Simulation: Addressing the Challenges of Low Frequency Pediatric Emergencies

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Approach

• When problems or barriers are identified, they are represented through simulation allowing us to:
  • Increase the “n”
  • Explore new solutions
  • Measure chosen outcomes
  • Implement & monitor revised clinical practices
Setting

Trauma Medical

3,938 Resuscitation Area Patients

40% 1,575
44% 2,363
30% 1,222
56% 2,061

Cincinnati Children’s
changing the outcome together
## Problem

- Low Frequency: 261 procedures, 194 patients (0.2% ED patients)

<table>
<thead>
<tr>
<th>Procedure</th>
<th>2009-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracheal intubation</td>
<td>147</td>
</tr>
<tr>
<td>Intraosseous catheter</td>
<td>41</td>
</tr>
<tr>
<td>Tube thoracostomy</td>
<td>18</td>
</tr>
<tr>
<td>Central line</td>
<td>15</td>
</tr>
</tbody>
</table>

- Median faculty procedures = 0

Problem

Methods
- Video review of RSI
- 12 months

Results
- 48% 1st attempt failure
- 33% desaturation
- Prolonged attempt duration
- Younger age
- 20% esophageal placement

Strategy

Simulation

Non-technical Training
Teamwork
Communication
Team Leadership
Use of cognitive aids

Technical Training
Knowledge around RSI
Skills with Video Laryngoscopy
Attitudes around timing, including empowerment of staff
Strategy

Emergency Department RSI Checklist
Preparation

Second senior physician at bedside to be in charge of the checklist “CO-PILOT”

<table>
<thead>
<tr>
<th>Preparation</th>
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</table>
| - Ask if a difficult airway suspected (consider CAT)  
- Is the PICU-ED Team (PET) needed? (see reverse)  
- Confirm apneic oxygenation (rate 2 L/kg, max 15 lpm)  
- Confirm pre-oxygenation started by NRB/CPAP/BMV  
- Start pre-ox timer (re-start if interrupted)  
- Identify intubator: any attending, PEM fellow, 2nd-4th year EM resident, approved respiratory therapist  
| Pre-medications |  
| - Atropine if: bradycardia, age <12 mos, <5 yr & giving sux, or 2nd dose of sux (give ASAP)  
- Succinylcholine  
- Rocuronium if: K >5.5, suspected neuromuscular disease, or hx of malignant hyperthermia  
| Sedatives |  
| - Etomidate  
- Ketamine  
| Paralytics |  
| - Fentanyl if: heart dz with septic shock (4 mcg/kg)  
- Confirm RSI Medication Selection |  
| - Confirm atropine given (if indicated)  
- Confirm preparation of post-intubation medications  
- Confirm RT prepared airway cart/Storz  

Use of apneic oxygenation & pre-oxygenation

Limited recommendations for pre-medications, sedatives & paralytics
## Laryngoscopy

- Confirm 3 min of uninterrupted pre-ox
- Confirm RT/proceduralist record attempt
- Ensure sedative and paralytic in rapid succession (med-flush-med-flush)
  - Start paralytic timer with flush
- Ensure 45 seconds since paralytic flushed
- Start attempt timer (45 seconds) upon insertion of blade into mouth

**Stop attempt for:**
- 45 seconds timer (alarms)
- $O_2$ saturation drops below 95%

- Visualize ETT on Storz monitor passing through cords
  - No – start re-oxygenation

### STORZ C-MAC VIDEO LARYNGOSCOPY

**Timing of intubation attempt in relation to RSI medications**

### Limitation on duration of laryngoscopy
Confirmation

- Confirm capnometry tracings are present within 20 sec of ETT insertion
  - No – pull ETT and start re-oxygenation
- Administer post-intubation meds

Unsuccessful Attempt

- Confirm adequate re-oxygenation
  - Re-oxygenate via BMV until highest achievable sat and then maintain for 1 min before next attempt (Consider oral airway to assist BVM)
- Discuss **specific** change in approach (position, equipment, intubator, ANE)
- Re-dose sedative/paralytic for patient movement OR 2 failed attempts

Recovery techniques for missed intubations, including timing
## Strategy

<table>
<thead>
<tr>
<th>Course</th>
<th>Setting</th>
<th>Foci</th>
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</thead>
<tbody>
<tr>
<td>ED Procedural Training</td>
<td>Lab</td>
<td>Video Laryngoscopy</td>
</tr>
<tr>
<td>ED/ICU Bootcamp</td>
<td>Lab</td>
<td>Video Laryngoscopy, Checklist</td>
</tr>
<tr>
<td>ED Patient Safety*</td>
<td>Lab</td>
<td>Checklist, Co-piloting</td>
</tr>
<tr>
<td>ED Team Safety*</td>
<td>Lab</td>
<td>Checklist, Co-piloting</td>
</tr>
<tr>
<td>Trauma Team*</td>
<td>Lab</td>
<td>Checklist, Co-piloting</td>
</tr>
<tr>
<td>ED In Situ*</td>
<td>Trauma Bay</td>
<td>Video Laryngoscopy, Checklist, Co-piloting</td>
</tr>
<tr>
<td>Airway Management</td>
<td>Lab, Trauma Bay, Classroom</td>
<td>Video Laryngoscopy</td>
</tr>
<tr>
<td>Medical Video Review*</td>
<td>Classroom</td>
<td>Video Laryngoscopy, Checklist, Co-piloting</td>
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</tbody>
</table>

*interprofessional +/- multidisciplinary training
## Outcomes

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Age (median, IQR)</strong></td>
<td>2.4 (0.4, 10.1)</td>
<td>3.0 (0.4, 10.8)</td>
<td>2.3 (0.4, 10.6)</td>
</tr>
<tr>
<td>&lt; 24 months</td>
<td>53 (46%)</td>
<td>43 (41%)</td>
<td>186 (47%)</td>
</tr>
<tr>
<td><strong>Diagnostic Category</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neurologic</td>
<td>39 (34%)</td>
<td>33 (31%)</td>
<td>141 (36%)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>29 (26%)</td>
<td>13 (13%)</td>
<td>101 (26%)</td>
</tr>
<tr>
<td>Trauma</td>
<td>21 (18%)</td>
<td>22 (22%)</td>
<td>91 (23%)</td>
</tr>
<tr>
<td>Shock</td>
<td>13 (11%)</td>
<td>21 (21%)</td>
<td>27 (7%)</td>
</tr>
<tr>
<td>Other</td>
<td>12 (11%)</td>
<td>13 (13%)</td>
<td>36 (9%)</td>
</tr>
<tr>
<td><strong>Attempt Success</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>59 (52%)</td>
<td>66 (63%)</td>
<td>266 (67%)</td>
</tr>
<tr>
<td>First or Second</td>
<td>84 (74%)</td>
<td>92 (90%)</td>
<td>335 (85%)</td>
</tr>
</tbody>
</table>

## Outcomes

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<tbody>
<tr>
<td>Use of checklist</td>
<td>n/a</td>
<td>87%</td>
<td>93%</td>
</tr>
<tr>
<td>Attempt &lt; 45 sec</td>
<td>72%</td>
<td>87%</td>
<td>93%</td>
</tr>
<tr>
<td>Video Laryngoscopy</td>
<td>n/a</td>
<td>85%</td>
<td>94%</td>
</tr>
<tr>
<td>Desaturation</td>
<td>33%</td>
<td>18%</td>
<td>18%</td>
</tr>
<tr>
<td>Esophageal placement</td>
<td>20%</td>
<td>&lt;2%</td>
<td>&lt;2%</td>
</tr>
</tbody>
</table>
Outcomes

c) Failure to Perform Adequate Preoxygenation before the 1st Attempt at Laryngoscopy

- Proportion with preoxygenation failure
- Average failures in preoxygenation
- Control Limits

Baseline: April 2009 - March 2010
Intervention: July 2012 - December 2013
Operational: January 2014 - December 2018
Next steps

• This strategy was expanded to focus on high-risk intubations:

  □ Ask if a difficult airway suspected (consider CAT)
  □ Is the PICU-ED Team (PET) needed? (see reverse)

• Difficult airway
  • Critical Airway Team (CAT): Anesthesia, ENT, Respiratory Therapy and a similar checklist tool
  • 13 activations in the ED since 2015
  • >100 activations hospital wide

• Physiologically challenging patient
  • PICU-ED Team (PET): Critical Care, Emergency Medicine, Respiratory Therapy and a novel checklist tool
  • 13 activations in the ED since 2019

## Next steps

*Data for all *medical* RSI cases from 2016-present.*

<table>
<thead>
<tr>
<th></th>
<th>Non-PET Eligible (Historical Controls by Chart Review)</th>
<th>PET Eligible (Historical Cases by Chart Review)</th>
<th>PET Intubations Since Go-Live in April 2019 (Obtained by Video Review)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>180 (82.9%)</td>
<td>37 (17.1%)</td>
<td>13</td>
</tr>
<tr>
<td>Peri-intubation arrest</td>
<td>0/180 (0%)</td>
<td>2/37 (5.4%)</td>
<td>0/13 (0%)</td>
</tr>
<tr>
<td>Any post-intubation STS arrest</td>
<td>0/180 (0%)</td>
<td>4/37 (10.8%)</td>
<td>0/13 (0%)</td>
</tr>
<tr>
<td>In-hospital Mortality</td>
<td>5/179 (2.8%)</td>
<td>9/36 (25%)</td>
<td>2/13 (15.4%)</td>
</tr>
<tr>
<td>ECMO</td>
<td>0/179 (0%)</td>
<td>3/36 (8.3%)</td>
<td>1/13 (7.7%)</td>
</tr>
<tr>
<td>First pass success</td>
<td>120/180 (66.7%)</td>
<td>18/37 (48.6%)</td>
<td>8/13 (61.5%)</td>
</tr>
<tr>
<td>IVF prior to RSI</td>
<td>127/180 (70.6%)</td>
<td>36/37 (97.2%)</td>
<td>12/13 (92.3%)</td>
</tr>
<tr>
<td>Vasopressor support prior to RSI</td>
<td>0/180 (0%)</td>
<td>11/37 (29.7%)</td>
<td>5/13 (38.5%)</td>
</tr>
<tr>
<td>Defibrillator pads on prior to RSI</td>
<td>n/a</td>
<td>n/a</td>
<td>6/13 (46.2%)</td>
</tr>
<tr>
<td>Backboard under patient prior to RSI</td>
<td>n/a</td>
<td>n/a</td>
<td>6/13 (46.2%)</td>
</tr>
</tbody>
</table>

Summary

• Simulation can increase the “n” when faced with infrequent, high risk clinical situations in healthcare, creating a safe and efficient setting for training & assessment

• Simulation is a great strategy for quality improvement science

• Lessons learned from one simulation-based project translate across clinical units and care processes