An Advanced Resuscitative Care Bundle in Pediatric Trauma

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Tulane University

9th ANNUAL MEETING
PEDIATRICTRAUMASOCIETY.ORG
November 1-4, 2023
Sheraton New Orleans | New Orleans, LA

Disclosures

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Background

- Traumatic injury is the leading cause of death in children
- Gun violence is the leading cause of trauma-related mortality in children
- Hypotension on ED arrival is the greatest risk factor for death in pediatric trauma patients in hemorrhagic shock (OR 13.6)
- Approximately half (46%) of pediatric trauma patients found to be hypotensive on ED arrival did not survive to discharge

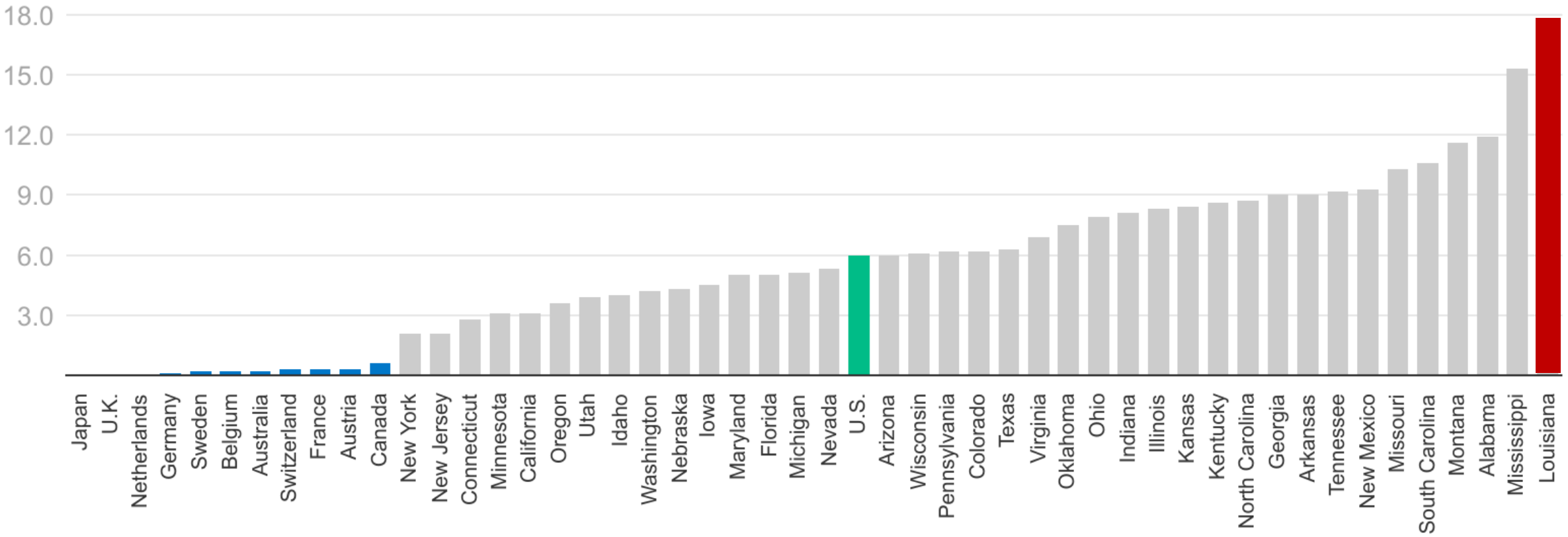
Tulane ACUTE CARE SURGERY

LEVEL 1 TRAUMA TEAM

DAMAGE CONTROL RESUSCITATION
MULTI-SPECIALTY | CONSENSUS | EVIDENCE-BASED

NEW ORLEANS EMS

Firearm mortality rate per 100,000 for children and teens ages 1-19 years, U.S. state (2021) and peer countries (2019)



https://www.kff.org/mental-health/issue-brief/child-and-teen-firearm-mortality-in-the-u-s-and-peer-countries/

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A Voice for the Injured Child
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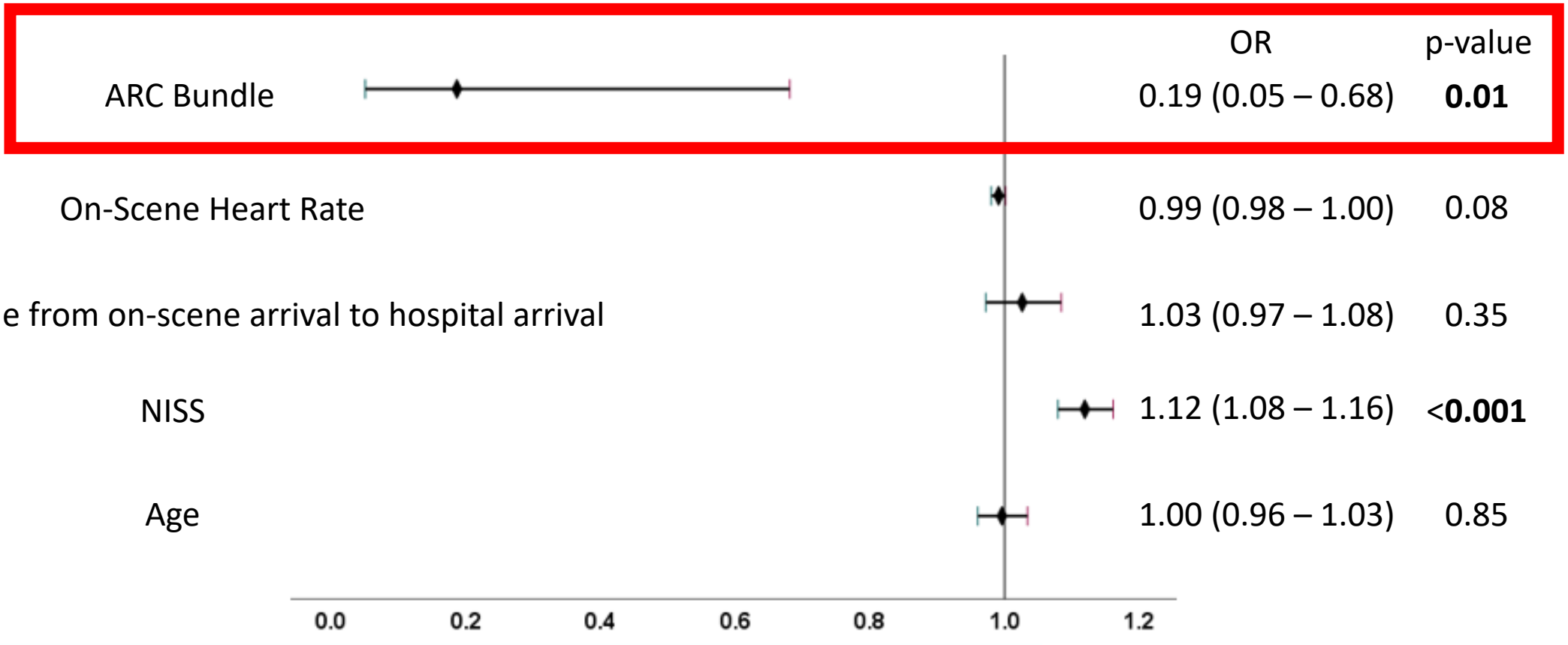
Factors Associated with Mortality Among Adults with Penetrating Torso Trauma and Shock



NOEMS Pre-hospital ARC bundle

- ARC Criteria – Penetrating Trauma with Shock:

SBP < 70 mmHg
Or
SBP < 90mmHg & HR ≥ 110 bpm

< 10yo:
SBP < 70 + (2x age)

- ARC Bundle Components:
  - Age ≥ 10 years: 2u pRBCs via rapid infuser, 2g CaCl, 2g TXA
  - Age 5-9 years: 1u pRBCs via rapid infuser, 1g CaCl, 1g TXA

- Blood products were stored at 1-6 °C and were not warmed during infusion

Objective

This series presents data on all pediatric recipients of ARC by NOEMS to date.

Methods

- All administrations of ARC bundle components to patients age ≤ 18 years from October 2021 to September 2023
  - Pre-hospital data from NOEMS run reports
  - ED data from University Medical Center New Orleans trauma registry

- Exclusion criteria:
  - Isolated traumatic brain injuries
  - Pre-hospital cardiac arrest

Continuous variables reported as median and interquartile range (IQR)
  - Compared using Wilcoxon matched pairs signed rank test analysis
  - A p-value of < 0.05 was considered statistically significant

Outcomes

- Primary
  - All cause in-hospital mortality
- Secondary
  - Vital signs on EMS arrival and on arrival at ED
    - Heart rate (HR)
    - Systolic blood pressure (SBP)
    - Shock index (SI)
    - Glasgow Coma Scale (GCS)

Patient Population

- To date, 13 pediatric patients have received ARC components
- All patients were male
- Age ranged from 8-18 years
- All sustained gunshot wounds (GSW)
- 10/13 (77%) sustained multiple GSWs

Head	1/13 (8%)
Chest	9/13 (69%)
Abdomen/Pelvis	6/13 (46%)
Extremity	6/13 (46%)

Patient Population

- Exclusions:
  - 3 underwent cardiac prior to EMS arrival
    - None achieved ROSC
  - 1 sustained isolated head GSW

- Of note, 3/9 included patients required immediate operative intervention

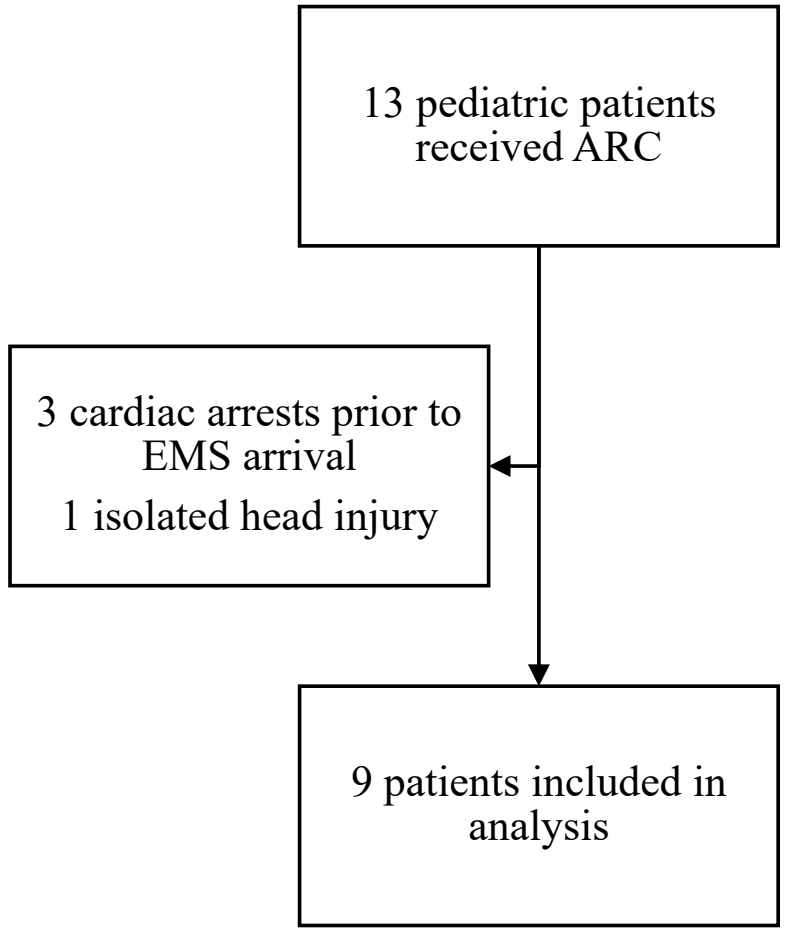


Figure 1. Patient Selection Flow Diagram

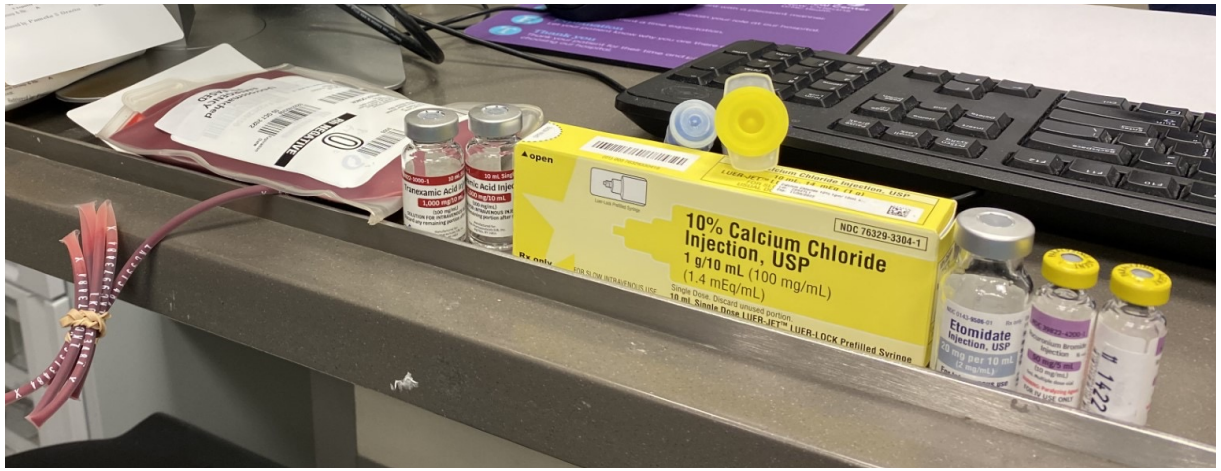
ARC Bundle Components

- All 9 included patients received one or more components

pRBC alone	3/9 (33%)
pRBC + CaCl	1/9 (11%)
pRBC + CaCl + TXA	5/9 (55%)

Results - Mortality

All 9 included patients survived to discharge.



Results - Vital Signs

Parameter, median (IQR)	Scene	ED	p-value [a]
Heart rate, bpm	115 (101.5-135)	98 (89.5-130)	0.0078
Systolic blood pressure, mmHg	82 (55-116.5)	110 (98-130.5)	0.0625
Shock Index [b]	1.52 (1.27-2.25)	0.9 (0.795-1.05)	0.0625
Glasgow Coma Scale	15 (13-15)	15 (14-15)	0.5000

[a] Calculated using Wilcoxon matched-pairs signed-rank test. Significance level was set at 0.05
[b] Calculated by dividing heart rate (bpm) by systolic blood pressure (mmHg)

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Discussion

- This is the first study reporting the use of an ARC bundle in a US pediatric population for penetrating trauma with hemorrhagic shock
- We saw improvement in HR, SBP, and SI from scene to arrival
- Of patients with penetrating torso trauma and hypotension who received ARC, and who had not experienced cardiac arrest prior to EMS arrival, **all** survived to hospital discharge

Limitations

- Small sample size
- Single EMS system
- Novelty of intervention
- Missing data
- Lack of comparison group

Conclusion

Early administration of ARC bundle components appears safe and improves the physiology associated with mortality in pediatric trauma.

Future Work

- NOEMS will continue administration of ARC bundle to pediatric patients showing signs of hemorrhagic shock
- A warmer has been added to the protocol
- As patient population increases, comparison to patients who received crystalloid fluids alone is warranted

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