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Mastering a Life-Saving Technique: Analysis of Learning from a Cricothyrotomy Workshop

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Abstract: *Cricothyrotomy is an emergency procedure that is utilized in situations that require immediate access to a breathing pathway. This procedure may be performed by professionals in a variety of healthcare fields depending upon the specific emergency scenario, so the development of an interprofessional workshop is imperative for procedural confidence and skill development. Our team developed a training workshop with a specific focus on procedural skills, risks, benefits, and psychological ramifications associated with a cricothyrotomy procedure. Pre-workshop and post-workshop surveys were obtained for comparison of participant confidence. Overall, the organization and delivery of a cricothyrotomy training workshop significantly increased the overall participant confidence surrounding this procedure.*

Keywords: Medical education, workshop, curriculum development

INTRODUCTION

Cricothyrotomy, also referred to as cricothyroidotomy, is an emergency procedure that is utilized in situations that require immediate access to a breathing pathway. It serves as a last resort when other more preferred and conservative options to establish an airway have been unsuccessful. Common indications for a cricothyrotomy procedure include trauma, suspected spinal injury, blood filling the airway or oral cavity, or when placing a tube in the airway is difficult or impossible (McKenna et al., 2023; Schroeder, 2000). Many times, this procedure is performed when the patients cannot ventilate and their heart has stopped (Spait & Joseph, 1990).

The process of performing a cricothyrotomy procedure involves making a small incision in the front of the patient's throat just below the laryngeal prominence (commonly known as the Adam's apple) and inserting a tube directly into the patient's airway (McKenna et al., 2023). In hospital settings, a cricothyrotomy is only utilized as a part of 2.3 out of every 1,000 intubations (Kwon et al., 2019). On the other hand, approximately 5 out of every 1,000 intubations that occur in emergency situations outside of the hospital setting require cricothyrotomy intervention (Wang et al., 2018). Because of the fact that cricothyrotomy is rarely required, training of this life-saving technique is not typically offered to healthcare professionals.

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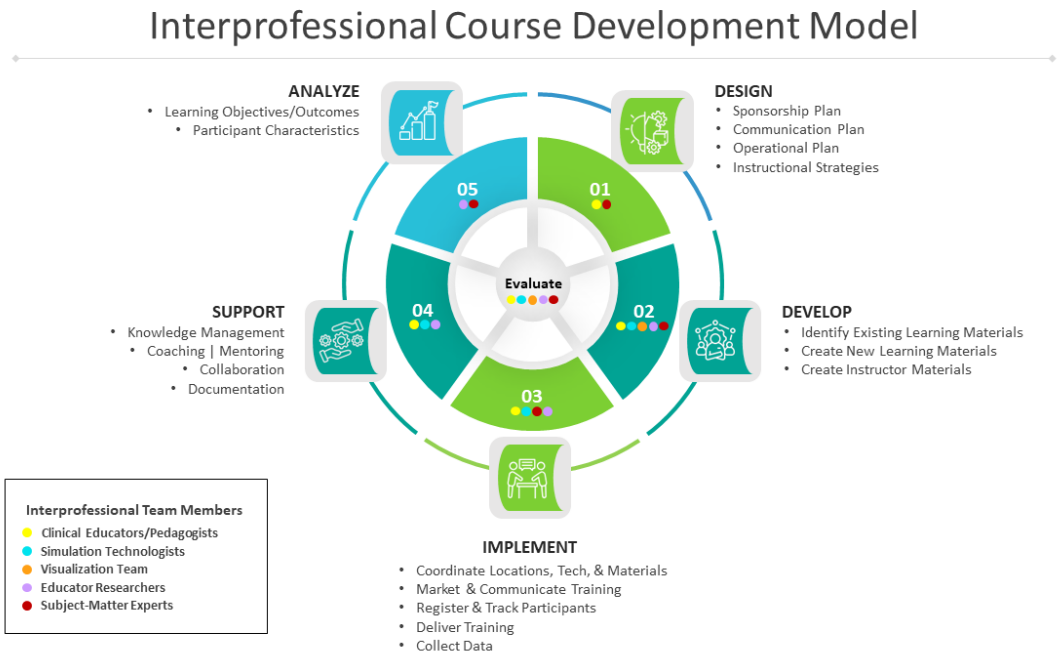
In academic environments, medical educators are often tasked with developing formal courses as a result of their subject-matter expertise. Although engaging professionals from diverse disciplines is beneficial in the development of educational courses, resource constraints often lead to a siloed approach with minimal interprofessional involvement. Clinical educators face unique challenges when developing courses for both interprofessional and intraprofessional education, particularly involving simulation training. This may be due to a critical missing element: prior educational experience in course design, development, and evaluation. Additional reasons for this disconnect involve the complex nature of healthcare delivery and a lack of shared understanding across disciplines. Creating a meaningful medical training course requires the involvement of a diverse interprofessional team including subject-matter experts, clinical educators, pedagogists, education researchers, simulation technologists, and a visualization team (Cassidy et al., 2022; Cleland et al., 2016; Jackson et al., 2022).

A successful iterative process (Figure 1) includes a structured approach to learning objectives and evaluation, detailed critiques of the didactic presentation, ongoing team communication, visualization, cost analysis, and logistics planning to deliver the course (Deitte & Omary, 2019; Henriksen et al., 2017). The process of initial course development, and ultimate course evaluation and evolution, followed the template as outlined in Figure 1. After the initial steps of Workshop Design (Step 1) and Content Development (Step 2), the trial course was piloted with student groups. This allowed for a focus to be placed on Implementation (Step 3), in which course timing, flow, and delivery were evaluated. With the resulting pilot group feedback, course leadership was able to reconvene with subject matter experts and collaborate on the best steps to optimize the workshop for future iterations (Step 4). Finally, workshop analysis continues going forward in the form of participant pre- and post-survey data to assess for effectiveness and future directions of development (Step 5).

Figure 1
Interprofessional Course Development Model



There are a variety of approaches that different institutions take in order to increase exposure to cricothyrotomy procedures. In one study, Wong et al., outlined a teaching course that utilized a demonstration video followed by practicing 10 procedures on mannequins. They found that success rates plateaued after the 5th attempt, and the time to perform the procedure plateaued after the 4th attempt (Wong et al., 2003). Other studies have utilized cadaveric human models or household items such as a toilet paper roll to simulate the procedure (Aho et al., 2015; Zagona-Prizio et al., 2023). High-fidelity models, such as human cadavers, benefit from the fact that they are the most realistic examples to learn from, however these are commonly associated with the highest costs and resource burden. Alternatively, models like toilet paper rolls may be less realistic but more affordable. Ultimately, the current literature has shown that simply performing these procedures, even if on a low fidelity model, increases overall success rates, as measured by time to procedure completion and medically appropriate anatomic placement (Wong et al., 2003).

Overall, the purpose of this study is to analyze an educational program designed to develop the skills that are necessary to perform cricothyrotomy, address misinformation surrounding cricothyrotomy, and develop tools that may be necessary when dealing with the emotional toll of performing a cricothyrotomy.

METHODS

The initial inspiration for this course design process was developed during the COVID-19 pandemic with an effort to provide training to a diverse group of learners regarding the correct nasopharyngeal swab procedure (Carlson et al., 2022; Misra et al., 2021). This strategy was subsequently adapted to develop a cricothyrotomy airway course designed to meet the needs of multidisciplinary learners. Following a pilot workshop, the course content was redesigned using a process map (Figure 1). Integration of learner feedback and modification for the simulation component occurred each of the three times the course has been delivered in the past year.

Our team of educators, simulation specialists, and physicians developed this training workshop focusing on addressing procedural skills, risks, benefits, and psychological ramifications associated with a cricothyrotomy procedure. In this course design, PowerPoint was utilized as a general introduction to the subject followed by a hands-on portion where participants performed a cricothyrotomy on an isolated pig/sheep airway model. A 15-question assessment was created and distributed before and after the cricothyrotomy course. The assessment was developed with information collected during a working pilot session with subject matter experts from Otolaryngology and Pulmonary Critical Care medicine. The pre-post confidence questions were conceived based on the information necessary to understand a cricothyrotomy (anatomy, patient positioning, etc.) and the skills required to complete the procedure. For example, participants were asked, “How confident are you in knowing the steps of a cricothyrotomy procedure?” The scale provided the following options: Not Confident (1), Somewhat Confident (2), Confident (3), and Very Confident (4). Results were compiled and the average was calculated for each question in both the pre-course and post-course setting, as well as the difference between the post-course and pre-course interval.

RESULTS

This study consisted of 16 participants who attended the workshop and completed both the pre- and post-course questionnaires. On aggregate, all survey questions saw an increase in

participant confidence from pre- to post-workshop. A complete outline of survey results can be found in Table 1. Overall, respondents' confidence in performing a cricothyrotomy procedure increased from 1.6 pre-workshop to 2.8 post-workshop, for a total increased confidence of 1.2, as outlined in Figure 2.

DISCUSSION

In this paper, we present a detailed process map providing concrete steps for interprofessional collaboration with subject matter experts, simulation technologists, visualization and education experts, and researchers. Over the course of the iteration and improvement process, the cost and preparation burden of the workshop decreased over time. The resulting innovations include simulation-specific improvements such as trying a variety of textures for our model, decreasing time for setup and preparation, improving cost effectiveness by exploring cheaper materials, and increasing the frequency and availability of the course.

The formation and delivery of this structured cricothyrotomy workshop improved the participants' confidence in both the underlying knowledge and clinical skill necessary to perform the procedure. Categories that saw the largest increase in confidence included: positioning of the healthcare provider (+ 1.9), positioning of the patient (+ 1.65), and identifying the necessary equipment (+ 1.4). These categories also saw the highest overall levels of post-workshop confidence: 3.6, 3.45, and 3.3, respectively. These three categories all share a common theme relating to the logistics of the procedure. Additionally, these question stems specifically assess confidence in direct recall rather than competence with a clinical skill or emotional management. It is likely that this style of question is more amenable to a large and rapid increase in participant confidence. With additional clinical practice and hands-on repetition, we would expect to see confidence in clinical skills continue to rise as well.

In terms of the emotional management of the procedure, participants responded with increased confidence in their ability to access debriefing resources (+ 1.35) and process their personal emotions following this procedure (+ 0.65). This is an encouraging finding to support this workshop's underlying goal of strengthening healthcare professional support and resilience. Many of the procedures shared in the medical community have the side effect of exposing healthcare professionals to traumatic experiences. The ability for an interprofessional workshop to address these shared situations and provide a means for emotional healing is a powerful tool for a variety of healthcare professionals.

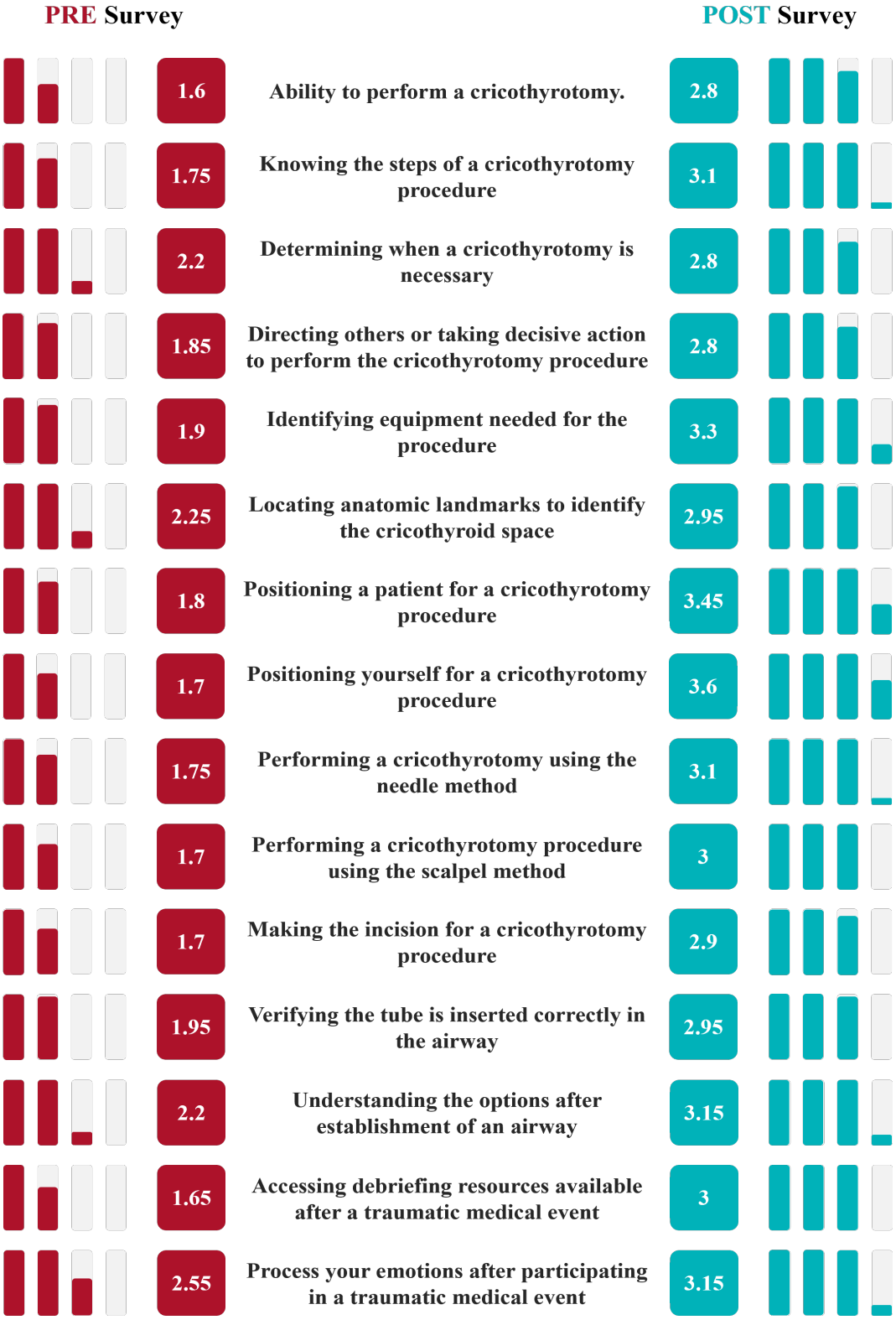
The cricothyrotomy workshop outlined in this study results in increased measurements of participant confidence, however the construction of this study does carry some limitations. First, the primary survey outcome was gathered in the immediate post-workshop period. Thus, longitudinal retention of procedural confidence is not assessed, and confidence may decrease as participants separate further from the workshop. Additionally, while this study demonstrates increased participant confidence with the cricothyrotomy procedure, it does not necessarily provide evidence that this increased confidence directly leads to improved patient outcomes. These two limitations may both be addressed in future iterations of this study with a longitudinal focus that assesses procedural retention and ultimate patient outcomes.

Table 1
Aggregate Survey Results

Question (How confident are you in …)	Pre-Workshop Average	Post-Workshop Average	Net Increase
Your ability to perform a cricothyrotomy?	1.6	2.8	+ 1.2
Knowing the steps of a cricothyrotomy procedure?	1.75	3.1	+ 1.35
Determining when a cricothyrotomy procedure is necessary?	2.2	2.8	+ 0.6
Directing others or taking decisive action yourself to perform the cricothyrotomy procedure?	1.85	2.8	+ 0.95
Identifying equipment needed for the procedure?	1.9	3.3	+ 1.4
Locating anatomic landmarks to identify the cricothyroid space?	2.25	2.95	+ 0.7
Positioning a patient for a cricothyrotomy procedure?	1.8	3.45	+ 1.65
Positioning yourself for a cricothyrotomy procedure?	1.7	3.6	+ 1.9
Performing cricothyrotomy using the needle method?	1.75	3.1	+ 1.35
Performing a cricothyrotomy using the scalpel method?	1.7	3	+ 1.3
Making the incision for a cricothyrotomy procedure?	1.7	2.9	+ 1.2
Verifying the tube is inserted correctly in the airway?	1.95	2.95	+ 1.0
Understanding the options available for oxygenation/ventilation after an airway is established?	2.2	3.15	+ 0.95
Accessing debriefing resources available after a traumatic medical event?	1.65	3	+ 1.35
Your ability to process your emotions after participating in a traumatic medical event?	2.55	3.15	+ 0.6

Figure 2

Pre- and Post-Survey Results



CONCLUSION

In this study, the organization and delivery of a cricothyrotomy training workshop led to increased overall participant confidence surrounding this procedure. As a result of the course, medical trainees have the opportunity to expand necessary skills with a simple anatomic model, receive live feedback from experienced staff, increase confidence in performing this procedure, and develop mechanisms to emotionally manage the dire situation in which it is performed. We conclude that this interprofessional course design is transformative, particularly in fields where technical expertise is required in emergency scenarios. An educational model that focuses on iteration creates ongoing collaboration and infuses the course with a dynamic learning environment. We propose this method of working as an example of how interprofessional course design can contribute to novel collaboration and a sustained dynamic learning environment. In the future, our plan is to continue to expand the trainee leaner pool and eventually provide continuing medical education for interprofessional practitioners.

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