Characterization of tracheal intubation process of care and safety outcomes in a tertiary pediatric intensive care unit

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**Objective:** To characterize tracheal intubation process of care and safety outcomes in a large tertiary pediatric intensive care unit using a pediatric adaptation of the National Emergency Airway Registry. Variations in process of care and safety outcome of intubation in the pediatric intensive care unit have not been described. We hypothesize that tracheal intubation is a common but high-risk procedure and that the novel pediatric adaptation of the National Emergency Airway Registry is a feasible tool to capture variances in process of care and outcomes.

**Design:** Prospective descriptive study.

**Setting:** A single 45-bed tertiary noncardiac pediatric intensive care unit in a large university-affiliated children's hospital.

**Patients:** Critically ill children who required intubation in the pediatric intensive care unit.

**Interventions:** Airway management data were prospectively collected for all initial airway management from July 2007 through September 2008 using the National Emergency Airway Registry tool tailored for pediatric application with explicit operational definitions.

**Measurement and Main Results:** One hundred ninety-seven initial intubation encounters were reported (averaging one every 2.3 days). The first course intubation method was oral intubation in 181 (91.9%) and nasal in 16 (9.1%). Unwanted tracheal intubation-associated events were frequently reported (n = 38 [19.3%]), but severe tracheal intubation-associated events were rare (n = 6 [3.0%]). Esophageal intubation with immediate recognition was the most common tracheal intubation-associated event (n = 22). Desaturation <80% was reported in 51 of 183 (27.7%) and more than two intubation attempts in 30 of 196 (15.3%), both associated with occurrence of a tracheal intubation-associated event (p < .001, p = .001, respectively). Interestingly, patient age, history of difficult airway, and first attempt by resident were not associated with tracheal intubation-associated events.

**Conclusions:** Unwanted tracheal intubation-associated events occurred frequently, but severe tracheal intubation-associated events were rare. Our novel registry can be used to describe the pediatric intensive care unit tracheal intubation procedural process of care and safety outcomes. (Pediatr Crit Care Med 2012; 13:e5–e10)

**Key Words:** pediatric; airway; safety; intubation; adverse event

Tracheal intubation is one of the major interventions often performed for critically ill children in pediatric intensive care units (PICUs). It is a life-saving procedure for many patients with impending respiratory failure and circulatory shock. It is also associated, however, with unwanted consequences in adults (1–4) and children (5–10). The risk inherent in airway management is dependent on the patient, provider, and practice characteristics.

The Accreditation Council for Graduate Medical Education expects pediatric residents to be trained for advanced airway management, including tracheal intubation during their PICU rotation (11, 12). Therefore, we have an educational imperative for resident training in our academic PICUs. However, the clinical condition and anatomic issues of children in the PICU can be quite complex and challenging, so we should evaluate the clinical safety and effectiveness of airway management and assure that the quality of this procedure is adequate in our academic training environments. Nevertheless, there is a paucity of data describing the outcomes and the risks of tracheal intubation in PICUs (9).

Because of similar educational and patient care issues in emergency medicine settings, Walls et al created the National Emergency Airway Registry (NEAR), a multicentered emergency department advanced airway management registry, in 1996 (13–17). We modified the data elements of the NEAR registry to accurately characterize the process of care and safety outcomes associated with advanced airway management in our tertiary care PICU. Our hypotheses were that: 1) tracheal intubation is a common procedure in our high-volume children’s hospital.
METHODS

Settings. This study was conducted in a 45-bed noncardiac tertiary PICU in a single institution. The PICU has 2800 admissions per year with a median length of stay at 2 days and an average Pediatric Risk of Mortality III score at 24 hrs 3.4 \pm 5.3 (mean \pm SD). Only intubations that were performed in the PICU were included.

Design. The quality improvement tool, NEAR-4-KIDS, was developed and implemented in December 2004 with support of investigators and research coordinators at the NEAR coordinating center, Brigham and Women’s Hospital. Because NEAR uses only deidentified data, the Institutional Review Board approved the data use without individual subject consent. After field testing on-site during a pilot phase, revisions were made to the NEAR-4-KIDS registry data form. Data collection, compliance, and verification processes for the current study were initiated in 2007.

The procedure is briefly described as follows. When any urgent or emergent tracheal intubation took place within our PICU, a data collection sheet was completed by one of the bedside airway providers. The data accuracy was crosschecked and verified by a research assistant. A designated data manager in the respiratory care department placed the deidentified data into a secured Excel spreadsheet (Microsoft Inc, Redmond, WA) in the Respiratory Care Quality Improvement database. The research assistant and PICU respiratory therapists interviewed members of the day and night care teams daily to confirm all advanced airway management procedures were captured.

Definitions and Outcome Measures. During the development phase, key definitions were agreed on. Undesired events were \textit{a priori} defined as tracheal intubation-associated events (TIAEs) with two categories: severe TIAEs and minor TIAEs (18, 19). Severe TIAEs include cardiac arrest, esophageal intubation with delayed recognition, emesis with witnessed aspiration, hypotension requiring intervention (fluid and/or pressors), laryngospasm, pneumothorax/pneumomediastinum, or direct airway injury. Esophageal intubation with delayed recognition was defined as misplacement of the tracheal tube in the upper esophagus or hypopharynx with a lapse of time and clinical deterioration (such as desaturation) before the removal of the misplaced tube.

Minor TIAEs include mainstem bronchial intubation, esophageal intubation with immediate recognition, emesis without aspiration, hypertension requiring therapy, epistaxis, dental or lip trauma, medication error, arrhythmia, or pain and/or agitation requiring additional medication and causing delay in intubation. Mainstem bronchial intubation was considered only when it was confirmed on a chest radiograph or recognized after the clinical team secured the tracheal tube.

Three airway management events, encounter, course, and attempt, were explicitly defined to describe the event accurately and precisely. “Encounter” is defined as one episode of completed advanced airway management intervention, including tracheal intubation.

“Course” is defined as one method or approach to secure an airway (eg, oral, nasal, or by bronchoscope) and one set of medications including premedication and induction.

“Attempt” is defined as a single advanced airway maneuver (eg, beginning with the insertion of the device such as laryngoscope/laryngeal mask into patient’s mouth or nose and ending when the device is removed).

Multiple attempts may be made within an intubation course. More than one course and multiple attempts can be associated with one encounter. For example, an unsuccessful course of nasal intubation involving three attempts followed by a successful intubation on the second attempt of a course of rapid sequence intubation (oral) could all occur with one encounter.

We defined successful airway management as placement of the tracheal tube in the trachea confirmed by a primary (eg, chest rise, auscultation) and secondary (end-tidal carbon dioxide) method of confirmation or a laryngeal mask airway in a supraglottic place with an adequate seal.

Process of care variances were defined as more than two attempts per course or desaturation during the course <80% without pre-existing cyanotic heart disease. Note that desaturation <80% alone was not counted as a TIAE.

Statistical Methods. Statistical analysis was performed using STATA 10.0 (Stata Corp, College Station, TX). Summary statistics were described with mean and so for parametric variables and median with interquartile range for nonparametric variables. For categorical variables with dichotomous outcome, the contingency table method was used with chi square test or Fisher’s exact test, as appropriate. Wilcoxon rank-sum test was used for comparison of nonparametric variables. \( p < .05 \) was considered significant.

RESULTS

From July 1, 2007, to September 30, 2008, a total of 200 initial intubation encounters were reported to occur within the PICU (one encounter every 2.3 days). Three encounters were excluded as a result of incomplete outcome data, leaving 197 initial intubation encounters for analysis. Most (195 of 197 [99.0%]) of the encounters required only one course for a success. One encounter required two courses, and one encounter required four courses to establish a stable invasive airway. Therefore, a total of 197 encounters and 201 intubation courses are analyzed in this report.

Patient Characteristics. The patient demographic data are presented in Table 1. Median age was 47 months (interquartile range, 12–132 months), and weight was 15 kg (interquartile range, 8–35 kg). History of difficult airway was reported in 26 (13.2%), and at least one sign of a potential difficult airway such as micrognathia or limited neck motion was observed in 89 (45.2%). The most common indications for airway intervention were oxygenation failure in 81 (41.1%) and ventilation failure in 61 (31.0%).

Provider Characteristics. Board-eligible/board-certified pediatric critical care attending physicians were physically present in all cases. The first tracheal intubation attempt was performed by a resident in 68 of 197 (34.5%) primary
courses and by a fellow in 113 (57.4%). An attending physician performed the first attempt in 12 (6.1%). Successful intubation was accomplished by a resident in 47 (23.9%), by a fellow in 124 (62.9%), and by the attending physician in 22 (11.2%). As noted in Table 2, there was often a transition from less to more experienced providers with subsequent attempts during an encounter (Table 2).

**Practice Characteristics.** Of the 197 encounters, the initial intubation course method was oral in 181 (91.9%) and nasal in 16 (8.1%). For the first course method within each encounter, a conventional direct laryngoscope was used as a first method in 195 (99.0%), whereas a laryngeal mask was chosen in one course and fiberoptic bronchoscope in another course. The fiberoptic bronchoscope was chosen in a patient with a history of a difficult airway with midface hypoplasia, facial asymmetry, and a small mouth.

One encounter required four courses to achieve successful tracheal tube placement. This patient had a limited mouth opening and neck motion from previous radiation therapy. The first course with direct laryngoscopy was unsuccessful. This was followed by three courses with a fiberoptic bronchoscopy. The fourth course with a fiberoptic bronchoscopy was successful.

Cuffed tracheal tubes were placed in a majority of the encounters (173 of 197 [87.8%]).

**Airway Management Outcomes.** The first intubation course (method) undertaken was successful in 195 of 197 encounters (99.0%) (Fig. 1). One encounter required two courses and was successful during the second course of direct laryngoscopy. The other encounter required a total four courses until success. Therefore, of 201 total courses, success occurred with one attempt in 159 (79.1%), two attempts in 30 (14.9%), three attempts in nine (4.5%), and four attempts in two (1.0%). All encounters ended with successful airway placement. There were no deaths associated with these intubation encounters.

Providers performed an immediate tube change after initial orotracheal intubation.

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**Table 2. Primary airway management: provider characteristics**

<table>
<thead>
<tr>
<th>Provider</th>
<th>First Attempt</th>
<th>Successful Intubation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resident</td>
<td>68 (34.5%)</td>
<td>47 (23.9%)</td>
</tr>
<tr>
<td>Fellow</td>
<td>113 (57.4%)</td>
<td>124 (62.9%)</td>
</tr>
<tr>
<td>Attending</td>
<td>12 (6.1%)</td>
<td>22 (11.2%)</td>
</tr>
<tr>
<td>Nurse Practitioner</td>
<td>3 (1.5%)</td>
<td>3 (1.5%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>1 (0.5%)</td>
<td>1 (0.5%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>197</strong></td>
<td><strong>197</strong></td>
</tr>
</tbody>
</table>

*Provider performed first attempt in the first course of the encounter.*

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**Table 3. Occurrence of tracheal intubation associated events (number of the primary courses)**

<table>
<thead>
<tr>
<th>Event</th>
<th>Number (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe TIAE&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6 (3.0%)</td>
</tr>
<tr>
<td>Hypotension requiring treatment</td>
<td>3 (1.5%)</td>
</tr>
<tr>
<td>Emesis with aspiration</td>
<td>2 (1.0%)</td>
</tr>
<tr>
<td>Cardiac arrest (patient survived)</td>
<td>1 (0.5%)</td>
</tr>
<tr>
<td>Cardiac arrest (patient died)</td>
<td>0</td>
</tr>
<tr>
<td>Esophageal intubation without immediate recognition</td>
<td>0</td>
</tr>
<tr>
<td>Laryngospasm</td>
<td>0</td>
</tr>
<tr>
<td>Malignant Hyperthermia</td>
<td>0</td>
</tr>
<tr>
<td>Pneumothorax Pneumomediastinum</td>
<td>0</td>
</tr>
<tr>
<td>Direct airway injury</td>
<td>0</td>
</tr>
<tr>
<td><strong>Minor TIAE&lt;sup&gt;b&lt;/sup&gt;</strong></td>
<td><strong>34 (17.3%)</strong></td>
</tr>
<tr>
<td>Esophageal intubation with immediate recognition</td>
<td>22 (11.2%)</td>
</tr>
<tr>
<td>Mainstem bronchial intubation with delayed recognition</td>
<td>11 (5.6%)</td>
</tr>
<tr>
<td>Dental/lip trauma</td>
<td>5 (2.5%)</td>
</tr>
<tr>
<td>Esmsis without aspiration</td>
<td>2 (1.0%)</td>
</tr>
<tr>
<td>Hypertension requiring treatment</td>
<td>0</td>
</tr>
<tr>
<td>Epistaxis</td>
<td>0</td>
</tr>
<tr>
<td>Medication error</td>
<td>0</td>
</tr>
<tr>
<td>Dysrhythmia</td>
<td>0</td>
</tr>
<tr>
<td>Pain/agitation requiring additional medication and delaying intubation</td>
<td>0</td>
</tr>
</tbody>
</table>

TIAE, tracheal intubation-associated event.

<sup>a</sup>Two courses had both severe TIAE and minor TIAE; <sup>b</sup>six courses had more than one minor TIAE.
tubation in 20 patient encounters (11%). Seventeen were to change orotracheal tubes to nasotracheal tubes. One laryngeal mask was replaced by a tracheal tube using fiberoptic bronchoscopy for stability. Two orotracheal tubes were replaced by larger orotracheal tubes.

**TIAEs and Other Process Variances.** Severe and minor unwanted TIAEs were reported in 38 of 197 (19.3%) first courses of patient encounters. No TIAEs were observed in the subsequent course of the patient encounter. The most commonly reported minor TIAE was esophageal intubation with immediate recognition observed in 22 encounters (11.2%) (Table 3). Mainstem bronchial intubation was noted by radiograph in 11 encounters (5.6%). Severe desaturation ($SpO_2 < 80\%$) was reported in 50 (28.1%) courses.

Severe TIAEs were reported in only six encounters (3.0%). The most commonly reported severe TIAE was hypotension requiring treatment, reported in three encounters (1.5%). Eminis with aspiration occurred in two encounters (1.0%), and cardiac arrest occurred in one encounter (0.5%). Cardiac arrest occurred in a 3-month-old child with severe hypoxemia. Cardiopulmonary resuscitation was initiated during the airway management. Tracheal intubation was successful at the second attempt, and the patient survived from this event. Table 4 summarizes the patient, provider, practice variables, process variances, and occurrence of TIAEs in the first course of the patient encounter.

Both process of care variances, desaturation <$80\%$ and more than two attempts per course, were associated with occurrence of TIAEs ($p < .001$, $p = .001$, chi square test, respectively). Other patient (including age and weight), provider, and practice variables were not associated with presence of TIAEs, except the use of vagolytic (anticholinergic) medication. This result did not change with sensitivity analysis for missing data.

**DISCUSSION**

Using the novel NEAR-4-KIDS registry, we describe the patients, providers, and practice characteristics of tracheal intubation in a PICU setting as well as important acute patient safety outcomes. This registry is unique because of its high documentation compliance and redundant data cross-checks. Somewhat surprisingly, tracheal intubation procedures performed within the PICU were relatively uncommon (only one every 2.3 days), even in our large, 45-bed PICU with 2800 patient admissions per year staffed by many residents, fellows, and attendings. Although most courses were successful, unwanted TIAEs were more common (19%) than we expected. The proportion with resident participation (35%) was also lower than we anticipated.

The risk inherent in tracheal intubation is dependent on the “three Ps”: patient, provider, and practice/planning, similar to other PICU safety events (10). The inherent risks with each of the three are the following.

**Patient Condition.** The patient’s instability might limit the choice of medications or necessitate the use of an accelerated method of intubation, and the patient’s airway anatomy may require modification of the approach such as when a difficult airway is identified (20, 21).

**Provider Psychomotor and Teamwork Competence.** Risks are higher with inexperienced intubationists and teams (18, 19). The provider, particularly in an academic medical center, is often a trainee who is supervised by a person of advanced training status (18). The trainee’s relative inexperience and relative lack of leadership skills may significantly affect individual and team performance.

**Practice and Planning.** Inadequate practice and planning are always a risk for any psychomotor skill. Optimal practice timing and quantity remain to be defined, but preparation for intubation can play a key role in success and minimization of possible adverse events. This is especially true for patients with a difficult airway (20).

Few data address the safety outcomes of tracheal intubations in the PICU setting. Easley et al (6) evaluated 250 consecutive pediatric airway management encounters in the emergency department before transfer to the PICU. They defined major variances as technical problems resulting in a significant risk for airway trauma and increased morbidity such as mainstem bronchial intubation, airway trauma, dental damage, barotraumas, or multiple attempts (more than two attempts) and minor variances as problems of airway management that should be avoided but do not significantly increase the immediate risk to the patient such as inappropriate sizing of tracheal tube or excessive cuff volume. Major or minor variances were documented in 136 of 250 (54%), whereas major variances were observed in 93 of 250 (37%), including

| Table 4. Univariate analysis for patient, provider, and practice variables and TIAEs |
|---------------------------------|-----------------|-----------------|---|
| Patient                        | TIAE (n = 38)   | No TIAE (n = 159) | p  |
| Age, months                    | 38 (IQR, 5–108)  | 48 (IQR, 14–138) | .25* |
| Weight, kg                     | 13.6 (IQR, 7.3–25) | 16.5 (IQR, 9–38) | .37* |
| Indication                     |                |                 |    |
| Oxygenation failure            | 18 (47.4%)      | 63 (39.6%)     | .38b |
| Ventilation failure            | 15 (39.5%)      | 46 (28.9%)     | .21b |
| Elective                       | 9 (23.7%)       | 42 (26.4%)     | .73b |
| History of DA                  | 6 (16.2%)       | 20 (12.6%)     | .59b |
| Sign of potential DA           | 19 (50.0%)      | 70 (44.0%)     | .59b |
| Provider                       |                |                 |    |
| First attempt by resident      | 16 (42.1%)      | 52 (32.7%)     | .34b |
| First attempt by fellow        | 19 (50.0%)      | 94 (59.3%)     | .29b |
| Practice                       |                |                 |    |
| First half of academic year    | 21 (55.3%)      | 88 (54.0%)     | .99b |
| Time (night: 11:00 PM to 6:59 AM)   | 10 (26.3%)  | 36 (22.9%)     | .66b,c |
| Method (nasal)                 | 2 (5.3%)        | 14 (8.8%)      | .47b |
| Paralytic use                  | 36 (94.7%)      | 153 (94.3%)    | .92b |
| Vagolytic use                  | 31 (81.6%)      | 94 (59.1%)     | .01b |
| Sedative/narcotic use          |                |                 |    |
| Midazolam                      | 16 (42.1%)      | 70 (44.0%)     | .83b |
| Fentanyl                       | 19 (50.0%)      | 97 (61.0%)     | .22b |
| Ketamine                       | 6 (15.8%)       | 33 (20.8%)     | .49b |
| Etomidate                      | 5 (13.2%)       | 11 (6.9%)      | .21b |
| Process of care variances      |                |                 |    |
| Desaturation <80%              | 20 (57.1%)      | 30 (20.1%)     | <.001* |
| Number of attempts >2          | 13 (34.2%)      | 17 (10.8%)     | .001* |

TIAE, tracheal intubation-associated event; IQR, interquartile range; DA, difficult airway.

*Wilcoxon rank-sum; bchi square test; *one missing data in the no TIAE group; btwo missing data in the no TIAE group; two missing data in the TIAE group; 11 missing in the no TIAE group; known cyanotic disease was excluded. Bold: p value <.05.
mainstem bronchial intubation in 70 of 250 (28%), multiple attempts in 51 of 250 (20%), and airway trauma in 11 of 250 (4%). The rate for those TIAEs was lower in our study. This may be attributable to the difference in the provider experience of pediatric airway management. Pediatric critical care attending physicians were present at all intubations in our study. In addition, airway management in PICU patients has undoubtedly evolved over the 10 yrs since the Easley et al study was conducted.

Carroll et al (9) evaluated safety profile of PICU intubations from a single free-standing children hospital in a retrospective manner. They reported 137 urgent and emergent nonoperating room intubations over 2 yrs. Emergent intubations occurred more often during off-hours (5 PM to 8 AM). Complications were seen in 41% of all urgent and emergent intubations. The most common complications were desaturations defined as SpO2 <90% (29%), hypotension (16%), and bradycardia (7%). In their multivariate analysis, three or more attempts of intubation, emergency intubation, and off-hour intubation are associated with complications. Interestingly, these complications were not associated with prolonged PICU stay or duration of mechanical ventilation.

In our study, we prospectively captured all intubations occurred in PICU. The TIAE rate is lower in our study (19.3%), which seems to reflect the different definition of the complications. The incidence of desaturation at a lower threshold (<80%) in our study is surprisingly similar to Carroll et al’s study. We speculate this is the result of high accuracy of the data in complications and process of care variance such as desaturation using prospective data collection at the bedside.

Sagarin (13) reported the incidence of adverse events in pediatric intubations at emergency departments from the existing emergency department NEAR. Pediatric intubations consisted 156 of 1129 (14%) of all emergency department intubations. Of note, 77 of 156 were trauma cases. They reported two cases of failure to intubate and two cases (1.3%) with “true complications” (one with laryngospasm, one with dental trauma), 19 cases (12.1%) with a “technical problem” (11 with a mainstem intubation, five with a detected esophageal intubation, one with an air leak resulting from a small tube, one with a tube obstruction, and one with a wrong medication dose), and four cases with a “physical alteration” (two with desaturation, one with pneumothorax, and one with pneumomediastinum). Although the definition of complications is somewhat different, the incidence of TIAEs in our study is higher (19%). We speculate this may be the result of the critical nature of the PICU patients.

Although 46% of patients had at least one sign of potential difficult airway and 15% had a history of prior difficult intubation reported by providers, nearly all of the endotracheal intubation encounters were successful with conventional methods. This high success rate is probably a function of the experience and expertise of our team and the use of medications to facilitate the procedure as reported in multiple adult and pediatric intubation studies in prehospital and emergency department settings (13, 14, 22, 23).

Our providers used both sedative and paralytic medications in the vast majority of cases (96.7% of orotracheal intubation). In contrast, paralytic medications were used in only 4.4% of tracheal intubations in European PICU/Neonatal Intensive Care Unit practices (24).

It is clear from our study results that the process of care variances (number of intubation attempts and desaturation <80%) were associated with occurrence of TIAEs. This finding is consistent with other studies in adult (3) and pediatrics (9). This suggests the process of care variances should be considered as a “near miss” of a potentially harmful event.

We were surprised at the high proportion of cuffed tracheal tube placement (87.3%). This has become more of an accepted practice in the United States (25), but not yet in Europe (26). Because our study did not include any midterm or long-term outcome data such as extubation failure or development of subglottic stenosis, we are not able to comment on the safety of cuffed tracheal tube use, but simply to describe the landscape of recent tracheal intubation procedure practice at one large institution.

In our study, patient, provider, and practice characteristics (including patient’s history of difficult airway) were not associated with occurrence of TIAEs except for the use of vagolytic (anticholinergic) medications. We speculate this association may be the result of more frequent use of vagolytic medications in clinically unstable patients. The signs of a difficult airway were reported in 45% of the patients in our result, which seems to be quite high. Although we used a standardized item list to capture commonly described features (Table 1), this might have resulted in a protective definition. As a result, those difficult airway features became less sensitive indicators for the occurrence of TIAEs. A larger study is necessary to quantitatively evaluate the significance of each difficult airway feature in children.

Resident participation as a laryngoscopist was not high (35%). Although there is no local policy, it is an expectation for residents to participate in airway management (18). It was left to the attending physician’s discretion who was assigned to attempt the first tracheal intubation on a case-by-case manner based on the patient condition and the provider skills.

Our results need to be interpreted in light of several limitations. First, an underreporting bias for TIAEs may exist. Although the respiratory care quality improvement team and research team members contacted the on-call team regarding the occurrence of advanced airway management, and cross-checked any information preliminarily filled in the data collection form by bedside team members, underreporting in the number of attempts and TIAEs is still possible. We also acknowledge that the definition of esophageal intubation with “delayed recognition” vs. “immediate recognition” is subjective and could have led to underreporting. This was not explicitly defined (the time between the esophageal placement and removal or the criteria of clinical deterioration) and the decision to report as “delayed” or “immediate” was left to the bedside team’s interpretation. Revision of this operational definition with consensus duration for “immediate” vs. “delayed” is under consideration.

In our data, desaturation (<80%) may be subject to underreporting, because it relied on self-report. In addition, the investigators could not come to consensus on a cutoff to define a desaturation as a minor or major TIAE but felt that those events would be captured by other TIAEs.

In addition, detailed information regarding diagnosis and severity of illness was not recorded, which may have influenced the choice of operator, device, and drugs used. For this quality improvement study initiative, the Institutional Review Board requested that no personal health information be recorded. For future studies, we anticipate collecting specific severity of illness and diagnostic category information with Institutional Review Board approval.
Finally, this study reports the landscape of tracheal intubation practice in a single, noncardiac PICU. The generalizability of this finding to other PICUs and to cardiac intensive care units may be limited. A prospective multicentered PICU NEAR-4-KIDS registry project is under development to answer this question.

CONCLUSION

A prospective database adapted from the NEAR-4-KIDS was used to characterize the landscape of tracheal intubation process of care, provider participation, and safety in our PICU. Even in our busy tertiary care referral PICU, tracheal intubation is an infrequent event, which may have training implications. Although nearly all of the endotracheal intubation encounters were successful, unwanted TIAEs were observed frequently (19% of encounters). Residents participated in first intubation attempts less frequently (35%) than expected. Further multicentered prospective data collection using this NEAR-4-KIDS registry with a rigorous data compliance and completion cross-check system is warranted to describe the association between process of care and outcomes across a broad spectrum of PICUs.

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