Simulation: Addressing the Challenges of Low Frequency Pediatric Emergencies

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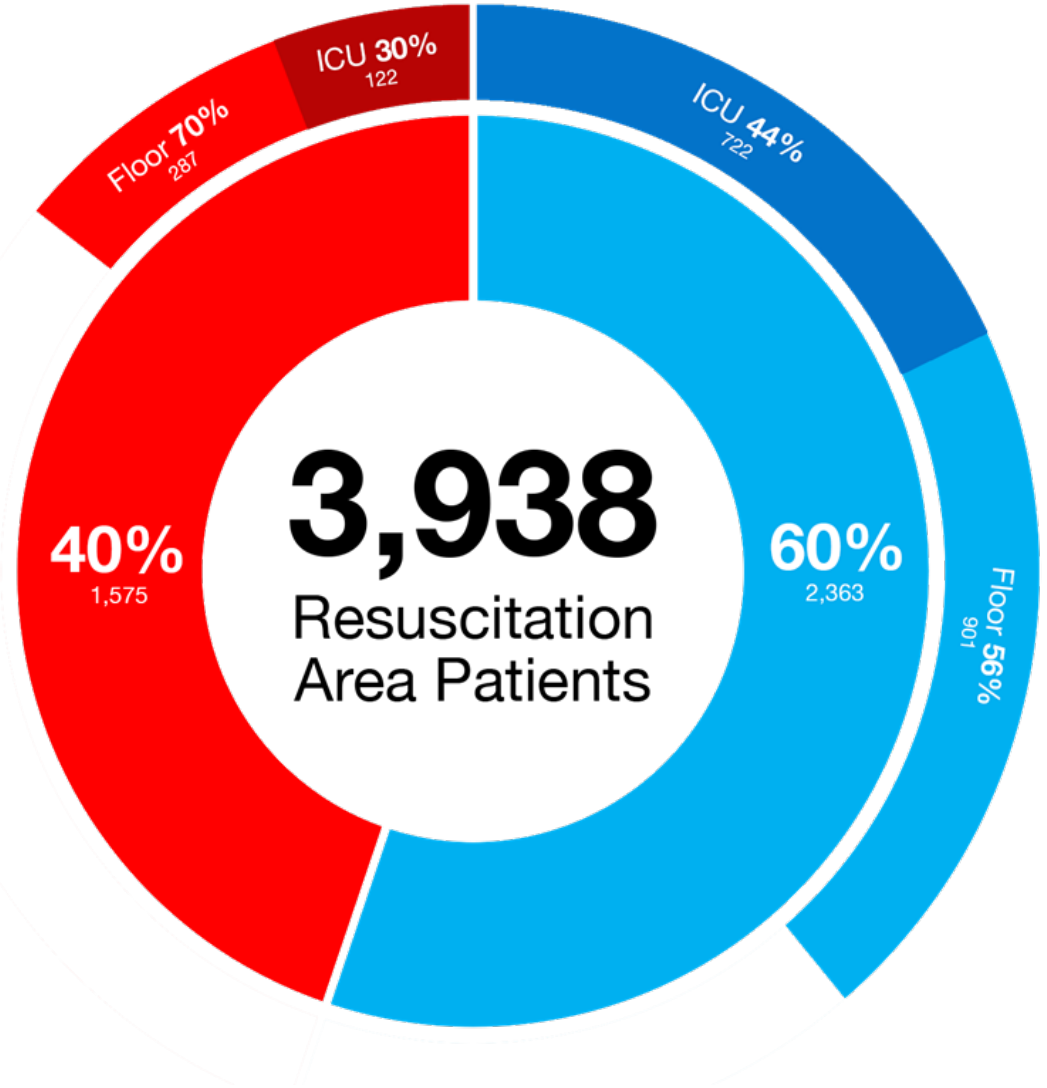
Approach

- 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



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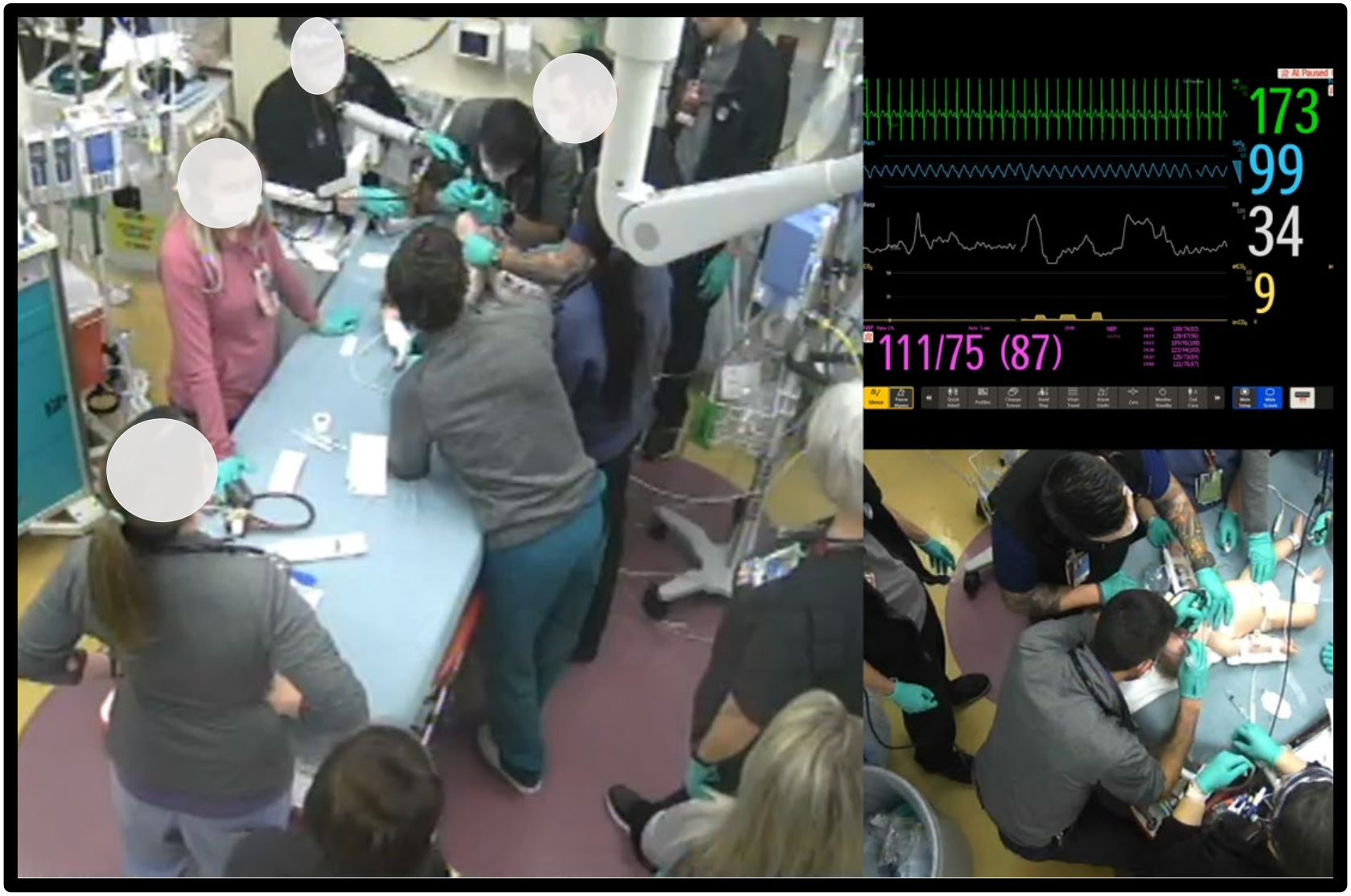

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Problem

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

Procedure	2009-10
Tracheal intubation	147
Intraosseous catheter	41
Tube thoracostomy	18
Central line	15

- Median faculty procedures = 0

Mittiga MR, et al. *Ann Emerg Med*. 2012

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Problem

Methods

- Video review of RSI
- 12 months

Results

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

Kerrey BT, et al. *Ann Emerg Med*. 2012
Rinderknecht AS, et al. *Acad Emerg Med*. 2015

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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

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Strategy

Preparation

- ☐ Ask Team Leader if difficult airway suspected
- ☐ Confirm apneic oxygenation started
- ☐ Confirm pre-oxygenation started by NRB/CPAP/BMV
  - ☐ Start pre-ox timer (re-start if interrupted)
- ☐ Identify intubator for initial and backup attempts
  (Attending, PEM fellow or 2nd-4th year EM)
- ☐ Define equipment for initial and backup attempts
- ☐ Prepare one size smaller ETT (stylet and tube)
- ☐ Confirm Medication selection/preparation
  - Pre-medications
    - ☐ Atropine (Bradycardia, age<12mo, <5yr & getting Succinylcholine, 2nd dose succinylcholine)
      - ☐ N/A
    - ☐ Lidocaine (suspected ↑ICP or asthma)
      - ☐ N/A
  - Sedative
    - ☐ Etomidate
    - ☐ Ketamine
    - ☐ Fentanyl (heart dz with septic shock, 4 mcg/kg)
  - Paralytic
    - ☐ Succinylcholine
    - ☐ Rocuronium (K >5.5, suspected neuromusc. dz)
- ☐ Confirm administration ASAP of Atropine/ Lidocaine
  - ☐ N/A
- ☐ Confirm preparation of post-intubation medications
- ☐ Confirm $ETCO_2$ monitor calibrated and ready for use
- ☐ Confirm Storz in position/working (then turn off)

→

Laryngoscopy

- ☐ Confirm 3 min of uninterrupted pre-ox
- ☐ Confirm Storz turned on/ready
- ☐ Ensure RN administers sedative and paralytic medications in rapid succession
  - ☐ Start paralytic timer with flush
- ☐ Ensure 45 seconds since paralytic flushed
- ☐ Start attempt timer (45 seconds) upon insertion of blade into mouth

Enforce stopping laryngoscopy for:

- ☐ 45 seconds since initial blade insertion
  - ☐ N/A
- ☐ O2 saturation drops below 95%
  - ☐ N/A
- ☐ Visualize ETT on Storz monitor passing through cords
  - ☐ No – start re-oxygenation

→

Confirmation

- ☐ Confirm ETCO2 present within 20 seconds of ETT placement
  - ☐ 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 change in approach
  (position, equipment, intubator, ANE)
- ☐ Re-dose sedative/ paralytic for:
  Patient movement, ≥10 min since etomidate or succinylcholine, OR
  2 failed attempts

Emergency Department RSI Checklist

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Preparation

- ☐ 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*)
- ☐ Confirm RSI Medication Selection

  Sedatives
  - ☐ Etomidate
  - ☐ Ketamine
  - ☐ Fentanyl if: heart dz with septic shock (4 mcg/kg)

  Paralytics
  - ☐ Succinylcholine
  - ☐ Rocuronium if: K >5.5, suspected neuromuscular disease, or hx of malignant hyperthermia
- ☐ Confirm atropine given (if indicated)
- ☐ Confirm preparation of post-intubation medications
- ☐ Confirm RT prepared airway cart/Storz

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

Use of apneic oxygenation & pre-oxygenation

Limited recommendations for pre-medications, sedatives & paralytics

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Laryngoscopy

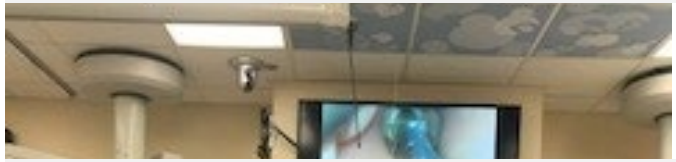
- ☐ Confirm 3 min of uninterrupted pre-ox
- ☐ Confirm RT/proceduralist record attempt
- ☐ Ensure sedative and paralytic in rapid succession (med-flush-med-flush)
  - ☐ Start paralytic timer with flush
- ☐ Ensure 45 seconds since paralytic flushed
- ☐ Start attempt timer (45 seconds) upon insertion of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

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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

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Strategy

Course	Setting	Foci
ED Procedural Training	Lab	Video Laryngoscopy
ED/ICU Bootcamp	Lab	Video Laryngoscopy, Checklist
ED Patient Safety*	Lab	Checklist, Co-piloting
ED Team Safety*	Lab	Checklist, Co-piloting
Trauma Team*	Lab	Checklist, Co-piloting
ED In Situ*	Trauma Bay	Video Laryngoscopy, Checklist, Co-piloting
Airway Management	Lab, Trauma Bay, Classroom	Video Laryngoscopy
Medical Video Review*	Classroom	Video Laryngoscopy, Checklist, Co-piloting

*interprofessional +/- multidisciplinary training

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Outcomes

	Baseline (2009-2010) n=114	Intervention (2012-2013) n=105	Operational (2014-2018) n=377
Age (median, IQR)	2.4 (0.4, 10.1)	3.0 (0.4, 10.8)	2.3 (0.4, 10.6)
< 24 months	53 (46%)	43 (41%)	186 (47%)
Diagnostic Category			
Neurologic	39 (34%)	33 (31%)	141 (36%)
Respiratory	29 (26%)	13 (13%)	101 (26%)
Trauma	21 (18%)	22 (22%)	91 (23%)
Shock	13 (11%)	21 (21%)	27 (7%)
Other	12 (11%)	13 (13%)	36 (9%)
Attempt Success			
First	59 (52%)	66 (63%)	266 (67%)
First or Second	84 (74%)	92 (90%)	335 (85%)

Kerrey BT, et al. *BMJ Qual Saf*. 2015

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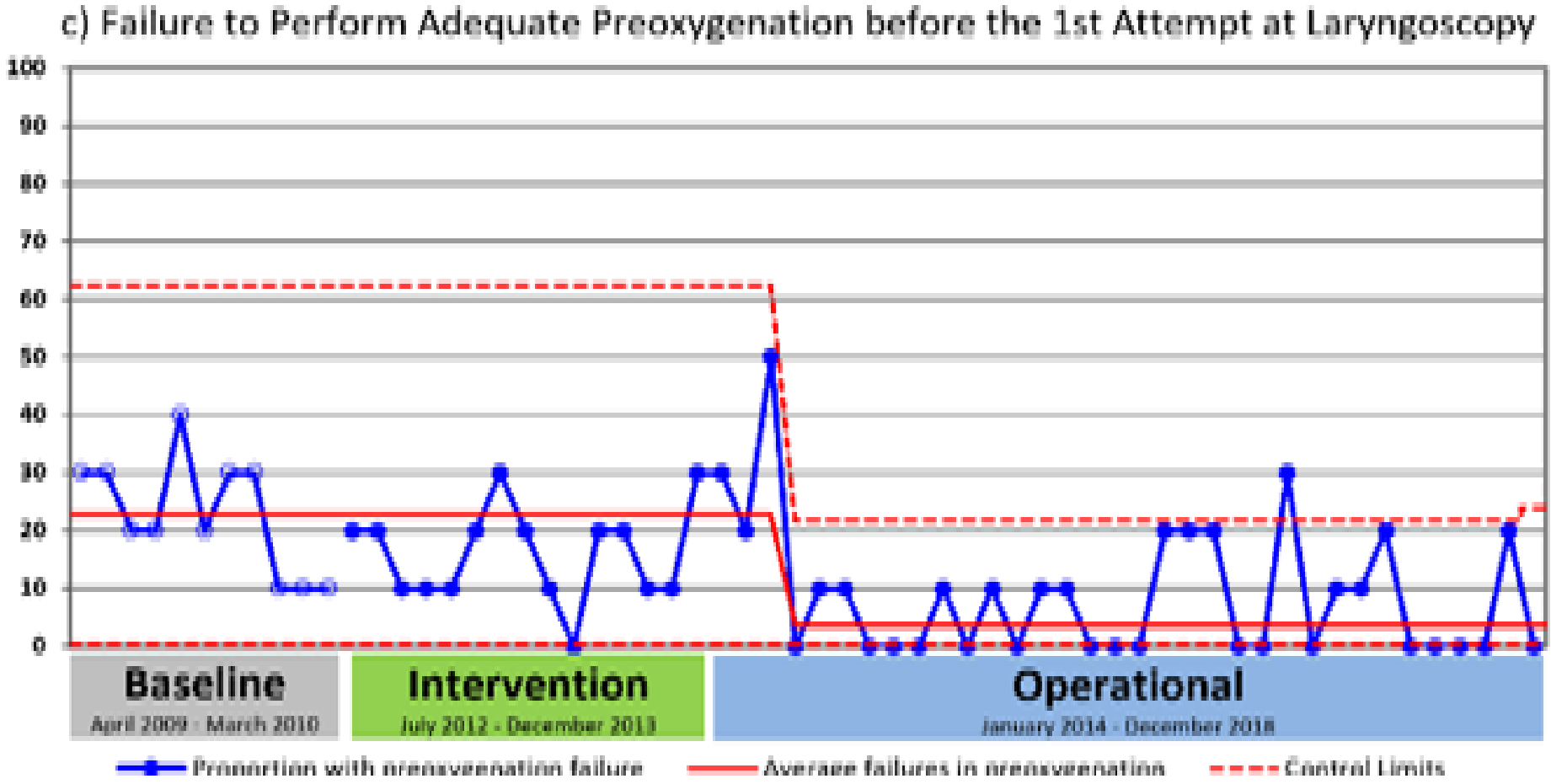
Outcomes

	Baseline (2009-10) n=114	Intervention (2012-13) n=108	Operational (2014-19) n>300
Use of checklist	n/a	87%	93%
Attempt < 45 sec	72%	87%	93%
Video Laryngoscopy	n/a	85%	94%
Desaturation	33%	18%	18%
Esophageal placement	20%	<2%	<2%

Outcomes



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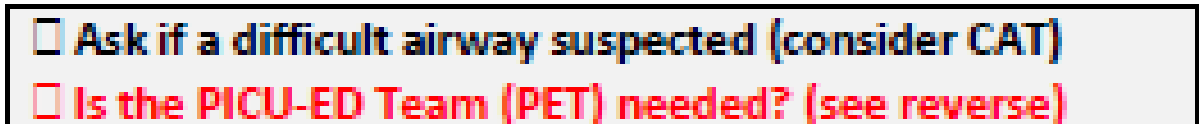
Next steps

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



  - 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 an a novel checklist tool
    - 13 activations in the ED since 2019

Johnson K, et al. *Arch Otolaryngol Head Neck Surg*. 2012

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Next steps

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

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

Dean P, et al. *Unpublished data*. Abstract accepted to PAS Meeting May 2020.

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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