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Tracheal intubations for critically ill children outside specialized centers in UK- patient, provider, practice factors and adverse events

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Performing airway management in a sick pediatric patient is a stressful event on many levels. Specifically patient, provider, and practice factors have substantial impact in the outcomes of airway management. Oftentimes the child presents in extremis with refractory hypoxia or hypercarbia, hypotension, and a full stomach to an inauspicious setting with less-experienced staff (direct airway provider as well as supporting staff) and a limited selection of airway devices (e.g., unavailability of video laryngoscopy or laryngeal mask as a rescue device). These suboptimal patient, provider, and practice conditions will increase adverse events and complications even in the best of hands (i.e., trained, board-certified anesthesiologist). In the multicenter pediatric intensive care unit (ICU) database, with the majority of data from the United States (US), 16–20% of pediatric tracheal intubations are associated with adverse events (1–4)

In this issue of *Pediatric Critical Care Medicine*, Matettore et al. reported their multicenter prospective observational study that tracked tracheal intubations that were performed in children (0–16 years of age) at 47 non-specialized local hospitals in the North Thames and East Anglia region of the United Kingdom (UK) over a 24-month period (5). They evaluated adverse tracheal intubation associated events (TIAEs) which included those categorized as non-severe, such as endobronchial (mainstem) intubation, airway trauma, bradycardia, hypertension, tachycardia, and unanticipated difficult airway, as well as severe TIAEs, such as esophageal intubation, hypoxia (SpO₂ <90% for greater than 2 minutes), cardiac arrest, aspiration of gastric contents, pneumothorax, hypotension, surgical airway, “Can’t intubate, CAN ventilate” and “Can’t intubate; CANNOT ventilate”. Bradycardia, tachycardia, hypotension, and hypertension had age-specific criteria.

They were able to analyze 1,051 patients out of the eligible 1,237. Adverse TIAEs occurred in 22.7% of the patients. This TIAE rate seems higher than those in pediatric ICUs and cardiac ICUs, likely due to these reasons: (1) their TIAE definitions include hypoxia while the National Emergency Airway Registry for Children (NEAR4KIDS) reports hypoxia separately, and (2) their patient population may be more acutely ill, as most tracheal intubations (TIs) are for urgent and emergent indications, whereas pediatric ICU intubations from NEAR4KIDS include 15–20% as “procedural” intubations (4, 6). Given that the overwhelming majority of intubations were performed by an anesthesiologist in their cohort, their adverse TIAE rates may have been higher if the majority of their providers were non-anesthesiologist trainees. They found that 45% of the patients had pre-existing comorbidities. The most common induction agents included fentanyl, ketamine, and propofol, while succinylcholine was the most common neuromuscular blocking agent. The most common non-severe TIAEs included endobronchial intubation, bradycardia, and unanticipated difficult airway. The predominant severe TIAEs included hypotension, hypoxia and esophageal intubation. Cardiac arrest occurred 1.6% of the time which is surprisingly similar to TIs in the pediatric ICUs (7). Their findings were similar to Easley et al. who conducted a prospective study of 244 children intubated in community hospitals, emergency rooms, and children’s hospital emergency rooms in the US, finding that major and minor variances occurred in 37% of patients who were intubated outside of a children’s hospital (8).

Not surprisingly, children with a higher grade of airway difficulty experienced more complications. Patients with comorbidities were more likely to suffer severe TIAEs during tracheal intubation. Interestingly, system factors, such as hospital volume, location of the intubation, and time of the procedure, were not associated with the risk of TIAEs. Tracheal intubations performed by non-anesthetists and multiple attempts at intubation were associated with a higher rate of TIAEs, similar to other pediatric studies². Multivariable analysis revealed that three factors were associated with adverse events: low volume specialist centers, consultant level providers, and intubators in the emergency medicine specialty.

Pediatric airway management for acutely ill children in non-specialized centers in the UK would likely benefit from new strategies. There needs to be a comprehensive approach to optimize the patient condition (i.e., correct hypotension or acidosis), train interdisciplinary staff to support airway management (as opposed to the anesthesiologist managing both the airway and systemic condition of the patient simultaneously), and ensure the availability of appropriate backup devices such as pediatric-sized video laryngoscopy and/or laryngeal mask airway. This concept is well aligned with the Royal College of Anaesthetists and Difficult Airway Society recommendation from their National Audit Project (NAP4), to institute the (1) development of a clear pathway for airway escalation, and (2) standardization of approach and equipment, universal use of pre-intubation checklist, universal use of end-tidal capnography, and joint simulation training for technical and non-technical skills (9, 10). Simulation-based assessment and training for pediatric airway management readiness have been conducted across 10 emergency departments (ED) in the state of Indiana as well as 12 community EDs in Connecticut (11, 12).

The implementation a system change utilizing Plan, Do, Study, Act (PDSA) cycles is possible with the current airway safety data collection tool across these non-specialized centers (13). Telemedicine offers opportunities to create new solutions, as it has been shown to be feasible and beneficial in the emergent tracheal intubation of adults (14, 15). Van Oeveren et al. reported on the use of telemedicine for tracheal intubations in 99 rural emergency departments within a large midwestern telemedicine network, where they evaluated over 200 intubations with 30% of the providers consulted via the telemedicine service (16). Complications occurred in 17% of patients intubated with the assistance of telemedicine compared to 27% who were intubated without telemedicine intervention; $p=0.135$.

In summary, there are system differences in pediatric airway management that separate the non-specialized centers from pediatric ICUs. To improve safety outcomes, the conceptual model evaluating patient, provider, and practice factors associated with adverse TIAEs needs to be utilized. The development of a pediatric airway algorithm may offer a standardized approach to airway manipulation and instrumentation. Simulation for skill improvement and team training as well as telemedicine implementation may be considered to improve quality and safety measures surrounding the management of the too-often illusive pediatric airway.

Copyright form disclosure:

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Abbreviations:

NEAR4KIDS	National Emergency Airway Registry for Children
ED	emergency department
ICU	intensive care unit
NAP4	National Audit Project
PDSA	Plan, Act, Do, Study
SpO₂	peripheral capillary hemoglobin oxygen saturation
TI	tracheal intubation
TIAE	tracheal intubation-associated events
UK	United Kingdom
US	United States

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