Safe Procedures are a Team Sport: Simulation for Multidisciplinary Performance and Education Improvement in Endotracheal Intubation

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Program Description:

The University of Kansas fellowship program trains four pulmonary and critical care fellows per class at an academic, tertiary care center in Kansas City that includes three geographically connected medical ICUs, each with 14 beds.

Introduction:

Nearly half of all patients undergoing endotracheal intubation experience at least 1 major adverse peri-intubation event.[1] Thus, there is a need to both improve the safety of the procedure and to prepare critical care fellows for this essential skill. In our institution, like many, intubation was historically regarded as a procedure for which the success primarily rested on the skills of the physician. Aviation and other industries have seen improved safety by reconceiving of work, such as completing a flight, as a team activity dependent on coordination of the crew. In these settings, simulation has been instrumental in providing opportunities for the team to rehearse together.[2] Our aim was to build on this previous work by first using simulation to engage fellows in the derivation of a multidisciplinary approach to intubation, and then to design a simulation-based curriculum to provide opportunities for the fellows, nurses, and respiratory therapists to practice as a team. This curriculum focuses on deliberate practice and feedback, which leads to the ultimate paradigm shift that intubation not only needs, but more robustly *succeeds*, via a team-based approach.

Methods:

The first step was to reframe intubation as a team activity through a series of facilitated discussions with attendings, fellows, nurses, and respiratory therapists. The multidisciplinary team completed a needs analysis which revealed inconsistent preparatory steps, suboptimal advanced airway equipment, lack of defined roles and intubation workflow, inconsistent communication practices, and variable thresholds to call for assistance (Figure 1). Each of these identified gaps were addressed through a process of simulation-based problem analysis, draft solution generation, testing, and iteration. Fellows were key stakeholders in this simulation-based design which yielded definition of team roles and responsibilities, procurement of advanced airway supplies and customization of a supply tray, standardization of preparatory and procedural steps, and design of a timeout that structured team conversation about the

plan and contingencies. These key elements of the multidisciplinary approach culminated in the ICU Team Airway Checklist (Figure 2).

Categorically, the skills that required cultivation were separated into "Task Training" and "Team Training". Fellows participated in the "Airway Task Training Course" which provided hands on practice with the checklist as well as specific airway skills including direct and video laryngoscopy, effective bag-valve-mask technique, and utilization of the laryngeal mask airway. Subsequently, first- and second-year fellows joined the full ICU team for a basic and then advanced "Airway Team Training Course" to care for patients requiring urgent intubation, with each case followed by structured debriefing to discuss shared decision making, communication, and team troubleshooting. Surveys were completed to assess the impact of the training on the quality and safety of intubations.

Results:

Since simulation-based design launched in 2014, 28 fellows have participated in the three-part simulation-based curriculum alongside 72 ICU nurses and 24 respiratory therapists. The multidisciplinary approach represented by the ICU Team Airway Checklist was rolled out in 2016. Based on the survey data collected, 92% of 41 participants in the simulation-based training "definitely agreed" that the experience would impact the quality of care in endotracheal intubation. 95% of participants were "extremely" or "very" confident in their ability to translate to clinical practice. This initiative provided a platform for similar work with other procedures (implementation of thoracentesis, paracentesis, and central line insertion checklists) as well as development of a difficult airway simulation, which is set to include emergent cricothyrotomy, placement of a bronchial blocker for airway bleeding, and multi-disciplinary troubleshooting with Anesthesia and Otolaryngology teams.

Conclusion:

The use of simulation to engage fellows in the design and implementation of a multidisciplinary performance improvement program related to ICU intubations has proven effective and durable. This approach enables simulation-based training for fellows and the ICU team that supports transfer of individual and team skills from the safe learning environment of simulation to the clinical environment.

References:

1. Russsotto V, Nainan SN, Laffey JG, et al; INTUB Study Investigators. JAMA. 2021: 325(12): 1164-1172.
2. Salas, E, Bowers CA, Rhodenizer L. Int. J. of Aviat Psychol. 8 (3), 197-208.

Figure 1

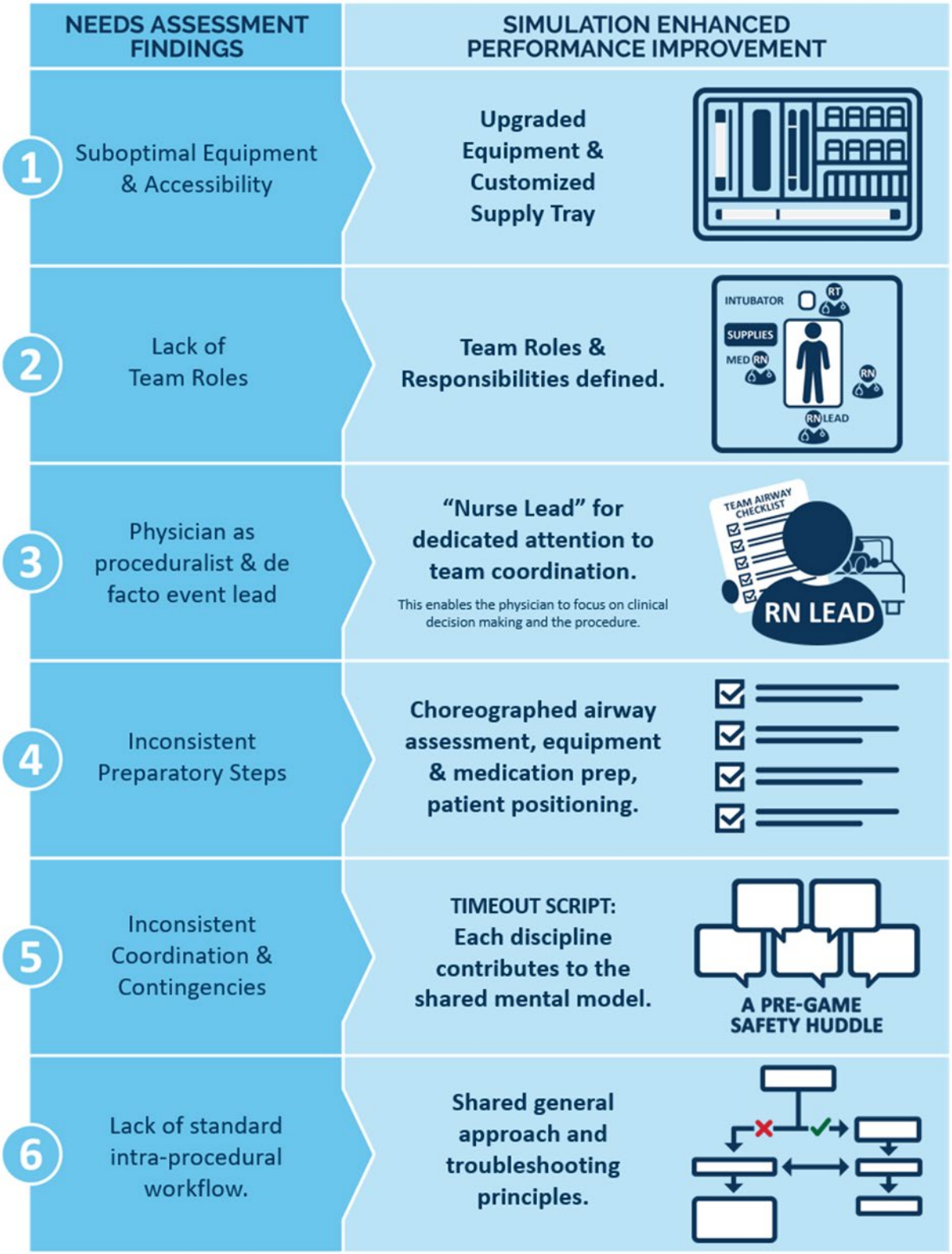
NEEDS ASSESSMENT FINDINGS
SIMULATION ENHANCED PERFORMANCE IMPROVEMENT
1
Suboptimal Equipment & Accessibility
Upgraded Equipment & Customized Supply Tray
2
Lack of Team Roles
Team Roles & Responsibilities defined.
INTUBATOR
RT
SUPPLIES
MED RN
RN
RN LEAD
3
Physician as proceduralist & de facto event lead
"Nurse Lead" for dedicated attention to team coordination.
This enables the physician to focus on clinical decision making and the procedure.
TEAM AIRWAY CHECKLIST
RN LEAD
4
Inconsistent Preparatory Steps
Choreographed airway assessment, equipment & medication prep, patient positioning.
5
Inconsistent Coordination & Contingencies
TIMEOUT SCRIPT:
Each discipline contributes to the shared mental model.
A PRE-GAME SAFETY HUDDLE
6
Lack of standard intra-procedural workflow.
Shared general approach and troubleshooting principles.

Figure 2

ICU TEAM AIRWAY CHECKLIST

Date: _____ *Time:* ___:___ *Location:* _____ *Patient Weight* _____ *kg* *Code Status* _____

1° Intubator: _____ *Med RN:* _____ *RN lead:* _____

Back-up intubator: _____ *RT:* _____

PREOXYGENATION:

RT (or RN) initiate ASAP:	□ NRB	Consider:	□ HOB elevated □ PEEP (NIV if available)

AIRWAY ASSESSMENT

Intubator:	Thyromental Distance ≥ 3 Fingers? □ Yes □ No □ Unable Neck Flexion Normal? □ Yes □ No □ Unable Mouth opening ≥ 2 Fingers? □ Yes □ No □ Unable **Please circle:** Mallampati: □ Unable to perform  Dentures? □ Yes □ No H/o Difficult Airway? □ Yes □ No □ Unknown (> 3 attempts, staff intervention, awake fiberoptic) NPO for at least 4 hrs? □ Yes □ No □ Unsure Edentulous? □ Yes □ No Beard? □ Yes □ No OSA? □ Yes □ No □ Unsure

PREPARE MEDS & EQUIPMENT

RN:	□ Call RT	□ Confirm O_2 monitor	□ Stethoscope
	□ Intubation cart to room	□ BP cuff (set q 1 min)	□ Obtain ~10 bath towels
	□ Intubation tray in room	□ Confirm working IV	□ Inflate bed
	□ Videoscope to room	□ Prep 3 IV modules	□ Boost patient
	□ Table (patient right)	□ Continuous sedation & analgesia	
RT:	□ Colorimetric $ETCO_2$	□ Securement device	□ BVM to O_2 & 15 PEEP
	□ Suction set up	□ Headboard off	□ Prep ventilator
Med RN:	Induction:		Neuromuscular Blocker:
	□ Etomidate 0.3 mg/kg _____ @_____		□ Succinylcholine 1 mg/kg _____@_____
	□ Ketamine 1-2 mg/kg _____ @_____		[Contraindications: Burn, CVA within 6 mo, Active Neuromusc Disease, Crush Injury, ↑K+, Malig Hyper]
	□ Propofol 0.5-1 mg/kg _____ @_____		□ Rocuronium 0.6-1.2 mg/kg _____@ _____
	□ Phenylephrine syringe (1 mg/10mL = 100 µg/mL)		
Intubator:	□ Nasal & Oral Airway	Prep for direct laryngoscopy:	Prep for video laryngoscopy:
	□ LMA & Bougie	□ ETT #1: √ cuff, load stylet	□ ETT #2: √ cuff, load video stylet
	□ Lube	□ Assemble direct laryngoscope	□ Power on videoscope
	□ Suction on patient right	and √ bulb	

PATIENT POSITION

	□ Pt boost	□ Bed height (~xiphoid)	□ Ear anterior to sternal notch

TIMEOUT (Initiated by Lead RN):

Lead RN:	□ Confirm Med Plan □ Current Vital Signs _____
Intubator	□ Plan A _____ □ Plan B _____ □ Plan C_____ □ Threshold for Plan A→ Plan B → Plan C □ Vital Sign Cutoffs *(Please let me know if O2 sats fall below ____ and I'll abort attempt and resume BVM, or if SBP falls below ____, and we'll push_____).* □ Threshold to call for help? *('If ___ occurs, we will call an intubation only code at 8-5656')*
Lead RN:	Confirm roles and readiness: □ Med RN □ RT □ Lead RN □ Intubator

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