Background

• Pediatric emergencies represent a high risk, low frequency event in EMS
• EMS providers have difficulty managing pediatric illness* and errors are common*
• There is limited information on EMS team dynamics, human factors, and non-technical skills as a root cause of errors during pediatric encounters

Objective

To quantify human factors associated with medical errors in the prehospital management of pediatric emergencies

Methods

• Study setting: Mobile simulation laboratory conducting 2 scenarios
  • Pediatric Seizure
  • Infant hypoglycemia
• Study population: EMS providers from one urban fire agency
• Study design: Exploratory study utilizing task analysis of EMS providers participating in pediatric high-fidelity simulations
• Methods: Two investigators quantified
  • Time to task completion (minutes:seconds)
  • Process Mapping (swimlane diagram)
  • Human factors assessment (Anesthetists Non-Technical Skills [ANTS] instrument: 1-5 scale, <3= safety risks)

Results:

Table 1: Task Analysis (24 unique simulations with 112 EMS providers)

<table>
<thead>
<tr>
<th>Task (n)</th>
<th>Median number of providers involved (IQR)</th>
<th>Median task time (mm:ss)</th>
<th>Median time to completion from scenario start (mm:ss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsiveness check (11)</td>
<td>1 (1,2)</td>
<td>00:04</td>
<td>01:52</td>
</tr>
<tr>
<td>Breathing check (24)</td>
<td>1 (1,1)</td>
<td>00:22</td>
<td>00:54</td>
</tr>
<tr>
<td>Pulse check (23)</td>
<td>1 (1,1)</td>
<td>00:19</td>
<td>00:34</td>
</tr>
<tr>
<td>Blood pressure (22)</td>
<td>1 (1,2)</td>
<td>00:40</td>
<td>01:33</td>
</tr>
<tr>
<td>Oxygen delivery (24)</td>
<td>1 (1,2)</td>
<td>01:00</td>
<td>01:52</td>
</tr>
<tr>
<td>IV/IO access (24)</td>
<td>2 (1,3)</td>
<td>02:43</td>
<td>05:03</td>
</tr>
<tr>
<td>IV Fluid (22)</td>
<td>1 (1,2)</td>
<td>03:37</td>
<td>08:27</td>
</tr>
<tr>
<td>Medication Administration (24)</td>
<td>2 (1,2,5)</td>
<td>02:21</td>
<td>05:26</td>
</tr>
</tbody>
</table>

Table 2: Time Intervals

<table>
<thead>
<tr>
<th>Intervals</th>
<th>n</th>
<th>Median task time (mm:ss)</th>
<th>Median time from scenario start (mm:ss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to midazolam (seizure start to midazolam administration)</td>
<td>12</td>
<td>02:43</td>
<td>04:55</td>
</tr>
<tr>
<td>Time to dextrose (low BGL to dextrose administration)</td>
<td>12</td>
<td>02:37</td>
<td>5:43</td>
</tr>
</tbody>
</table>

Figure 1: Scenario One Timeline

18 month old with fever, tachycardia, seizure from sepsis

HR: 182, BP: 71/55, RR: 45, O₂: 87%.
Time 2:30 seizure & apnea.
Time 3:00 HR182, BP 59/36.
Continued decompenation without interventions.
Time 12:00 Scenario ends.

Primary Survey Vital Signs
Oxygen

Figure 2: Scenario Two Timeline

1 month old with sepsis and hypoglycemia

Continued decompenation without interventions.
Time 3:00 HR500, BP 58/37.
Time 6:00 seizure without dextrose.
Time 12:00 Scenario ends.

Primary Survey Vital Signs
Oxygen

Figure 3: Swimlane Diagrams Depicting Observed Tasks

Each box represents a provider and the task they complete. Timeline of intervention is from left to right.

Discussion

• Task Analysis
  • Significant delays in oxygen administration
  • Significant delays in obtaining IV/IO access and administering fluids
  • Longer intervals reflect poor team dynamics

• Human Factors
  • Risks to patient safety identified in all subcategories (ANTS<3)
  • Rare use of closed loop communication, clarification of team roles
  • Tasks repeated often due to poor communication
  • Team dynamics contributed significantly to errors observed

Conclusions

• In pediatric simulation, human factor challenges are associated with:
  • Delays in key interventions
  • Protocol adherence
  • Interventions such as defining responsibilities, utilizing checklists and effective communication may reduce errors during pediatric EMS encounters

References