 |
| PEDIATRIC GENERAL SURGERY | 33 |
| PEDIATRIC CRITICAL CARE | 17 |
| PEDIATRICS GENERAL | 14 |
| PEDIATRIC HOSPITAL MEDICINE | 13 |
| ORTHOPEDICS | 9 |
| PLASTIC SURGERY | 9 |
| PEDIATRIC PLASTIC SURGERY | 8 |
| PEDIATRIC NEUROSURGERY | 5 |
| ORAL/MAXILLOFACIAL SURGERY | 4 |
| Other | 5 |
| Total | 512 |

- 512 Trauma IP Admissions with Avg. Length of Stay of 3.45 and Case Mix Index of 2.17
- Top Service Lines include Trauma, Orthopedics and General Surgery (based on Attending Physician primary service)

Pediatric Trauma – Profitability

All Trauma Patients – CY2022

| Totals | Encounters | Net Revenue | Total Variable Costs | Contribution Margin | Contr. Margin % | Contr. Margin per Encounte |
|--------------|------------|---------------|----------------------|---------------------|-----------------|----------------------------|
| TECH | | | | | | |
| Inpatient | 512 | \$ 14,716,045 | \$ 5,165,612 | \$ 9,550,433 | 64.9% | \$ 18,653 |
| Outpatient | 1,929 | \$ 3,712,140 | \$ 2,457,609 | \$ 1,254,531 | 33.8% | \$ 650 |
| PRO | | | | | | |
| Inpatient | 512 | \$ 1,901,431 | \$ 1,734,503 | \$ 166,928 | 8.8% | \$ 326 |
| Outpatient | 1,929 | \$ 1,225,485 | \$ 1,482,117 | \$ (256,632) | -20.9% | \$ (133) |
| TOTAL | | | | | | |
| Inpatient | 512 | \$ 16,617,476 | \$ 6,900,115 | \$ 9,717,361 | 58.5% | \$ 18,979 |
| Outpatient | 1,929 | \$ 4,937,625 | \$ 3,939,725 | \$ 997,899 | 20.2% | \$ 517 |

Trauma Care accounts for \$10.7M in Net Revenue Margin in 2022, which doesn't include the funding provided by the State.

Injury Prevention Program

Calendar Year 2022

Through the efforts of our IP team, we have directly reached 3,730 people in 8 counties and had over 8.4 million interactions through social media, contributed to 12 media publications (both local and national platforms), and published 12 safety source newsletters that were sent out to community members.



| BITZ “Be In The Zone”- Teen Driver Safety Program | |
|--|---------------------------------|
| Approximate school & community reach: 24,000 across 9 counties | |
| County | 2022-2023 Participating Schools |
| Cheatham | Harpeth HS |
| Clarksville | Clarksville Academy |
| Davidson | Cane Ridge HS |
| Davidson | Pearl Cohn HS |
| Hickman | East Hickman HS |
| Montgomery | Montgomery Central HS |
| Montgomery | Rossvie HS |
| Rutherford | Holloway HS |
| Stewart | Stewart County HS |
| Sumner | Beech HS |
| Williamson | Ravenwood HS |



| Ride On- TN ATV Safety Program | |
|---|---------------------------------------|
| Approximate school & community reach: 2,206 across 3 counties | |
| County | 2022-2023 Participating Clubs/Schools |
| Giles | 4-H |
| Smith | High School |
| Smith | 4-H |
| East | High School |



| Stay Seat Smart Program |
|--|
| Safe Kids Cumberland Valley Reach Numbers: 3,220 |
| Safe Kids Cumberland Valley |
| Safe Kids Cumberland Valley Reach Numbers: 5,000 |



Current Decision-Making Tools & Clinical Practice Guidelines

Activation Criteria

- * [Pediatric Trauma Activation Criteria](#)
- * [Pediatric Trauma Activation Criteria \(Quick Reference\)](#)

Decision-Making Tools

- * [Abdominal CT Decision-Making Tool](#)
- * [Blunt Cerebrovascular Injury Decision-Making Tool](#)
- * [Cervical Spine CT Decision-Making Tool](#)
- * [Chest XRY/CT Decision-Making Tool](#)
- * [Head CT Decision-Making Tool](#)

Clinical Practice Guidelines/Protocols

General

- * [Injury-Related Admitting Service Guideline](#)
- * [Massive Transfusion Protocol \(Pediatrics\)](#)
- * [Operative NPO Guidelines](#)
- * [PICU Venous Thromboembolism \(VTE\) Risk Assessment and Prevention Tool](#)
- * [Service Response Guidelines \(Pediatric Trauma, Neurosurgical, Orthopaedic, Spine, Other Surgical Specialties\)](#)

Abuse

- * [Physical Abuse Clinical Practice Guideline](#)

Burn

- * [Pediatric Burn Hypermetabolic Protocol](#)
- * [Pediatric Burn Emergency Plan](#)
- * [Pediatric Burn Fluid Resuscitation](#)
- * [Pediatric Burn Nutrition Protocol](#)
- * [Pediatric Burn Pain Management](#)
- * [Pediatric Inhalation injury protocol](#)

Neurosurgical

- * [Brain Injury Central Diabetes Insipidus Management](#)
- * [Isolated Linear Skull Fracture Management](#)
- * [Neuroprotective Targeted Temperature Management](#)
- * [Paroxysmal Sympathetic Hyperactivity Management](#)
- * [Severe Traumatic Brain Injury Management](#)
- * [Severe Traumatic Brain Injury - ICP Monitor Placement](#)
- * [Traumatic Brain Injury Decision Tree \(PEM Resource\)](#)

Orthopaedic

- * [Antibiotic Management for Open Fractures](#)
- * [Endangered Extremity with Vascular Compromise Management \(Upper and Lower\)](#)
- * [Orthopaedic Complex Wound Management](#)
- * [Orthopaedic Trauma Management \(Complete List\)](#)

Spine

- * [Cervical Spine Guidelines and Clearance](#)
- * [Cervical Spine Clearance Algorithm \(Quick Reference\)](#)
- * [Selective Spinal Immobilization \(Pre-Hospital Recommendations\)](#)
- * [Spinal Cord Injury Acute Management](#)
- * [Spinal Cord Injury Acute Management \(By Day\)](#)
- * [Pediatric Spine Post-Acute SOP](#)
- * [Spinal Cord Injury Post-Acute Management](#)
- * [VCH PICU Spinal Cord Injury Ventilator Guidelines](#)

Trauma

- * [ED Thoracotomy Guidelines](#)
- * [Isolated Blunt Liver/Spleen Injury Management](#)
- * ["Seatbelt Sign" Algorithm](#)
- * [Screening for Blunt Cerebrovascular Injury](#)
- * [Traumatic Cardiac Arrest Algorithm](#)

Trauma/Urology

- * [Isolated Blunt Renal Injury](#)
- * [Suspected Bladder Injury](#)

2022 Trauma-Related Publications

Hanna DN, Haddadin Z, Stafman L, Godfrey CM, **Huang EY, Aiello B, Greeno AL, Unni P, Lovvorn HN** 3rd. Sledding while towed behind motorized vehicles associates with more severe and lethal injuries☆. *J Pediatr Surg.* 2022 Nov;57(11):644-648. doi: 10.1016/j.jpedsurg.2022.03.011. PMID: 35396085.

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