A Multidisciplinary Approach to a Pediatric Difficult Airway Simulation Course

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Abstract

Objective. To design and assess an advanced pediatric airway management course, through simulation-based team training and with multiple disciplines, to emphasize communication and cooperation across subspecialties and to provide a common skill set and knowledge base.

Methods. Trainees from anesthesiology, emergency medicine, critical care, pediatric surgery, and otolaryngology at a tertiary children's hospital participated in a 1-day workshop emphasizing airway skills and complex airway simulations. Small groups were multidisciplinary to promote teamwork. Participants completed pre- and postworkshop questionnaires.

Results. Thirty-nine trainees participated over the 3-year study period. Compared with their precourse responses, participants' postcourse responses indicated either agreement or strong agreement that the multidisciplinary format (1) helped in the development of team communication skills and (2) was preferred over single-discipline training. Improvement in confidence in managing critical airway situations and in advanced airway management skills was significant (P < .05). Eighty-one percent of participants had improved confidence in following the hospital's critical airway protocol, and 64% were better able to locate advanced airway management equipment.

Discussion. Multiple subspecialists manage pediatric respiratory failure, where successful care requires complex handoffs and teamwork. Multidisciplinary education to teach advanced airway management, teamwork, and communication skills is practical and preferred by learners and is possible to achieve despite differences in experience. Future study is required to better understand the impact of this course on patient care outcomes.

Implications for Practice. Implementation of a pediatric difficult airway course through simulation-based team training is feasible and preferred by learners among multiple disciplines. A multidisciplinary approach exposes previously unrecognized knowledge gaps and allows for better communication and collaboration among the fields.

Keywords

multidisciplinary simulation, pediatric airway simulation, pediatric difficult airway, simulation curriculum, adult education, simulation-based team training, PS/QI

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including some with anatomic and physiologic derangements that require emergent intubation. Successful airway management requires early recognition of difficult airway risks and notification of surgical subspecialists. Difficult airway management comprises situations that include difficult bag valve mask ventilation, direct laryngoscopy, placement of an endotracheal tube, and supraglottic and subglottic rescue. Anesthesiologists, pediatric surgeons, and otolaryngologists are key members of the subspecialty teams who may be called on for emergency airway assistance. Physicians responsible for pediatric critical airways and emergent intubations vary in airway management expertise due to differences in training. Routine rehearsal and practice of difficult and rare situations are essential for maintaining technical and teamwork skills for when these life-threatening circumstances arise.

Previously published work found that airway skills deteriorate after initial training. Given that trainees have limited exposure to emergency airway situations, developing effective training options and means to ensure long-term competency is imperative. Simulation training allows (1) rehearsal of complex clinical emergencies, (2) an opportunity to practice giving feedback, (3) learning by watching, and (4) active participation in faculty-led scripted debriefings. Integrating medical simulation courses into the curriculum of otolaryngology residency programs has been a successful educational tool. Unique anatomic or physiologic deformities, varying clinical environments, and lack of availability of adjunctive airway equipment are just a few challenges that a physician may face in these emergencies. Previous understanding of various team members’ roles and the resources available in different settings during emergency airway management are vital nontechnical skills. Practice and familiarity with communication and teamwork among subspecialties are valuable to facilitate seamless transitions in high-acuity settings. Multidisciplinary training of a difficult airway situation teaches rapid evaluation, effective communication, leadership, and teamwork, as well as knowledge of different hospital environments, equipment, and protocols.

Simulation-based team training (SBTT) has recently become a recognized platform for training interdisciplinary teams in these high-acuity but low-frequency scenarios. SBTT allows for team members in certain clinical contexts to learn technical skills needed for management of these situations, as well as improved coordination and communication. A consensus statement published in 2011 reported on the importance of designing SBTT activities with emphasis on teamwork, utilization of organizational resources, and importance of feedback on outcomes and behaviors. The statement indicated the importance of evaluating SBTT activities through clinical outcomes but also the need for improved objective assessment tools for these measures.

The purpose of this project was to develop a multidisciplinary pediatric airway management course to emphasize the importance of communication and cooperation across subspecialties and provide a common skill set and knowledge base for novice subspecialty trainees. The development of this course was partially prompted by a specific clinical event and the opportunities identified for improvement. We hypothesized that this collaboration would improve the trainees’ confidence in technical and nontechnical skills in the management of acute pediatric airway compromise and that this type of training could be successful despite a diverse learner population. The data are presented per the SQUIRE 2.0 guidelines (Standards for Quality Improvement Reporting Excellence).

Methods

Intervention

A simulation-based course was designed to familiarize trainees with appropriate pediatric airway interventions and to improve team-based communications in this type of high-stress situation. Objectives presented to learners at the outset of the course were as follows:

- Improve confidence level and technical skills with airway management of low-frequency, high-risk situations
- Practice using good communication and teamwork skills, especially among disciplines, and learn from one another
- Review Nationwide Children’s Hospital’s protocol for critical airways and difficult intubations in hopes of decreasing any preventable serious adverse patient events

Overview. This course has been performed for 3 consecutive years at Nationwide Children’s Hospital in Columbus, Ohio, which is a pediatric tertiary care center. It consists of an 8-hour day that involves a team-building “scavenger hunt,” short didactic lectures, small group skill stations, high-fidelity simulations, large group discussion, and formal debriefing sessions. A weekend day was chosen to allow for as many trainees to be exempt from clinical duties as possible, as well as improved access to high-demand in situ locations in the operating room. The Nationwide Children’s Hospital Institutional Review Board deemed the reporting of this course and its outcomes exempt.

Faculty. A small working group composed of a pediatric anesthesiologist, an otolaryngologist, and an intensivist—all of whom have formal positions at the institution in fellow and resident education—initially conceptualized the course. While none of the faculty has formal certification in simulation education, each has >5 consecutive years of experience serving as invited faculty at simulation-based airway management boot camps at other pediatric academic centers. The intensivist also serves as this institution’s medical director of simulation. Thus, the group members serve as both content experts and simulation educators. On the day of the course, additional subspecialty faculty from each discipline are enlisted to help as content experts for the skill
stations and progressive in situ simulation scenarios. Collaboration among multidisciplinary faculty members in the education of the trainees was helpful in providing different clinical perspectives as well as role-modeling good communication and mutual respect.

Participants. Participation was recommended for novice trainees across 5 pediatric subspecialties: otolaryngology, anesthesiology, surgery, emergency medicine, and critical care. Trainees were selected by the disciplines’ program directors. Participants ranged from postgraduate year 2 (PGY2) to PGY10 and were identified as “novice” based on previous experience with pediatric airway interventions. The variability in training years was due to differences in airway management exposure among the various subspecialties. Participation was voluntary and based on trainees’ availability within current Accreditation Council for Graduate Medical Education work hour restrictions. Trainees from different subspecialties were not often acquainted with one another and thus assigned to balanced multidisciplinary teams—the purpose of which was for teammates to learn from one another’s subspecialty knowledge and to demonstrate the necessity of multidisciplinary collaboration for successful patient management. Table 1 reports detailed demographic information on all participants.

Curriculum Design and Educational Strategies. The curriculum was designed to emphasize the course objectives, which included improving trainees’ familiarity with the institution’s published Critical Airway and Difficult Intubation Protocol. Additionally, the curriculum highlighted techniques for management of difficult airways, which included location and function of adjunctive airway equipment. Finally, complex scenarios were designed (1) to allow participants to practice as team leaders on medical emergency teams or subspecialty consultants called to help with airway management and (2) to promote communication among the teams involved with pediatric airway management. Detailed information about the curriculum is available in the appendix (available in the online version of the article).

Team-Building Scavenger Hunt. After brief introductions and an overview of the agenda, participants were assigned to their multidisciplinary teams and tasked with locating emergency airway equipment stored in various locations throughout the hospital (operating room, PICU, emergency department, and radiology). The purpose of this activity was to encourage teamwork and collaboration among disciplines and to allow trainees to become familiar with the location of equipment critical to successful airway management in different areas in the hospital. This was a timed competition, with a prize awarded to the first team to complete the scavenger hunt. To “win,” team members needed to work together and rely on one another’s knowledge of environmental resources.

Medical Knowledge Lectures. After the scavenger hunt was completed, several brief lectures were presented to emphasize Nationwide Children’s Hospital’s critical airway pathway, crew resource management, and the rules for large group high-fidelity simulations. Brief lectures were also presented on recognition of the difficult airway and use of appropriate medications in airway management. The purpose of these lectures was to provide a common knowledge base for participants in the remainder of the days’ activities. Open discussion and sharing of concerns and perspectives related to each specialty were encouraged.

Small Group Skill Stations. The remainder of the morning allowed each multidisciplinary team to rotate through skill stations focused on various airway management techniques. Those trainees with expertise in an area were encouraged to teach their teammates in other subspecialties alongside the faculty instructors. This strategy gave participants the opportunity to practice teaching skills and reinforced a collaborative team environment. Additionally, this approach helped to keep learning objectives relevant for these trainees with diverse experiences in airway management. Skill stations included (1) basic airway skills, such as bag valve mask, laryngeal mask airway placement, and endotracheal intubation; (2) advanced airway skills (eg, video laryngoscope and fiberoptic intubation); (3) rigid laryngoscopy and bronchoscopy; and (4) in years 2 and 3, emergent surgical airway placement, including cricothyrotomy and tracheotomy techniques with porcine airways.

Case Discussions. During the lunch hour, faculty presented case discussions of specific difficult airway scenarios highlighting approach and clinical management. Use of an audience response system in a question/answer format kept participants actively involved in this discussion.

High-Fidelity Complex Scenarios. In the afternoon session, each multidisciplinary team participated in 2 complex scenarios where application of the technical skills practiced earlier and implementation of the Critical Airway and Difficult Intubation Protocol were necessary for successful patient management. In addition to simulation educators, additional medical and nursing faculty served as content experts and confederates. Each scenario was progressive and required multiple handoffs between teams in the patient’s transit from the emergency department to the operating room to the PICU (Figure 1). In each scenario, the trainee in each specialty functioned in his or her normal role.

The first scenario involves a child in respiratory distress due to an undiagnosed airway foreign body who develops severe airway obstruction requiring endotracheal intubation. The team worked together to successfully intubate the child and then provided advanced airway skills, including cricothyrotomy and fiberoptic intubation. The second scenario involved a child with a known history of airway foreign body who developed airway obstruction. The team worked together to perform cricothyrotomy and fiberoptic intubation to secure the airway and then provided advanced airway skills, including intubation of the endotracheal tube and tracheotomy.

Table 1. Participant Demographics (2013–2015).

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>PGY Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthesiology</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>5–10</td>
</tr>
<tr>
<td>ENT</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2–4</td>
</tr>
<tr>
<td>PEM</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3–5</td>
</tr>
<tr>
<td>PICU</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4–7</td>
</tr>
<tr>
<td>Pediatric surgery</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>8–9</td>
</tr>
<tr>
<td>Total (female)</td>
<td>14 (10)</td>
<td>12 (8)</td>
<td>13 (7)</td>
<td></td>
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</tbody>
</table>

Abbreviations: ENT, otolaryngology; PEM, pediatric emergency medicine; PGY, postgraduate year; PICU, pediatric intensive care.

Table 1. Participant Demographics (2013–2015).
significant hypoxemia and hemodynamic instability. The second scenario involves a patient who sustained blunt neck trauma during an all-terrain vehicle accident and is high risk for laryngotraheal separation if managed incorrectly. The scenarios are progressive and require multiple handoffs between teams in the patient’s transit from emergency department to the operating room to the PICU. For practical reasons but to be as authentic as possible, a portion of the postanesthesia care unit was used as a stand-in for the emergency department and PICU, to require teams to transport the patient between these areas. Detail regarding the scenarios and their progression is available in the appendix.

A scripted learner-centered debriefing session to highlight positive outcomes and opportunities for improvement followed each scenario. Trainees were encouraged to identify their own mistakes and weaknesses, as well as their strengths, and to use this information to direct future study and skills development. Learners also identified personal attitudes and cognitive barriers to calling for help. Debriefing sessions focused on team communication and nontechnical skills for formative feedback. No instruments were used to summatively evaluate these skills.

Course Evaluation and Postcourse Debriefing

Just prior to the course, participants completed a questionnaire of basic demographic data, including subspecialty discipline and PGY year, as well as data on previous experience with a difficult airway and with airway simulation courses. Participants completed surveys measuring self-efficacy and confidence in technical and nontechnical skills of airway management before the start of the workshop, immediately following the course, and 6 months afterward. Additionally, an anonymous evaluation was provided at the end of the day for participants to evaluate the content of the course and relay its strengths and weaknesses in a free text area. Because the primary goal of the course was to familiarize trainees with appropriate interventions and to improve team interactions and communications, the most relevant initial evaluation of the course was analysis of trainees’ responses on these surveys. The entire pre- and postcourse surveys are included in the appendix.

Statistical Analysis

Statistical analysis was performed to examine change in participants’ confidence in technical and nontechnical skills after the course. In addition to an analysis of the group as a whole, each discipline’s responses were analyzed individually. This was to establish whether all disciplines benefited equally from the various components of the course.

Change in scores for each question was calculated as postscore minus prescore such that positive change scores indicate improvement. Change scores are summarized with means (SD) and medians (range) to allow for a better understanding of their distribution. Statistical analysis with the Wilcoxon signed rank test was applied to determine change in the participants’ confidence in performing technical and nontechnical skills before and immediately after the course. The proportion of participants who improved was compared by subspecialty with Fisher’s exact test. Difference in score change by prior simulation experience (categorized as none, 1-3 experiences, and ≥4 experiences) was assessed with a Kruskal-Wallis test and a Dunn post hoc test where significant global group differences were found.

Results

In the first 3 years that the simulation course was offered, a total of 39 residents and fellows participated (PGY range, 2-10; Table 1). Thirty trainees (77%) had clinical experience involving a patient with a critical airway. Twenty (51%) had participated in a simulation training experience involving a critical/difficult airway.

There was significant improvement in trainees’ overall level of confidence in their technical abilities. The greatest improvements were in fiberoptic intubation, rigid laryngoscopy and bronchoscopy, and cricothyrotomy/tracheostomy (Table 2). Anesthesiology respondents reported significantly lower rates of improvement for bag mask ventilation, orotracheal intubation, and laryngeal mask airway placement; however, initial self-assessment of confidence in each of these skills was already high. Each subspecialty reported greater than or equal confidence in its technical skill levels following course participation.

Participants felt significantly more confident in all nontechnical skills, including communication with other disciplines (Table 2). Improvements were most notable for compliance with the Critical Airway and Difficult Intubation Protocol and locating advanced airway equipment in the hospital. Before the course, 25% felt competent...
following the hospital’s critical airway protocol, and 31% knew the location of advanced airway management equipment throughout the hospital. After completion of the course, 81% of trainees reported improvement in confidence in following the protocol, and 65% reported improved knowledge of the location of adjunctive airway management equipment. Significant improvement was noted in all non-technical skills evaluated, and there were no significant differences in rates of improvement noted among disciplines in these areas (Figure 3).

Details of the free text comments from participants are available in the appendix; however, the majority of the comments regarding what was “good about the workshop” centered on the structure of working with different teams and subspecialties throughout the day. Most comments on areas for improvement included requests for more large group simulations.

To analyze the impact of simulation experience, trainees were categorized as having had extensive prior participation in airway simulation experiences (≥4 experiences), limited

### Table 2. Change in Self-confidence Scores on Skill Competencies.

<table>
<thead>
<tr>
<th>Skills Assessed</th>
<th>Responses, n</th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>Range</th>
<th>P Valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical skill competencies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Bag mask ventilation</td>
<td>33</td>
<td>0.212</td>
<td>0.485</td>
<td>0</td>
<td>0 to 2</td>
<td>.0313</td>
</tr>
<tr>
<td>2. Orotracheal intubation</td>
<td>33</td>
<td>0.333</td>
<td>0.479</td>
<td>0</td>
<td>0 to 1</td>
<td>.001</td>
</tr>
<tr>
<td>3. Laryngeal mask airway placement</td>
<td>33</td>
<td>0.455</td>
<td>0.794</td>
<td>0</td>
<td>–1 to 3</td>
<td>.0027</td>
</tr>
<tr>
<td>4. Fiberoptic intubation</td>
<td>33</td>
<td>0.727</td>
<td>0.911</td>
<td>1</td>
<td>–1 to 4</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>5. Rigid bronchoscopy</td>
<td>33</td>
<td>1.182</td>
<td>1.074</td>
<td>1</td>
<td>–1 to 4</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>6. Cricothyrotomy</td>
<td>20</td>
<td>1.2</td>
<td>0.894</td>
<td>1</td>
<td>0 to 3</td>
<td>&lt;.0001</td>
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<tr>
<td>Nontechnical skill competencies</td>
<td></td>
<td></td>
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<tr>
<td>7. Recognition of critical airway</td>
<td>31</td>
<td>0.452</td>
<td>0.81</td>
<td>0</td>
<td>–1 to 2</td>
<td>.0072</td>
</tr>
<tr>
<td>8. Choosing appropriate sedative medications</td>
<td>31</td>
<td>0.71</td>
<td>1.039</td>
<td>1</td>
<td>–1 to 3</td>
<td>.0009</td>
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<tr>
<td>9. Leading a resuscitation team</td>
<td>33</td>
<td>0.394</td>
<td>0.747</td>
<td>0</td>
<td>–2 to 2</td>
<td>.0085</td>
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<tr>
<td>10. Effectively communicating with other disciplines</td>
<td>33</td>
<td>0.576</td>
<td>0.751</td>
<td>0</td>
<td>–1 to 2</td>
<td>.0002</td>
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<tr>
<td>11. Correctly following difficult intubation protocol</td>
<td>32</td>
<td>1.5</td>
<td>0.672</td>
<td>2</td>
<td>0 to 3</td>
<td>&lt;.0001</td>
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<tr>
<td>12. Knowledge of location of advanced airway manage-</td>
<td>32</td>
<td>1.156</td>
<td>0.92</td>
<td>1</td>
<td>–1 to 3</td>
<td>&lt;.0001</td>
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</tbody>
</table>

*Bold indicates P < .05.*
(1-3), or none. There was not a significant difference in improvement in self-confidence in any of the technical skills related to a trainee’s previous participation in airway simulation courses. For those who had extensive prior participation in airway simulation, there was significantly less improvement in “effective communication with other disciplines” as compared with those with limited participation ($P = .04$) or no experience ($P = .01$). Likewise, for “knowledge of location of advanced airway equipment,” there was significantly less improvement noted for those participants who had extensive prior participation than for those with limited participation ($P = .02$) or no experience ($P = .02$). There was no significant difference in improvement of the remainder of the nontechnical skills among the groups.

Analysis of the available 6-month follow-up surveys revealed that all respondents had participated in the management of an “airway emergency” at least once since the course. Of the course attendees, 90% reported greater confidence in the management of the patient because of the course, and 100% reported greater comfort in communicating with other services during this emergency.

On the postcourse evaluation, all participants agreed or strongly agreed that the training better prepared them to manage a real-life patient. All participants reported that the multidisciplinary format was helpful in developing intraprofessional teamwork skills and was preferred over a training session that involved only their discipline. Multidisciplinary teams supported interaction and cooperation. Response rates for the pre- and postcourse surveys were excellent and ranged 84% to 89% depending on the questions. For response rates for all questions, see Table 3.

Based on feedback from participants, faculty, and staff, the course was modified for subsequent years. The biggest change from year 1 to year 2 was inclusion of the cricothyrotomy/tracheotomy skill station, which allows each trainee to practice surgical airway placement with a porcine larynx and trachea that are draped with latex “skin” (Figure 4). These porcine airways were obtained from Oiler Meat Processing (Utica, Ohio), and would have otherwise been discarded. Other changes included revision of the airway foreign body scenario so that before presentation, the child experienced maxillofacial trauma and had aspirated a tooth. This allowed improved participation of the emergency department and pediatric surgery trainees in this scenario. In the most recent year’s course, a third large group scenario was added to simulate a “cannot ventilate/cannot intubate” scenario requiring trainees to insert a surgical airway emergently into a task trainer.

**Discussion**

With limitations on trainees’ work hours, training programs have had to develop innovative ways to expose trainees to critical experiences and skill sets. Airway management, among the more commonly encountered pediatric emergencies, is one of those critical areas where development of simulation activities to increase trainees’ confidence and technical skills is essential. Physicians, nurses, and respiratory therapists have all identified airway problems as their first area of interest for simulation courses. While management of a pediatric difficult airway typically requires a multidisciplinary health care team, most simulation courses involve trainees from a single discipline.
Trainees from all disciplines who participated in our boot camp course reported improved confidence in the advanced technical airway management skills, including laryngeal mask airway placement, fiberoptic intubation, rigid laryngoscopy and bronchoscopy, and tracheostomy. Six months later, all trainees had been involved in at least 1 emergency airway situation, and the majority reported improved confidence in their ability to manage this issue due to their participation in this training exercise.

In 2011, Malekzadeh et al described a boot camp for onboarding otolaryngology residents. This course addressed multiple emergencies that otolaryngology trainees might encounter, including various skill stations to address airway issues (eg, bag mask ventilation, endotracheal intubation, flexible laryngoscopy, rigid laryngoscopy/bronchoscopy, and cricothyrotomy). Trainees reported significant improvement in their confidence in performing these tasks after the course. In 2013, Amin and Friedmann reported objective improvement in trainees’ performance in advanced airway skills after a short simulation course, when assessed by a panel of faculty otolaryngologists.

Patient outcomes in emergency airway scenarios depend on nontechnical skills, including early recognition of impending issues and rapid team activation and decision making. Many institutions have developed difficult airway protocols that require recognition of a difficult or critical airway situation and knowledge of and familiarity with the protocol steps to succeed. A program in Amiens, France, was designed to familiarize anesthesiology residents with the protocol for escalating to a surgical airway in a “cannot intubate/cannot ventilate” situation. After completion of the program, trainees’ compliance with the protocol improved from 63% before the course to 100% after the course (up to 12 months posttraining). Similarly, perceived competence in following our hospital’s difficult airway protocol was noted in only 25% of learners before the course but improved to 81% after the course.

Critical airways tend to be particularly complex emergencies requiring teamwork and communication across disciplines and care teams. This issue makes the difficult airway scenario an excellent opportunity to promote effective communication among caregivers. Ideally, these communication skills should be fostered before entry into a critical situation and thus were a primary emphasis in the development of this course. Teams were designed to include members from each specialty to foster this relationship. Handoffs—another point of emphasis as patients transferred from different phases of care during the complex airway scenarios—were encouraged during the complex scenarios and were discussed in depth in the debriefing sessions that followed each scenario. In 2011, Volk et al described a

<table>
<thead>
<tr>
<th>Skills Assessed</th>
<th>Precourse</th>
<th>Postcourse</th>
<th>Participants With Both, n</th>
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<tbody>
<tr>
<td><strong>Technical skill competencies</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Bag mask ventilation</td>
<td>34</td>
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</tr>
<tr>
<td>2. Orotracheal intubation</td>
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<td>33</td>
</tr>
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<td>3. Laryngeal mask airway placement</td>
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<td>4. Fiberoptic intubation</td>
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<td><strong>Nontechnical skill competencies</strong></td>
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<tr>
<td>7. Recognition of critical airway</td>
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<td>8. Choosing appropriate sedative medications</td>
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<td>10. Effectively communicating with other disciplines</td>
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<td>11. Correctly following difficult intubation protocol</td>
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<tr>
<td>12. Knowledge of location of advanced airway management equipment</td>
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A course in Great Britain included trainees in otolaryngology, anesthesiology, and nursing. All participants in that course also agreed or strongly agreed that it had improved their clinical knowledge and nontechnical skills, including teamwork and leadership. The participants in our course all agreed that this training would better prepare them to manage a comparable situation with a real patient. In our 6-month follow-up survey, 90% reported greater confidence in the management of an actual airway emergency due to course participation. Although half of our trainees had prior simulation training for airway management, their preference for this course was due to the multidisciplinary nature that was emphasized.

Our study noted several incongruities when survey responses were analyzed by discipline. Experienced anesthesiology trainees (PGY >4) did not benefit significantly from the basic airway skills training, although their ability to communicate patient-specific concerns to those outside their specialty did improve. Additionally, these trainees rated the basic airway skill station as being worthwhile and agreed that it should be retained in future workshops. Specialists in the PICU and emergency room, who frequently communicate with other consultants, still benefited from the communication and collaboration portion by teaching those interactive skills to others. PICU and emergency room trainees clearly benefited from exposure to alternative airway adjunctive equipment used by anesthesiology, pediatrics, and otolaryngology. By the end, all trainees reported that the course improved their ability to communicate concerns to other subspecialists.

A major strength of this program was the multidisciplinary nature. One of its challenges was making this workshop inclusive and relevant for all trainees across disciplines, regardless of their previous exposures. A simple solution was enlisting the help of the more experienced to teach those with less experience. This had an additional effect of reinforcing collaboration among specialties. For each specialty, however, portions of the course were less effective than others.

Additional challenges included scheduling of physical space and participants for the course. Out of necessity, the course was held on a weekend, which allowed for in situ scenarios that could evolve in the operating room. This may have been of benefit to learners, as several studies noted that in situ simulation facilitates transfer of skills and behaviors learned during the training to actual patient care. Specifically, with in situ simulation, learners function in their actual roles as part of the health care team, use available medical equipment, and rehearse communication in their live clinical setting.14,15 Despite weekend scheduling, some trainees could not be excused from clinical duties or had exceeded their weekly work hour limitations; therefore, not all qualified trainees could participate in the course.

The course and curriculum were designed to improve difficult airway recognition and communication among novice trainees specific to our institution and its Critical Airway and Difficult Intubation Protocol. Because of this, as well as the limitations of physical location, scheduling, and additional faculty and staff, we chose not to open the course described here to trainees from other institutions or to additional faculty and staff from our institution. A future goal is to implement this course on a wider platform, but this is also why we chose to present the course specifics here, as portions of our workshop could be adapted to fit other audiences and institutions.

Throughout the course, faculty emphasize that this is an introduction to various skills and equipment that can be used in a variety of emergency airway situations. Communication and teamwork are emphasized throughout. The course is not meant to make trainees proficient in any particular airway management modality but to introduce them to those modalities and disciplines that may be useful in certain clinical situations and to increase their comfort in deciding when to seek consult and/or assistance. In the 6 months following the course, all participants reported increased comfort in communicating with other disciplines in the airway emergencies that they encountered.

A significant limitation of the analysis of this SBTT course is that it is primarily based on trainees’ responses to pre- and postcourse surveys and their confidence in their ability to perform the technical and nontechnical skills presented in it. While confidence improved after the course in all advanced airway skills and all nontechnical skills, this does not necessarily translate into improved patient care outcomes. Other studies reported on similar difficulty in collection of data to demonstrate impact on patient outcomes. Figueroa et al reported on their SBTT course for pediatric cardiac intensive care unit staff. Outcomes included significantly improved confidence in skills utilized in their scenarios as well as improved confidence in ability to function as team leader and run a code.16 At our institution, future directions include analysis of our database of intubation events, including number of intubation attempts in a given scenario, time to recognition of a difficult airway, and time to activation of the Difficult Intubation Protocol, including time to call for anesthesia and surgical teams for assistance.

Implications for Practice

The multidisciplinary nature of our SBTT program advanced technical skills and promoted communication, adherence to the advanced airway protocol, and leading a resuscitation team. A multidisciplinary approach exposes previously unrecognized knowledge gaps among disciplines and allows for collaboration among the fields. Despite the attendees’ training differences, a multidisciplinary simulation course in advanced airway management is feasible, practical, valuable, and preferred by learners. This program advanced the technical skills needed for emergency interventions and prepared trainees to provide team-based patient management.
Author Contributions
Meredith Merz Lind, conception and design, acquisition and interpretation of data, drafting and revision of the manuscript, final approval of the manuscript, agreement to be accountable for all aspects of the work; Marco Corridore, conception and design, revision of the manuscript, final approval of the manuscript, agreement to be accountable for all aspects of the work; Cameron Sheehan, acquisition and interpretation of data, drafting and revision of the manuscript, agreement to be accountable for all aspects of the work; Melissa Moore-Clingenpeel, analysis and interpretation of data, revision of the manuscript, final approval of the manuscript, agreement to be accountable for all aspects of the work; Tensing Maa, conception and design, acquisition and interpretation of data, revision of the manuscript, final approval of the manuscript, agreement to be accountable for all aspects of the work.

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Supplemental Material
Additional supporting information is available in the online version of the article.

References