

# Tracheostomy Care Education for the Nonsurgical First Responder: A Needs-Based Assessment and Quality Improvement Initiative

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## Abstract

**Objectives.** To perform a needs-based assessment for tracheostomy care education for nonsurgical first responders in the hospital setting and to implement and assess the efficacy of a targeted tracheostomy educational program.

**Methods.** A prospective observational study conducted between October 2017 and May 2018 including emergency medicine (EM) residents, internal medicine (IM) residents, and intensive care unit (ICU) advanced practice providers at 2 tertiary hospitals. Needs-based assessments were conducted, leading to specialty specific curricula. One-hour educational sessions included didactics and case-based simulation. A pre- and posttest objective knowledge quiz and self-assessment were administered, and a posttest was repeated at 6 months.

**Results.** There were 85 participants (13 ICU, 40 EM, 32 IM). Significant improvement ( $P < .05$ ) in mean objective knowledge score was seen across all groups between pre- and postintervention assessments with relative but not significant improvement at 6 months. There were significant increases in comfort level from pre- to postintervention. At 6-month follow-up, comfort level remained significantly increased for the majority of questions for the EM group and for select questions for IM and ICU advanced practice provider groups.

**Discussion.** Nonsurgeons are often first responders to critical airway situations yet receive limited formal education regarding tracheostomy. We demonstrated improvement in knowledge and comfort after a targeted educational module for tracheostomy care and management.

**Implications for Practice.** Although tracheostomy care is multidisciplinary, specialty-specific education may provide a more relevant foundation on which to build skills. Prompt and

effective management of tracheostomy emergencies by first responders may improve patient safety and reduce mortality.

## Keywords

tracheostomy care, tracheotomy, patient simulation, needs-based assessment

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Reported benefits of tracheostomy include faster ventilator weaning, reduced intensive care unit (ICU) stays, decreased risk of laryngeal injury, and improved patient comfort<sup>1</sup>; therefore, tracheostomy has been increasingly performed in ICU settings.<sup>2,3</sup> Between 1993 and 2008, there was a substantial increase in tracheostomy and, in turn, an increase in the number of patients discharged to long-term care facilities with tracheostomy tubes.<sup>4</sup> Despite this increased prevalence of tracheostomy patients, tracheostomy care remains highly variable.<sup>5</sup> Furthermore, physicians and advanced practice providers (APPs) of varying specialties provide care for patients with tracheostomy tubes in inpatient and outpatient settings. Patients with a tracheostomy are at risk for airway compromise and life-threatening complications secondary to mucus plugging, accidental decannulation, or bleeding. Prompt and

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effective identification and management of these events can help mitigate this risk. Studies have shown that tracheostomy patients discharged from the ICU to the ward are often at risk of suboptimal care and increased morbidity due to insufficient skills and experience of the involved providers.<sup>6,7</sup>

When a complication occurs, an otolaryngologist is unlikely to be the first responder even when the patient is admitted to the hospital or in the emergency department (ED). We observed that the current state of nonsurgical graduate medical education does not include adequate teaching about tracheostomy management or complications. This knowledge and education gap is common throughout the country.<sup>1,8</sup> Survey studies of internal medicine (IM) residents<sup>9</sup> and emergency medicine (EM) junior doctors<sup>10</sup> showed low levels of comfort and limited training as related to airway assessment. Casserly et al<sup>11</sup> assessed health care professionals' knowledge of life-saving strategies in the setting of accidental decannulation. Nonotolaryngology providers (anesthesiologists, ICU nurses, ward nurses) demonstrated a lack of understanding of the potential pitfalls of attempted reinsertion of a tracheostomy tube in an emergency situation.

Prior studies have demonstrated the benefits of a tracheostomy care education module among nurses and physicians showing significant increases in knowledge and confidence following a didactic program.<sup>1,12</sup> Dorton et al<sup>1</sup> presented a simulation model, assessing the competency and comfort level of providers involved in tracheostomy care, including EM residents, critical care fellows, ICU and floor nurses, anesthesiology residents, medical students, and ICU providers. In addition, Agarwal et al<sup>13</sup> assessed a simulation-based education program among nonsurgical pediatric providers (residents, hospitalists, and advanced practice registered nurses) reporting significantly improved levels of comfort related to routine tube care and tube change as well as objective knowledge after the course.

Needs-based assessments are systematic processes to identify and address perceived gaps in desired conditions being studied. Given the demonstrated efficacy of a hybrid didactic and simulation educational module within a broad audience, we theorized that taking a needs-based approach would allow us to maximize the educational impact. Therefore, we developed specialty-specific modules to target physician-level, nonsurgeon first responders for hospital-based tracheostomy-related emergencies. We chose a needs-based subgroup approach (EM residents, IM residents, ICU APPs) to address knowledge and technical deficiencies specific to these groups by partnering with physician educators from each specialty to allow for improved knowledge acquisition, engagement, and transference into practice.

Given the reported and observed knowledge gap in tracheostomy education, the specific aim of this study was to perform a needs-based assessment and to implement and assess the efficacy of a targeted tracheostomy education and simulation program for nonsurgical resident physicians (EM and IM) and advanced practice critical airway first responders in the hospital setting.

## Methods

This was a prospective, observational pilot study approved by the institutional review boards at the University of Connecticut Health Center and Connecticut Children's Medical Center. All IM residents, EM residents, and ICU APPs at 2 tertiary care centers were invited to participate. There were no specific exclusion criteria within these groups. Sessions were conducted during the standard didactic time for each specialty, except for the advanced practice ICU provider group for whom a separate time block was arranged. Although the IM and EM residents were required to attend the session as part of their didactic programs, their participation in the data collection for the study was voluntary.

Using the clinical consensus statement on tracheostomy care developed by the American Academy of Otolaryngology–Head and Neck Surgery Foundation,<sup>2</sup> essential components of tracheostomy care were incorporated into the curriculum, which was then accordingly modified after review with a faculty member from each respective specialty. The clinical consensus statement identifies 13 key items related to supplies for tube change, initial tube change, cuff management, decannulation preparation, discharge care protocol, and emergency management for a dislodged tube, specifically replacement or intubation. In addition to the key statements, an additional 43 statements achieved consensus with a range of information regarding size determination, timing for initial tube change, importance of humidification, inner cannula use, suctioning, causes of acute occlusion, and speaking valve use.<sup>2</sup> Using these statements and ideas, pertinent management information was identified and used as the basis for creation of the original material, ensuring that most of these key statements were appropriately covered.

To perform a needs-based assessment specific to each subgroup, the course materials were reviewed with IM and EM residency program faculty physicians and revised in accordance with their separate recommendations. Furthermore, informal needs assessments were performed via respective discussion with the chief IM resident, select EM residents, and a lead critical care nurse practitioner regarding their opinions on valuable teaching points for their specialty as related to tracheostomy care. Knowledge gaps were identified in each group based on relevance to their practice. For the IM group, relevant knowledge gaps identified included tracheostomy tube parts, routine postoperative care (humidification, suctioning, speech and language evaluation), and decannulation protocol. For the EM group, relevant knowledge gaps identified included tracheostomy tube parts, insertion and replacement, pediatric airway anatomy, and tracheostomy differences. Tracheostomy complications and troubleshooting were identified weaknesses for both groups; therefore, a significant portion of the material and case simulation was dedicated to identification, assessment, and intervention for common complications. Given the comparable nature of the area of practice between the ICU APP and IM resident groups, the same program was used for these 2 groups. Finally, the course material was also reviewed by otolaryngology faculty and residents for accuracy and pilot testing of the objective tests.

Prior to the educational program, the subjects completed a demographics form, a self-assessment questionnaire, and an objective knowledge test. There are no validated tools to assess tracheostomy care; therefore, our assessment tools were experimental in nature, based on the clinical consensus statement and respective faculty and staff feedback. Comfort level as related to tracheostomy was assessed with a subjective questionnaire form that used a 5-point Likert scale, based on that used by Dorton et al<sup>1</sup> in their simulation model (**Figure 1**). The hour-long educational program consisted of a Microsoft PowerPoint presentation followed by 3 hands-on simulation cases given by an otolaryngology resident and supervised by a board-certified otolaryngology attending faculty member. For all 3 groups, the cases reviewed tracheostomy complications including mucus plugging, accidental decannulation, false passage, and tracheoinnominate fistula; however, the setting and context of the case varied as related to the provider (ie, emergency department, medical floor/intensive care unit). Immediately after the intervention, the subjects completed the self-assessment questionnaire and respective objective knowledge posttest.

To determine whether the intervention would result in long-term knowledge acquisition and sustained comfort, we repeated a second survey 6 months later.

**Results**

Eighty-five providers participated in the program between October and December 2017. There were 40 (47%) EM residents, 32 (37.6%) IM residents, and 13 (15.3%) ICU APPs who completed the program and assessments. Between all 3 subgroups, there was variable yet limited experience with tracheostomy tube insertion and suctioning (**Figure 2**). Although these providers comprise the majority of in-house physician-level staff during off hours, their experience, as demonstrated, is limited, which may be due in part due to the presence of other trained providers responding to such events (eg, respiratory therapist) or may also be a result of the general infrequency of such events.

**Statistical Analysis**

A 2-tailed paired *t* test was used to compare pre- and postintervention assessments. A 2-tailed, 2-sample *t* test was used to compare the pre- and postintervention assessments with the 6-month assessment, respectively. Equal variance was assumed in this analysis.

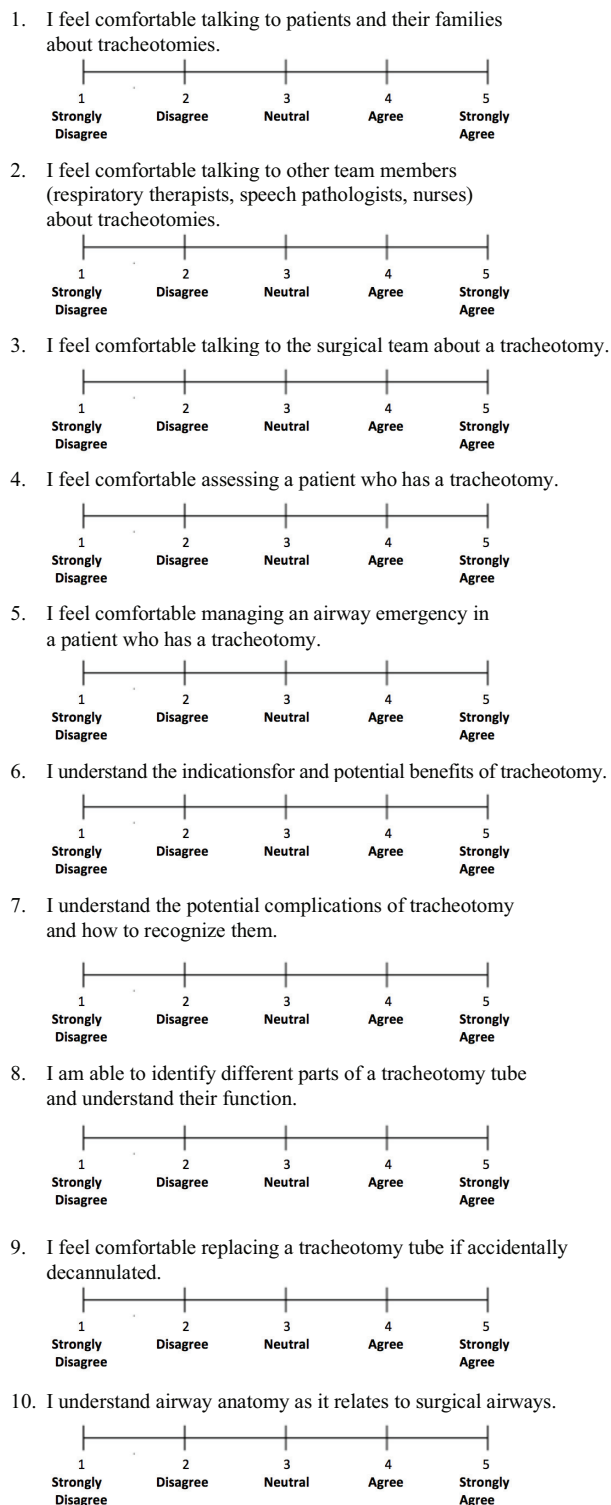
**Objective Knowledge Test**

Between the pre- and postintervention assessment objective knowledge test mean score, there was statistically significant improvement among all 3 subject groups (**Figure 3**). Although there was an increase in mean score at the 6-month follow-up relative to the preintervention assessment, these changes were not significant.

**Subjective Questionnaire**

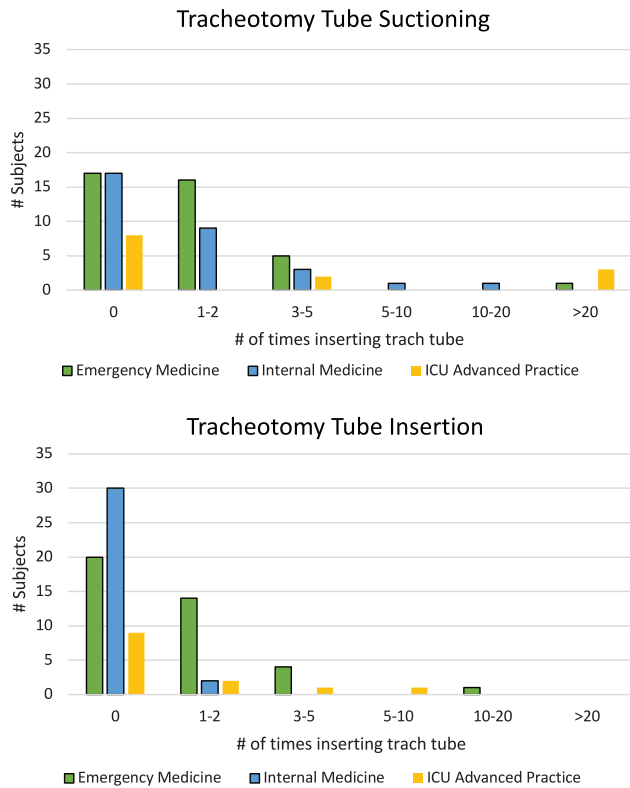
Between the pre- and postintervention assessment subjective questionnaire responses, there were statistically significant

**Tracheotomy - Self-Assessment Questionnaire**

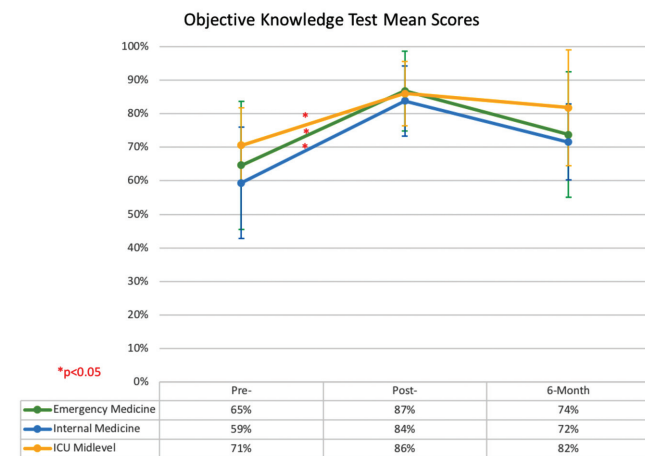


**Figure 1.** Subjective comfort level self-assessment questionnaire.

increases in the mean Likert scale response across the majority if not all of the questions for all the groups (**Table 1**). At 6-month follow-up, EM resident responses remained significantly increased compared with the preintervention response for the majority of questions. Similarly, the IM



**Figure 2.** Prior experience with tracheostomy suctioning and insertion by specialty. The majority of participants in all specialties had only suctioned or inserted a tracheostomy tube either zero or 1 to 2 times. ICU, intensive care unit.



**Figure 3.** Objective knowledge test mean scores and standard deviation by provider type at pre, post, and 6-month follow-up. Significant improvement seen at the postintervention timepoint. Relative improvement from pre- to 6-month assessment; however, no significant difference. ICU, intensive care unit.

group demonstrated relative increase at the 6-month follow-up; however, fewer responses were significant. This demonstrates a sustained increased comfort level after the educational program within a 6-month time period for the EM group but also suggests the opportunity for more reinforcement among the IM group.

The ICU APP group demonstrated a progressive increase from pre to post to 6 months with regard to comfort level scores. This may be related to ICU APPs having sustained exposure to the care of tracheostomy patients. Although the initial postintervention assessment results can be attributed directly to the educational program, 6-month follow-up results for both objective knowledge and subjective questionnaire responses may be influenced by each provider's variable clinical experience during the 6-month interim.

## Discussion

This study demonstrates the efficacy of a tracheostomy education program targeted to specific learners using a needs-based assessment. Significant improvement in mean objective knowledge scores was seen across all 3 specialty groups between pre- and postintervention assessments, indicating the short-term efficacy of the educational program. Although 6-month mean objective knowledge scores were relatively decreased from the postintervention period, they remained higher than the preintervention scores, suggesting the potential for retention. However, the pre- to 6-month change was not significant, and we believe that ongoing education may be necessary. As residents may not have the opportunity to practice their technical skills related to tracheostomy due to the relative infrequency of emergent events, they may need an interval “refresher” either through an online module or a regularly scheduled educational session.

With regards to comfort level related to tracheostomy care, results demonstrated significant increases from pre- to postintervention assessment. More important, at the 6-month period, EM residents notably had significantly increased comfort levels relative to the preintervention period. IM and ICU APPs had similarly increased levels for all questions from pre- to postintervention and pre- to 6-month follow-up, with significant increases for certain questions. Interestingly, the ICU APP group had increased comfort levels from pre to post and from post to 6 months. This upward trend in comfort level in this group may be attributable to their more consistent interaction with tracheostomy patients given their daily ICU setting vs the resident groups who have distinct rotation schedules. Regardless, these results demonstrate overall increased comfort levels regarding tracheostomy care across all involved groups.

The results of this study are consistent with previous publications with regard to tracheostomy care education.<sup>1,8,12,14,15</sup> Although previous studies have demonstrated some general improvement, and nursing specific programs and assessments have been conducted,<sup>15,16</sup> there are limited specialty-specific data available among different physician groups with regard to such educational programs. Khademi et al<sup>17</sup> provided one example through a study of physical medicine and rehabilitation (PMR) residents undergoing a didactic and hands-on workshop regarding tracheostomy care. Following the program, there was noted to be significant increase in knowledge and successful clinical proficiency as outlined by the Accreditation Council for

**Table 1.** Number of Questions in the Subjective Self-Assessment Questionnaire That Achieved Significant ( $P < .05$ ) Change between the Pre- and Postassessment and the Pre- and 6-Month Assessment.

	Pre- to Postintervention, No.	Pre- to 6-Month Follow-up, No.
Emergency medicine	10/10	8/10
Internal medicine	10/10	2/10
ICU advanced practice provider	9/10	5/10

Abbreviation: ICU, intensive care unit.

Graduate Medical Education for PMR residents with regard to tracheostomy care. Although tracheostomy care has become a multidisciplinary effort, basic training on a specialty-specific level may provide a more substantial foundation on which to build as trainees may find more personal relevance when the tracheostomy emergency case scenario is presented in a way that they can easily picture themselves as the first responder.

Although purposeful, the specialty-focused curriculum also results in a limitation as it provides a less realistic environment for the simulation cases given that residents/APPs are unlikely to be the sole responder to a tracheostomy emergency. In reality, there are likely to be other providers, nurses, and respiratory therapists available. Nonetheless, this physician-level needs-based assessment and educational program may be subsequently combined with a multidisciplinary simulation program to provide more realistic training scenarios regarding tracheostomy care. Given the heterogeneity of our EM and IM/ICU programs, true differences between specialty outcomes cannot be reliably assessed; however, our results indicate the respective program was positively influential on the respective specialty with regard to comfort and knowledge. Additional limitations of our study include the nature and number of questions on the objective testing. Unfortunately, there is no validated measure for tracheostomy knowledge assessment. In an effort to address this issue, questions were created using the clinical consensus statements as the basis for the topics covered and in conjunction with the involved specialty attending provider and otolaryngology faculty. Finally, there are additional challenges to sustainability of the program as it may not be feasible to be directed by otolaryngology staff and residents each year. Therefore, future directions to continue or implement such a program at our institution or elsewhere may include efforts to create refresher courses, self-directed modules, and standardized simulated cases.

## Implications for Practice

In our institution, as well as many others, otolaryngology residents take home call, meaning that a night or weekend tracheostomy emergency is likely to have a nonotolaryngologist first responder.<sup>18</sup> While this applies to those hospitals that have resident coverage, most hospital coverage in areas without a residency program has otolaryngology providers on call from home instead of in house. Furthermore, many

emergency departments do not even have otolaryngology consultation services available. In fact, a survey of California ED directors found that while 80% of respondent EDs had internal medicine available on call, fewer than 60% reported on-call services for otolaryngology. In addition, they found that more than 40% of otolaryngology transfers would take more than 3 hours.<sup>19</sup> Given the urgency of tracheostomy complications, these lengthy delays could result in patient harm or death without a competent nonotolaryngologist to intervene. The limitations of otolaryngology in-house availability both at our institution and many of the future practice sites of the EM and IM trainees were a driving force behind the development of our specialty-specific educational intervention. As these nonsurgeon physician-level providers comprise a significant proportion of in-hospital staff available at off-hours, their education may increase patient safety for this vulnerable population.

## Conclusion

While this was a preliminary initiative, the results indicate a need for consistent tracheostomy education. We propose that although tracheostomy care is multidisciplinary, tracheostomy education may be more effective if approached from a specialty-specific standpoint. Tailoring education to a specific specialty allows the learner to “buy in” to the necessity of the session as well as conceptualize its relevance, an approach that is transferable to other institutions. While further research is needed to determine whether participants have applied their knowledge to patient care, we found evidence to pursue recurrent didactic or simulation sessions at our institution to establish sustained comfort and knowledge among nonsurgical providers with regard to tracheostomy care, which we believe will result in improved safety for patients living with a tracheostomy.

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## Author Contributions

**Kinneri Mehta**, study design, implementation, data analysis, conception, drafting, revising and final approval of manuscript; **Marissa Schwartz**, study design and implementation, revising and

final approval of manuscript; **Todd E. Falcone**, study design and implementation, conception, drafting, revising and final approval of manuscript; **Katherine R. Kavanagh**, study design and implementation, conception, drafting, revising and final approval of manuscript.

## Disclosures

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