Validation of a Novel Mobile Application for the Assessment of Adult Tracheostomy Emergency Simulations

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Background

- Tracheostomy emergencies are time-critical crises associated with high morbidity and mortality
- In-situ simulation is an effective tool for evaluating team and system response to tracheostomy emergencies in the actual clinical environment
- Evaluation of in-situ simulations has traditionally been video review, checklists, debriefs
- These methods can be cumbersome and vulnerable to data loss

Objective

- To evaluate whether a novel mobile application, previously validated for pediatric airway emergency scenarios, is a reliable option for real-time assessment of adult tracheostomy emergency in-situ simulations

Methods

- IRB-approved study from 11/2018 - 3/2025 at a single, tertiary care academic center
- The NeoCHART+™ for PEAK II Trach-Adult application interface was developed for assessment of tracheostomy simulations involving cuffed adult tracheostomy tubes with inner cannulas
- Ten deidentified video-recordings of tracheostomy emergency simulations completed from August 2021 to August 2023
- In-situ simulations completed across inpatient and critical care units
- Rating
  - Six independent raters each scored ten videos using the application interface
  - Raters consisted of two medical students, two otolaryngology attendings, and two critical care attending
  - One otolaryngology resident and one medical student completed independent manual rating, to serve as the reference standard

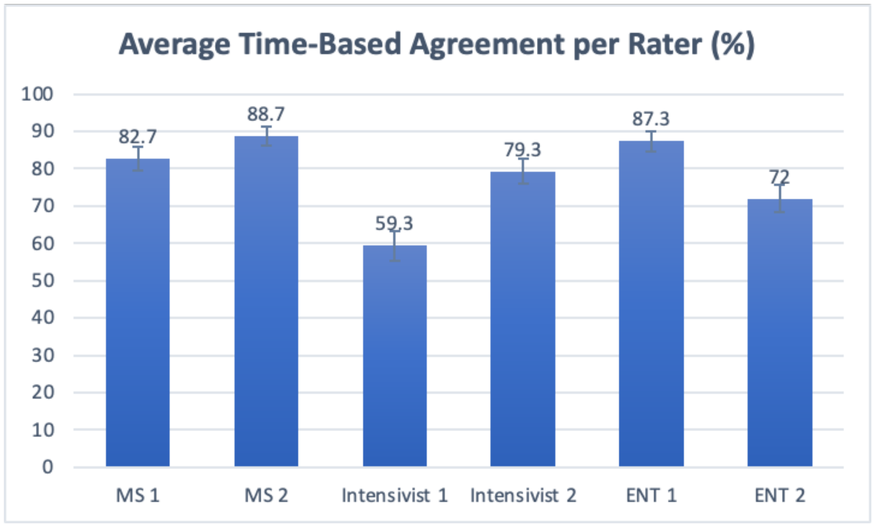

Figure 1. Average Time-Based Agreement per Rater

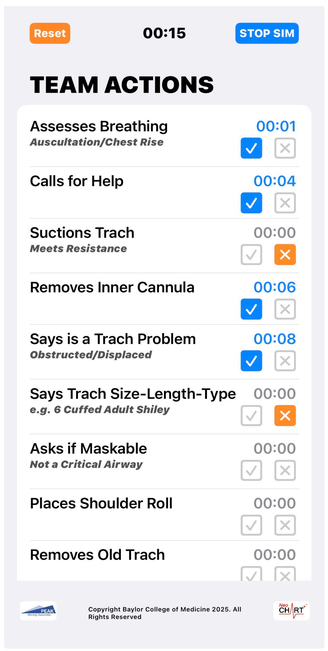

Figure 2. NeoCHART+™ for PEAK II Trach-Adult application interface

Simulation Scenario

64-year-old patient with **COPD** and **pneumonia**. They have a **tracheostomy** placed >1 month ago.
Frontline healthcare providers manage the emergency.

- Experiencing an obstructed inner cannula or a dislodged tracheostomy tube
- On the floor: Oxygen desaturation
- In the ICU: Ventilator alarm

Simulation complete after **five minutes** or if all three actions completed
- Secure trach ties on the new tube
- Remove shoulder roll.
- Confirm ventilation/oxygenation

Figure 3. Simulation Scenario

Results

- Time-based agreement with reference standard (step occurred and +/- 5 seconds apart) = 78.2% among all raters
  - 85.7% among medical students
  - 69.3% among critical care attendings
  - 79.7% among otolaryngology attendings
- Multivariable regression analysis demonstrated a marginally significant effect of role ($p = 0.082$) and a strongly significant effect of step number on agreement
  - Step 4 significantly lower than Step 1 ($p < 0.001$)
  - Step 7 significantly lower than Step 1 ($p = 0.021$)
- Inter-rater reliability for time stamp agreement was nearly excellent, with an intraclass correlation coefficient of 0.880 95% CI (0.819, 0.928)

Conclusions

- The NeoCHART+™ for PEAK II Trach-Adult application interface demonstrates strong inter-rater reliability, supporting its reproducibility across raters with varying levels of training
- Additional training for raters and reassessment of step definitions is necessary for further validation of the interface
- Simulation experience may influence likelihood of rater agreement with reference standards

Future Directions

- Utilizing NeoCHART+™ PEAK II Trach application in real-time adult tracheostomy simulation grading

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