Improving Pediatric Patient Safety: Lessons Learned from the Children's Safety Initiative EMS & Future Directions

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Disclosure

• CSI Funding
  – NIH PAR-08-261:
    • “Epidemiology of Preventable Safety Events in Pre-hospital EMS of Children” 2010-2016

Specific Aims

1. To identify reliable and valid measures for safety events in the prehospital care of children

2. To understand the incidence and risk factors for safety events in prehospital care for children

3. To understand individual, team, and systems errors that lead to safety events during in situ simulation of children’s emergencies
Methods

• Mixed Methods Study

RESULTS

Pediatric Safety Focus Groups

EMS Systems Level Factors
• Medications & Equipment
• Education
• Cultural Norms

EMS Team Factors
• Communication
• Teamwork
• Handoffs
• Feedback

Individual EMS Provider Factors
• Experience & Training
• Assessment & Decision Making
• Technical & Procedural Skills

Child and Family Level Factors
• Communication
• Clinical conditions
• Scene Characteristics
Top Factors Likely to Cause Safety Events

1) Lack of experience with pediatric airway management
2) Heightened anxiety when working with children
3) Lack of proficiency in pediatric skills
4) Lack of experience with pediatric equipment
5) Family member interference
6) Lack of ongoing pediatric training

Airway Decision Making Responses

- I have difficulty knowing when to start BVM
- I have difficulty knowing when to use an advanced airway over BLS
- EMS providers frequently waste time attempted to obtain a “definitive” airway when the could have used BVM safely
- I worry about causing airway trauma
- Providers are not well versed in pediatric assessment and treatment
Airway Equipment Responses

- The provider is faced not only with infrequency of the skill…
  but the ability to identify the proper sized equipment
- Equipment bags do not correspond to color codes on length
  based tapes
- Lack of length-based measurement tool to determine
  appropriate equipment sizes

Delphi: Provider Anxiety

| Sympathy/ identification with patient | “Sympathy for the patient can cloud judgement.”
|                                   | “The ‘what if that was my kid’ question causes distraction
during care.”
| Innocence of children/Perceived value of children | “Most people have a deeper emotional response to injured
   children.”
|                                   | “Fear or ruining someone’s WHOLE life, before they have
  had a chance to live it.”
| Experience/Exposure | “Due to rarity of peds trauma and the fragility of children
   workers are often shocked with WHUs.”
|                                   | “Lack of experience or confidence.”
|                                   | “Anxiety of not feeling proficient or experienced enough.”

Delphi: Provider Anxiety

| Family emotional response | “Bystanders and parents watching make doing your job
difficult. EMS providers are already stressed and then
you add a screaming mother, father or sibling.”
| Child's emotional response | “Crying! It's so difficult to calm an injured child, or ignore
the distraction of an upset child.”
| | “Children’s fears can exacerbate their perception of the
severity of injury and this excites the parents.”
| Rapid decompensation | “Children can have minimal symptoms from a trauma and
then crash quickly causing a constant stress during
treatment and transport.”
Chart Review: Overview

• Objective
  – Quantify pediatric patient safety events in the prehospital setting
  – Identify patient, call, and care characteristics associated with potentially severe safety events

• Methods
  – Expert review of critical ("code 3") pediatric transports in Portland, Oregon using standardized chart review tool

Chart Review: Results Highlights

<table>
<thead>
<tr>
<th>Factor</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-28 day age</td>
<td>5.5</td>
</tr>
<tr>
<td>1-12 month age</td>
<td>4.2</td>
</tr>
<tr>
<td>Cardiac Arrest</td>
<td>25.5</td>
</tr>
<tr>
<td>Anaphylaxis</td>
<td>4.3</td>
</tr>
<tr>
<td>Resuscitation</td>
<td>6.0</td>
</tr>
<tr>
<td>Airway Management</td>
<td>5.6</td>
</tr>
<tr>
<td>Medication Given</td>
<td>3.0</td>
</tr>
</tbody>
</table>
Chart Review Tool: Validation

- **Reliability**
  - Severe UNSEM vs. Non-severe/No UNSEM agreement 86% (Kappa=0.67)
  - UNSEM vs. No UNSEM agreement 70% (Kappa=0)
- **Usability**
  - Paper & electronic form
  - Median time to complete PEDS by RA & clinician was 7 minutes

Chart Review: Additional Results

- Critical croup commonly treated with albuterol
- 10X epi overdoses common in infants
- Newborns often treated with PALS
Simulation

- 190 in situ simulations
- Applied validated NASA TLX, CTS
- New technical performance tool
- Preliminary results:
  - More errors when teamwork was worse
  - Adult arrest paradigm applied to peds
  - Epinephrine dosing errors
  - Airway management concerns

Take Home Points

- Mixed methods including simulation gave broad perspective
- Pediatric safety challenged by rare high-risk scenarios
- Airway management and anxiety recurring concerns

Future Directions

- R01 Renewal Submitted
  - Focus on OHCA (highest risk)
  - Geographically diverse sample
  - Organizational factors in safety events
  - Provider anxiety
  - Cognitive aid pilot
  - CFIR constructs for future implementation
- Future Grants
  - National registry of safety events
  - Automation of chart review using NLP
- Additional Gaps
  - Rural EMS and pediatric patient safety
Questions

• What challenges do you face in improving pediatric safety?
• What additional tools would be helpful?
• What are the main challenges in pediatric care?
• What are the most important next steps?

Slides for Reference

Focus Groups
Table IV: Rank order of Delphi categories according to their likelihood to lead to a safety event or occurring the worst of hospital care (based on 1-5 most likely)

<table>
<thead>
<tr>
<th>Category</th>
<th>Total</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thérapien</td>
<td>9</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Surveillance</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Medication</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Monitoring</td>
<td>6</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NPE (future work)</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
## Chart Review: Neonates

**Table 1**: Knowledge gaps related to patient safety

| Knowledge Gap | Percentage of Neons
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect way to prepare oxygen reservoirs</td>
<td>75.8</td>
</tr>
<tr>
<td>Incorrect way to administer medication</td>
<td>56.6</td>
</tr>
<tr>
<td>Incorrect way to perform CPR</td>
<td>35.9</td>
</tr>
<tr>
<td>Incorrect way to handle IV tubing</td>
<td>40.9</td>
</tr>
<tr>
<td>Incorrect way to handle IV pumps</td>
<td>49.5</td>
</tr>
</tbody>
</table>

## Chart Review: Educational Needs

**Table 2**: Top 10 knowledge gaps related to procedural skills

| Knowledge Gap | Percentage of Neons
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect way to perform a chest x-ray</td>
<td>61.9</td>
</tr>
<tr>
<td>Incorrect way to dress a tube feeding</td>
<td>64.9</td>
</tr>
<tr>
<td>Incorrect way to administer continuous positive airway pressure (CPAP)</td>
<td>61.9</td>
</tr>
<tr>
<td>Incorrect way to perform a lumbar puncture</td>
<td>56.6</td>
</tr>
<tr>
<td>Incorrect way to administer IV medication</td>
<td>54.3</td>
</tr>
</tbody>
</table>

**Table 3**: The 3 most challenging procedures identified by Neons

| Procedure | Percentage of Neons
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Venipuncture</td>
<td>75.8</td>
</tr>
<tr>
<td>Lumbar puncture</td>
<td>61.9</td>
</tr>
<tr>
<td>Chest x-ray</td>
<td>61.9</td>
</tr>
</tbody>
</table>

## Chart Review: Educational Needs

**Table 4**: Top 10 knowledge gaps in the domain of computer and telephone calling

| Knowledge Gap | Percentage of Neons
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect way to call a patient's family member</td>
<td>75.8</td>
</tr>
<tr>
<td>Incorrect way to call a patient's physician</td>
<td>61.9</td>
</tr>
<tr>
<td>Incorrect way to call a patient's next of kin</td>
<td>56.6</td>
</tr>
<tr>
<td>Incorrect way to call a patient's hospital</td>
<td>54.3</td>
</tr>
<tr>
<td>Incorrect way to call a patient's emergency contact</td>
<td>49.5</td>
</tr>
</tbody>
</table>

**Note**: The percentages represent the proportion of neonates who indicated specific knowledge gaps in their responses to the survey.
Chart Review: Call Origin

Table 2. Regression Analysis: BLS/HY by Origin With Some Calls as Reference

<table>
<thead>
<tr>
<th>Group</th>
<th>Odds Ratio</th>
<th>Lower CI</th>
<th>Upper CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLS</td>
<td>1.00</td>
<td>0.96</td>
<td>1.04</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HY</td>
<td>1.00</td>
<td>0.96</td>
<td>1.04</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Chart Review: Lights & Sirens

Table 4. Multivariable analysis of factors associated with unexpected EMT transport

<table>
<thead>
<tr>
<th>Factor</th>
<th>Odds Ratio</th>
<th>Lower CI</th>
<th>Upper CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call Status</td>
<td>2.575</td>
<td>1.935</td>
<td>3.442</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age</td>
<td>1.004</td>
<td>0.997</td>
<td>1.011</td>
<td>0.459</td>
</tr>
<tr>
<td>Sex</td>
<td>1.006</td>
<td>0.998</td>
<td>1.014</td>
<td>0.283</td>
</tr>
<tr>
<td>Stroke</td>
<td>1.002</td>
<td>0.990</td>
<td>1.015</td>
<td>0.752</td>
</tr>
</tbody>
</table>

(Please note that the rest of the document contains similar tables and analyses.)
Bibliography


