Resuscitating Pediatric Care
Balancing Psychology, Innovation and Technology

Peter Antevy MD
Pediatric Emergency Standards, Founder & CMO
PEM Physician & EMS Medical Director
Disclosure

- Pediatric Emergency Standards, Inc.
  - Founder and CMO
  - Consulting
  - Pediatric Resuscitation System
Hurricane Advisory - 8AM

HURRICANE FORECASTERS SHOWING THEIR PREDICTIONS...
Lt. Jonathan Robbins
Test Your Brain

65 year old in cardiac arrest

65 year old in anaphylaxis

5 year old in cardiac arrest

5 year old in anaphylaxis
The Arrest Lifecycle

- Closure
- En Route
- Debrief
- On Scene
The Arrest Lifecycle

- En Route
- 65 YR old Arrest
- 2 YR old Arrest
The Arrest Lifecycle

“What Could We Have Done Better”

Debrief
Resuscitations That Never End
Originating From Unresolved Integrity-Related Moral Distress

Cardiopulmonary resuscitation (CPR) is a time-dependent clinical intervention. Unlike most other clinical interventions (e.g., antibiotics for sepsis, chemotherapy regimens, and duration of mechanical ventilation) that are marked with distinct start and stop times, attempts at CPR are dependent on many processes requiring intense multidisciplinary teamwork in a short period of time. Process times that are simultaneously coordinated and recorded include the following: when the nurses and physicians arrive in the patient's room; the administration of medications; the cycle of chest compressions; pulse and rhythm checks; defibrillations or cardioversion attempts; and the final decision to continue CPR or to stop. The resuscitation team leaves the patient’s room when the patient dies, “the end,” and the team’s work stops. The time to do so is when the patient dies, not when CPR ends. Thus, resuscitations are never truly over; they are ongoing, and the cycle continues. 

Laurence J. McGarraghan, MD
Center for Medical Ethics and Health Policy, Baylor College of Medicine, Houston, Texas.
Length Based Tape
Plus Math

Anaphylaxis
Femur Fracture
Seizure

Epi 1:1000 IM
Fentanyl IN
Midazolam IN
### RESUSCITATION

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Volume (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epinephrine</td>
<td>0.21 mg</td>
<td>2.1 mL</td>
</tr>
<tr>
<td>Epinephrine ET</td>
<td>2.1 mg</td>
<td>2.1 mL</td>
</tr>
<tr>
<td>Atropine</td>
<td>0.42 mg</td>
<td>4.2 mL</td>
</tr>
<tr>
<td>Atropine ET</td>
<td>0.6 mg</td>
<td>1.5 mL</td>
</tr>
<tr>
<td>Sodium Bicarbonate</td>
<td>21 mEq</td>
<td></td>
</tr>
<tr>
<td>Lidocaine</td>
<td>20 mg</td>
<td></td>
</tr>
<tr>
<td>Lidocaine ET</td>
<td>40-60 mgs</td>
<td></td>
</tr>
<tr>
<td>Defibrillation</td>
<td>40J/80J</td>
<td></td>
</tr>
<tr>
<td>Cardioversion</td>
<td>20J/40J</td>
<td></td>
</tr>
<tr>
<td>Adenosine 1st Dose</td>
<td>2.1 mg</td>
<td></td>
</tr>
<tr>
<td>2nd Dose If Needed</td>
<td>4.2 mg</td>
<td></td>
</tr>
<tr>
<td>Amiodarone</td>
<td>105 mg</td>
<td></td>
</tr>
<tr>
<td>Calcium Chloride</td>
<td>420 mg</td>
<td></td>
</tr>
<tr>
<td>Magnesium Sulfate</td>
<td>1050 mg</td>
<td></td>
</tr>
</tbody>
</table>

### RAPID SEQUENCE INTUBATION

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine</td>
<td>0.42 mg</td>
</tr>
<tr>
<td>Pan/Vecuronium</td>
<td>0.21 mg</td>
</tr>
<tr>
<td>Defasculating Agent</td>
<td>32 mg</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>63 mcg</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>63 mcg</td>
</tr>
</tbody>
</table>

### INDUCTION AGENTS

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Etomidate</td>
<td>6.3 mg</td>
</tr>
<tr>
<td>Ketamine</td>
<td>42 mg</td>
</tr>
<tr>
<td>Midazolam</td>
<td>6.3 mg</td>
</tr>
<tr>
<td>Propofol</td>
<td>63 mg</td>
</tr>
</tbody>
</table>

### PARALYTIC AGENTS

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Succinylcholine (give atropine prior)</td>
<td>40 mg</td>
</tr>
<tr>
<td>Pancuronium</td>
<td>4.2 mg</td>
</tr>
<tr>
<td>Vecuronium</td>
<td>4.2 mg</td>
</tr>
<tr>
<td>Rocuronium</td>
<td>21 mg</td>
</tr>
</tbody>
</table>

### MAINTENANCE

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pancuronium/Vecuronium</td>
<td>2.1 mg</td>
</tr>
<tr>
<td>Lorazepam</td>
<td>1 mg</td>
</tr>
</tbody>
</table>
Does it add up?

1000
1000
1000
30
20
40
1000
1000
10
SURVEY SAYS

? 1000
1000
1000
30
20
1000
40
1000
10

= 51000
A Comparison of Medications in 38 Pediatric EMS Protocols to Those Listed on the Broselow™ Length-Based Tape

Caroline Epstein EMT-B, Peter Antevy MD, Patrick Hardigan PhD
Joe DiMaggio Children’s Hospital, Hollywood, FL, Nova Southeastern University, Davie, FL

DISCLOSURE
Conflict of Interest / Disclosure Statement
Peter Antevy MD is the Founder & CMO of Pediatric Emergency Standards, Inc. and developer of a pediatric resuscitation system.

BACKGROUND
- Pediatric medication errors are common.¹
- PALS 2015 recommends the use of a length-based tape with precalculated doses.²
- This study seeks to compare pediatric drug dosages from large and small EMS agencies to those listed on the Broselow LBT and determine discordance rates.

RESULTS
38 EMS Agencies
Population 294 to 2.4 million
Urban – Suburban – Rural

49% Discordance

Pediatric ALS Protocols Compared to Broselow LBT

Table 1. Missing and Incorrect Dosages

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect Dose</td>
<td>10%</td>
<td>6%</td>
<td>0%</td>
<td>20%</td>
</tr>
<tr>
<td>Missing Medications</td>
<td>38%</td>
<td>7%</td>
<td>23%</td>
<td>50%</td>
</tr>
<tr>
<td>Missing Medication + Incorrect Dose</td>
<td>49%</td>
<td>8%</td>
<td>32%</td>
<td>63%</td>
</tr>
</tbody>
</table>

METHODS
- Determine the percentage of medications on the Broselow LBT found at incongruent dosages compared to the EMS protocols.
- Determine the total number of medications from each EMS protocol that were not present on the Broselow LBT.
- For each EMS agency, the discordance rate was determined.
- Calculation of the frequency of each of the medications in each EMS protocol that were missing from the Broselow LBT, as well as those that were listed at incongruent doses.

CONCLUSION
A significant discrepancy exists between the pediatric drug dosages found in 38 EMS protocols and those listed on the Broselow LBT.

REFERENCES
Utilizing the Broselow™ Pediatric Emergency Tape for Prehospital Management of Children According to Evidence-Based Guidelines

Kathleen Adelgais, MD, MPH, Pediatrics/Emergency Medicine, Children's Hospital Colorado/University of Colorado School of Medicine, Aurora, CO, Toni Gross, MD, MPH, Phoenix Children's Hospital, Phoenix, AZ, Manish Shah, MD, Pediatric Emergency Medicine, Baylor College of Medicine, Houston, TX and Lara Rappaport, MD, MPH, Denver Health Medical Center, Denver, CO

Presented at AAP Section on Emergency Medicine, October 23, 2015

**Evaluation of 7 Evidence Based Guidelines**

- **26 Medication Recommendations**
  - **15% Listed Correctly Broselow**
    - Normal Saline
    - Lorazepam
    - Glucagon
    - Dextrose
  - **54% Not Listed At All Broselow**
    - Bronchodilators
    - Steroids
    - Vasopressors
    - Morphine
    - Histamine Blockade
  - **31% Listed Incorrectly Broselow**
    - Epi 1:1,000
    - Fentanyl
    - Midazolam
    - Magnesium Sulfate
    - Antibiotics
Impact of High-Fidelity Pediatric Simulation on Paramedic Seizure Management

Manish I. Shah MD, MS, John M. Carey MD, Sarah E. Rapp MD, Marina Masciale MD, Wendy B. Alcanter MD, Juan A. Mondragon BS, Elizabeth A. Camp PhD, Samuel J. Prater MD & Cara B. Doughty MD, MEd
Pedi-STEPPs Training for EMS at Texas Children’s Hospital

Following on the heels of the newly opened Pavilion for Women, Texas Children’s Hospital has embarked on a two year training project to provide Pediatric Simulation Training for Emergency Pre-hospital Providers (Pedi-STEPPs) to members of the Houston Fire Department (HFD) EMS.

This training will be offered free of charge to the City of Houston for 500 first responders over the next two years.

Pedi-STEPPs started when Dr. Paul Serbaugh, Associate Medical Director of the Emergency Center and Director of Pre-hospital Medicine at Texas Children’s Hospital, and Dr. Jennifer Arnold, Neonatologist and Medical Director of the Simulation Center at Texas Children’s Hospital, started talking about the advantages of simulation training with Houston Fire Department’s EMS providers. Dr. Serbaugh knew that since pediatric emergency calls are rare in the fire department/EMS field, being able to practice high risk scenarios in a self environment was critical.

Three years later, with the help of a generous donation from the Hannon Trust for Healthcare, Dr. Serbaugh’s vision of the Pedi-STEPPs simulation curriculum started.

The Pedi-STEPPs curriculum also had the advantage of using the Simulation Center at Texas Children’s Hospital which is equipped with a clinical skills room, 3 simulation (stand-alone) rooms, 2 simulation theaters, labor and delivery rooms, and decontamination rooms. The 9,000 square foot simulation center, located in Houston, Texas, opened in November 2008.

• 8 Hours
• Peds Specific
• EMS Providers
2,200 Potential seizures reported by EMS between 9/1/2011 - 10/31/2013

1,942 (88%) Excluded:
  12 (0.6%) ALS not involved
  1930 (99.4%) Not actively seizing

258 (12%) Eligible patients

8 (3%) Excluded:
  No hospital records found

250 (97%) Included in the analysis

No Add’l Training

185 (74%)
Control Group
0 ALS Trained

Pedi-STEPPS Trained

65 (26%)
Trained Group
≥1 ALS Trained
<table>
<thead>
<tr>
<th></th>
<th>Total (n = 250)</th>
<th>Non-trained paramedics (n = 185)</th>
<th>PediSTEPPs trained paramedics (n = 65)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Received 1st midazolam dose</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>144 (58%)</td>
<td>103 (56%)</td>
<td>41 (63%)</td>
<td>0.30</td>
</tr>
<tr>
<td><strong>Route, 1st dose of midazolam</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.23</td>
</tr>
<tr>
<td>IV</td>
<td>98 (68%)</td>
<td>67 (65%)</td>
<td>31 (76%)</td>
<td></td>
</tr>
<tr>
<td>PR</td>
<td>17 (12%)</td>
<td>16 (16%)</td>
<td>1 (2%)</td>
<td></td>
</tr>
<tr>
<td>IM</td>
<td>16 (11%)</td>
<td>12 (12%)</td>
<td>4 (10%)</td>
<td></td>
</tr>
<tr>
<td>IN</td>
<td>11 (8%)</td>
<td>7 (7%)</td>
<td>4 (10%)</td>
<td></td>
</tr>
<tr>
<td>IO</td>
<td>2 (1%)</td>
<td>1 (1%)</td>
<td>1 (2%)</td>
<td></td>
</tr>
<tr>
<td><strong>Received 2nd midazolam dose</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.75</td>
</tr>
<tr>
<td><strong>Route, 2nd dose of midazolam</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.31</td>
</tr>
<tr>
<td>IV</td>
<td>10 (53%)</td>
<td>6 (46%)</td>
<td>4 (67%)</td>
<td></td>
</tr>
<tr>
<td>IM</td>
<td>5 (26%)</td>
<td>3 (23%)</td>
<td>2 (33%)</td>
<td></td>
</tr>
<tr>
<td>PR</td>
<td>4 (21%)</td>
<td>4 (31%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>IN</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>IO</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Correct dose given</strong> (midazolam)</td>
<td>82/161 (51%)</td>
<td>58/114 (51%)</td>
<td>24/47 (51%)</td>
<td>0.98</td>
</tr>
<tr>
<td><strong>Correct dose given</strong> (dextrose)</td>
<td>1/2 (50%)</td>
<td>0/1 (0%)</td>
<td>1/1 (100%)</td>
<td>1.00</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>25 (10%)</td>
<td>21 (11%)</td>
<td>4 (6%)</td>
<td>0.34</td>
</tr>
<tr>
<td>IV line attempted</td>
<td>200 (80%)</td>
<td>144 (78%)</td>
<td>56 (86%)</td>
<td>0.15</td>
</tr>
<tr>
<td>Seizure recurrence</td>
<td>54 (22%)</td>
<td>40 (22%)</td>
<td>14 (22%)</td>
<td>0.99</td>
</tr>
<tr>
<td>Median time on-scene (IQR) (minutes)</td>
<td>34 (27, 41)</td>
<td>34 (27–41)</td>
<td>35 (27.5–42)</td>
<td>0.66</td>
</tr>
<tr>
<td>Median time to 1st treatment (IQR) (minutes)</td>
<td>14 (7, 20)</td>
<td>14 (7–22)</td>
<td>14 (6.5–19.5)</td>
<td>0.56</td>
</tr>
</tbody>
</table>
Clinical paper

Time on the scene and interventions are associated with improved survival in pediatric out-of-hospital cardiac arrest

Janice A. Tijssen, David K. Prince, Laurie J. Morrison, Dianne L. Atkins

25-30 Minutes On Scene

Highest Survival to Discharge
The Arrest Lifecycle

- Closure
- En Route
- Debrief
- On Scene
1 Year Old Chokes on Grape – Found in Cardiac Arrest - Saved by Coral Springs Paramedics
Strangers inspire family of injured boy with sweet 'turtle power' messages on Facebook

The parents of 5-year-old James Edwards, who nearly drowned last week, say they are leaning on the prayers and thoughts sent by thousands of Facebook users.
Last Week in Florida
## Polk County Fire Rescue Pediatric Arrest

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arrests</strong></td>
<td>20</td>
<td>18</td>
<td>21</td>
<td>35</td>
<td>27</td>
</tr>
<tr>
<td><strong>ROSC (Pulse)</strong></td>
<td>0%</td>
<td>11%</td>
<td>33%</td>
<td>29%</td>
<td>56%</td>
</tr>
<tr>
<td><strong>Survivors</strong></td>
<td>0%</td>
<td>0%</td>
<td>71%</td>
<td>70%</td>
<td>87%</td>
</tr>
</tbody>
</table>

- 0 Survivors
- 25 Neuro Intact Survivors
Denver Paramedics Data

- Comparison of Before and After Implementation

Fentanyl IN - 116% Increase

Versed IN - 197% Increase

Improved Care

Children Under Age 6
4x higher rate of Fentanyl use
Welcome Bend,

Thank you for choosing Pediatric Emergency Standards, Inc. and the Handtevy Pediatric Box. It is our mission to provide critically ill children with access to rapid, efficient and safe pre-hospital care by customizing a pediatric resuscitation system to your needs. Before starting this process we recommend that you have the following items readily available:

- The most up to date version of your department’s protocols
- A comprehensive list of all the medications your department carries as well as their corresponding concentrations

From this page you can create a new Handtevy Medication Guide or revise/reprint prior guides. Our staff of expert Physicians and Pharmacists will ensure that your customized system is in line with local protocols and national standards.

Create New Handtevy Medication Guide

<table>
<thead>
<tr>
<th>ORDER STATUS</th>
</tr>
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<tbody>
<tr>
<td>NAME</td>
</tr>
<tr>
<td>Bend Fire Depar 1</td>
</tr>
</tbody>
</table>
Customization
New Orleans EMS

Pediatric Medication & Equipment Guide

NEW ORLEANS EMS


Handtevy Pediatric Bag
Comparison of Errors Using Two Length-Based Tape Systems for Prehospital Care in Children

Lara D. Rappaport MD, MPH, Lina Brou MPH, Tim Givens MD, Maria Mandt MD, Ashley Balakas RN, BSN, Kelley Roswell MD, Jason Kotas NREMT & Kathleen M. Adelgais MD, MPH

<table>
<thead>
<tr>
<th>Tape System</th>
<th>Error N (%)</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broselow (n = 160)</td>
<td>68 (42.5)</td>
<td>2.8</td>
</tr>
<tr>
<td>Handtevy (n = 160)</td>
<td>24 (15.0)</td>
<td>(1.8, 4.2)</td>
</tr>
</tbody>
</table>
e-Handtevy Mobile
Complete Pediatric Dosing and Documentation System at Your Fingertips

CUSTOMIZE
pediatric drug dosing and equipment guides 100% to your protocols

MOBILIZE
custom content to your phone, tablet, laptop or desktop

INTEGRATE
patient treatment information directly into the medical record
ACLS vs. PALS

Outcomes
Adult
Peds

Algorithms
Advanced Life Support

What’s the Difference?
Resuscitating Pediatric Care
Balancing Psychology, Innovation and Technology

TakeHeart America

Peter Antevy MD
Pediatric Emergency Standards, Founder & CMO
PEM Physician & EMS Medical Director

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Pediatric Emergency Standards