PREHOSPITAL EBGs

External Validation of Maryland TOR Rules for Pediatric Out-of-Hospital Cardiac Arrest

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Termination of Resuscitation

- TOR in adult patients
- Numerous ALS, BLS and mixed protocols
- Reduce futile transports, improved provider safety, and potentially ***improved outcomes?***

- Growing body of evidence in the literature and significant clinical buy-in by EMS agencies, medical directors and collaborators

Pediatric TOR (pTOR)

- Limited evidence has been amassed
- No current uniformly accepted guideline for medical TOR in pediatric patients*
- AAP, ACS and NAEMSP have generated a trauma pTOR position statement.
- Historical barrier (provider comfort, ‘kids deserve more, ***lack of guidelines***, etc).

The Maryland Criteria

Medical:

- A pediatric patient (has not yet reached the 18th birthday) after the patient has received 15 two-minute cycles of CPR, and at least 3 doses of epinephrine the patient is:
- (i) in asystole, AND
- (ii) has a sustained ETCO2 of less than 15 mmHg.
- (iii) In the judgement of EMS and law enforcement on scene, there is adequate social/emotional support and safety for civilians and professionals on scene

The Maryland Criteria

Trauma

- Pediatric patient (has not yet reached the 15th birthday) EMS clinicians may terminate resuscitation if:
- (a) after five two minute cycles of CPR without ROSC
- (b) If asystole on monitor;
- (c) and ETCO2 < 15 mm Hg.

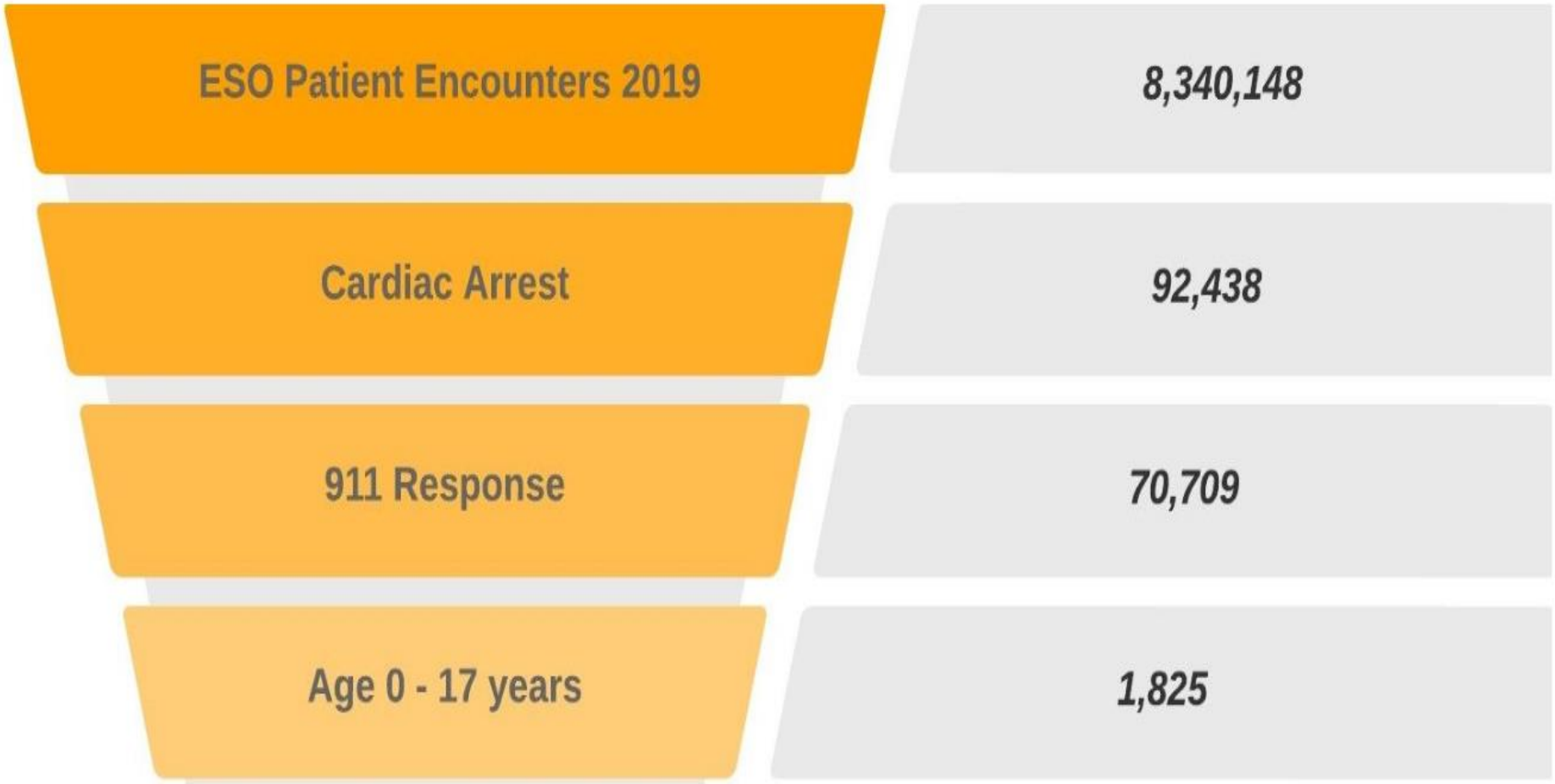
Methods:

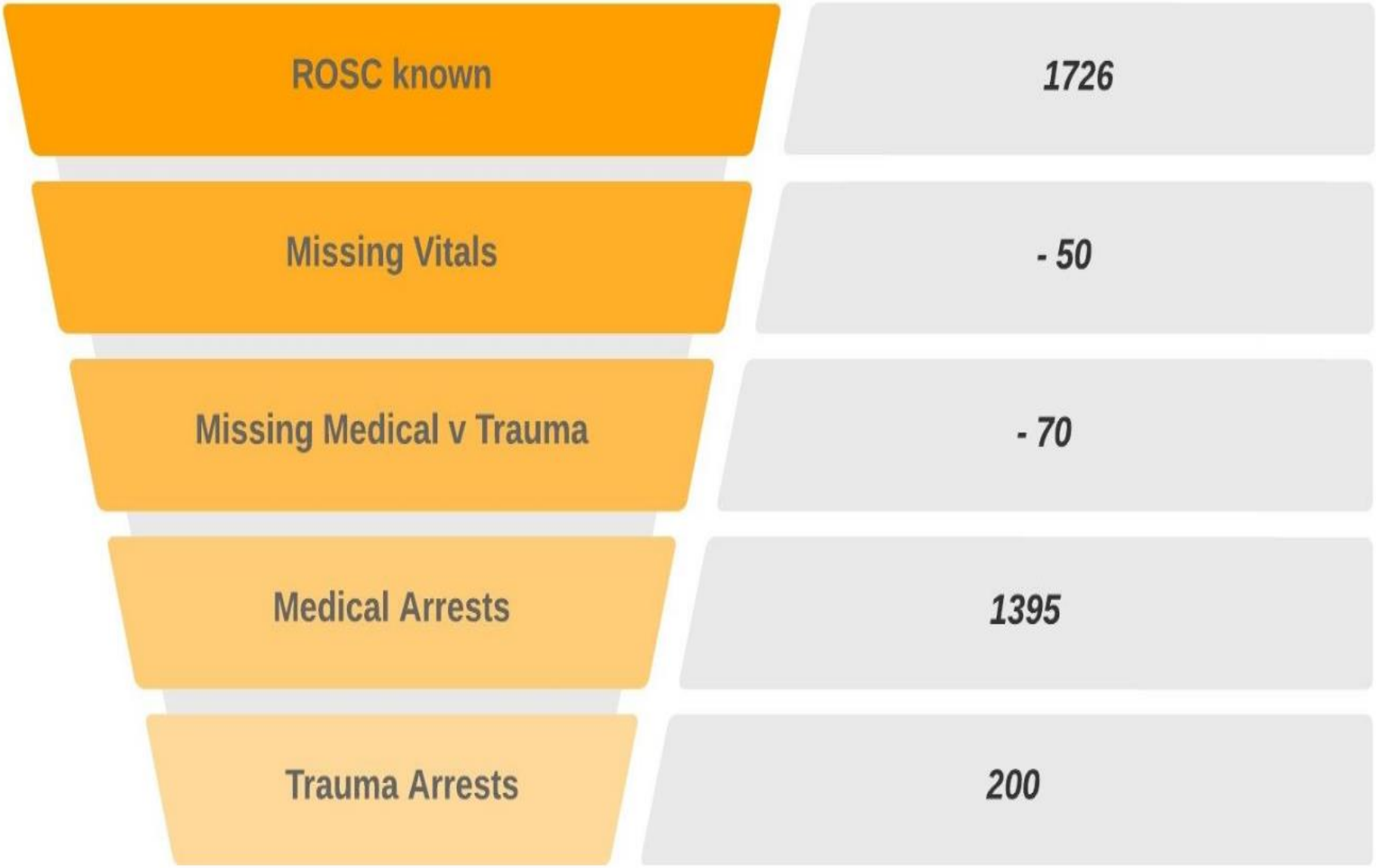
Study Design

This is a large descriptive and comparative analysis of a large administrative data set with discrete, de-identified data. ESO is a leading emergency medical services (EMS), fire, and hospital software and data company in the United States. ESO Currently serves more than 8,000 customers across the country.

Methods

- Descriptive analysis
- Univariate and Multivariable regression
- Natural Language Processing
- **Quantify the Predictive Value of the Maryland Medical and Trauma pTOR Guidelines**


ESO Patient Encounters 2019
8,340,148
Cardiac Arrest
92,438
911 Response
70,709
Age 0 - 17 years
1,825


ROSC known
1726
Missing Vitals
- 50
Missing Medical v Trauma
- 70
Medical Arrests
1395
Trauma Arrests
200

ESO Demographic Results

- 60% Male
- Median Age 1 year (IQR 0-9)
- 55% White, 31% Black/AAA, 8% Hispanic/latino
- 80% Urban/Suburban, 17% Rural, 3% Super Rural

Arrest Characteristics

- 60% unwitnessed (7% witnessed by EMS)
- 93% unshockable initial rhythm
- CPR started by bystander 33%

Univariate Analysis - ROSC

Variable	Unadjusted OR	95% CI
Trauma	1.2	0.9-1.7
Non-White Ethnicity	0.7	0.5-0.9
Male	1.2	0.9-1.5
Shockable rhythm	3.2	1.3-7.5
Unwitnessed Arrest	0.3	0.2-0.4
Arrest after EMS arrival	2.1	1.5-3.0

Univariate Analysis- ROSC

A decrease in ROSC was associated with:

- Decreasing age
- Prolonged Scene time
- Prolonged Transport time

Applying the Criteria

Medical TOR

N=1395

1

Asystole

(Initial rhythm not shockable)

2

Epinephrine

Greater than 3 doses

3

End Tidal CO2

Last ETCO2 less than 15

4

30 Min Resus

Scene time greater than 30 minutes

	No ROSC	ROSC	
TOR Applies	44	1	45
TOR Does not apply	1028	322	1350
	1072	323	1395

Sensitivity: 4.1%

Specificity: 99.6%

PPV: 97.8%

NPV: 76.1%

1

Misclassified

4 y/o pool submersion

Missed Case

4 y/o M s/p unwitnessed ***drowning***

- Submersion for 10-15 minutes prior to CPR

- ETT, 8 rounds of epi, 4 rounds of bicarb

- ROSC in field, unclear hospital outcome

Trauma TOR

N=200

1

Asystole

(Initial rhythm not shockable)

2

Hs & Ts

Unable to assess

3

End Tidal CO2

Last ETCO2 less than 15

4

10 Min Resus

Scene time greater than 10 minutes

	No ROSC	ROSC	
TOR Applies	42	4	46
TOR Does not apply	104	50	154
	146	54	200

4 **Misclassified**

Sensitivity: 28.7%

Specificity: 92.6%

PPV: 91.3%

NPV: 32.5%

Trauma TOR

N=200

1

Asystole

(Initial rhythm not shockable)

2

Hs & Ts

Unable to assess

3

End Tidal CO2

Last ETCO2 less than 15

4

20 Min Resus

Scene time greater than 20 minutes

	No ROSC	ROSC	
TOR Applies	22	1	23
TOR Does not apply	124	53	177
	146	54	200

Sensitivity: 15%

Specificity: 98.1%

PPV: 95.7%

NPV: 29.9%

1

Misclassified

MVA, Preschool age

Limitations

- Hospital outcomes were limited
- Dependent on accurate data reporting and documentation
- Provider perceptions of outcomes.

Discussion

- **What are ideal PPV and NPV values for TOR studies?**

- PPV of > 99% indicates that ***less than 1%*** of patients who meet TOR criteria will survive
- A high NPV reflects the likelihood of surviving if one ***does not*** meet TOR criteria
- Most studies of ***adult TOR criteria*** find PPV > 99% and NPV with a wider range of 1.3-46.3

Conclusions

Medical

- We found 97.8% PPV (Specificity 99.6%) and NPV of 76.1% (Sensitivity 4.1%)

- What is an acceptable PPV?

- Our NPV was notably *higher* than comparable adult studies.

Conclusions

Trauma

- Using a *10 minute* resuscitation interval:
- **PPV 91.3%** and specificity 92.6%
- NPV 38.5% and sensitivity 28.7%

- Using a *20 minute* resuscitation interval:
- **PPV 95.7%** and specificity 98.1%
- NPV 29.9% and sensitivity 15%

Future Direction

- Considering other clinical factors that might continue to improve PPV for both medical and trauma pTOR guidelines
- Community Engagement Efforts
- Prospective Evaluation