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Implementation of a Bougie-Assisted Cricothyrotomy Training Program

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Abstract

Phase II Site: David Grant Medical Center (DGMC), Travis Air Force Base

Project Title: Implementation of a Bougie-Assisted Cricothyrotomy Training Program

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Background or Problem/Issue: DGMC anesthesia department lacks a cricothyrotomy training program. Cannot intubate, cannot oxygenate scenarios occur in 0.07% of procedures, and may result in patient death. The last step of the difficult airway algorithm is to place a surgical airway. However, 30% of emergency cricothyrotomies placed by anesthesia providers fail.

Clinical Question or Purpose: In anesthesia providers at DGMC, how does the implementation of a cricothyrotomy training program compared to no training program affect performance of bougie-assisted cricothyrotomy (BAC) procedure, provider confidence with the procedure, and provider comfort with the procedure?

Project Design: This was an evidence-based project that implemented a BAC training program during one training day. Participants were evaluated on time to perform the procedure and number of correct procedural steps utilizing an airway task trainer. A survey was used to evaluate comfort and confidence before and after training.

Analysis of the Results: 13 anesthesia providers completed the training. The BAC placement mean time was 106 seconds (range 47-224) pre-training and 74 seconds (range 27-123) post-training. The mean procedural steps completed was 8 (range 7-11) pre-training and 11 (range 9-12) post-training. Participants (n=3) who practiced BAC on the airway task trainer had a mean increase of 3.33 procedural steps on their post-training evaluation compared to a mean increase of 2 procedural steps in participants (n=7) who did not practice at all. Using a Likert scale, comfort levels of 4 or greater (n=11) increased compared to pre-training comfort levels (n=8). Confidence levels of 4 or greater (n=10) increased compared to pre-training levels (n=9).

Organizational Impact/Implications for Practice: This project optimized training in emergency airway management resulting in improved performance of BAC placement, increased provider comfort, and confidence level. We propose implementing a sustainment plan to reinforce BAC skills every six months to mitigate skill loss and align with current evidence-based guidelines.

Abbreviated Abstract

Project Purpose: Evidence-based implementation of a bougie-assisted cricothyrotomy training program allows anesthesia providers practice critical skills in surgical airway management.

Impact: Optimizing simulated BAC training improves performance and increases provider comfort and confidence level.

Introduction

Emergency cricothyrotomy is the last step of the American Society of Anesthesiologists (ASA) difficult airway algorithm and is used as a rescue maneuver to restore oxygenation during a cannot intubate and cannot oxygenate (CICO) airway crisis. CICO is defined as the inability to intubate and ventilate a patient in the presence of continuous oxygen desaturation, lack of chest wall excursion or inadequate capnography tracing, resulting in 25% of anesthesia-related deaths (Altun et al., 2019; Cooper, 2019; Hubert et al., 2014). Emergency access to the trachea is achieved by making an incision through the cricothyroid membrane (CTM) and inserting a breathing tube to restore oxygenation after tracheal intubation, face-mask ventilation, and the use of a supraglottic airway have failed (Mandell & Orebaugh, 2019). Despite its crucial importance, surgical cricothyrotomy is rarely performed in clinical practice, resulting in a failure rate of 30% when performed by anesthesia providers during airway emergencies (Altun et al., 2019). Procedure failure is primarily due to limited clinical experience performing the procedure and misidentification of the CTM resulting in misplacement of airway devices, laryngotracheal injury, inability to ventilate the patient, and death (Aslani et al., 2012; Hessert & Bennet, 2013; Siddiqui et al., 2018).

Emergency cricothyrotomy is infrequently performed but is an essential skill to have in advanced airway management. Therefore, it is crucial to optimize training to perform this complex procedure (Hubert et al., 2014). Simulation cricothyrotomy training can significantly improve provider confidence in performing the procedure, enhance decision-making, and improve knowledge of upper airway anatomy (Aho et al., 2015; Hughes, 2018; Scott-Herring et al., 2020; You-Ten et al., 2015). David Grant Medical Center's anesthesia department currently lacks a cricothyrotomy training program. The anesthesia department desires to have a cricothyrotomy training program using low cost, high-fidelity airway task trainers so that they

can practice this emergency procedure using equipment that is readily available in every operating room including austere environments.

Significance of the Problem

Difficult intubation in conjunction with difficult ventilation occurs in 1.5% of operating room (OR) procedures, with impossible intubation and difficult ventilation seen in 0.3% of cases. CICO scenarios in the OR take place in 0.07% of cases and can rapidly progress to irreversible brain damage and death if not managed appropriately (Hubert et al., 2014). Outside the operating room, the rate of difficult intubations can be as high as 14% and are likely to result in multiple ineffective attempts increasing the risk for hypoxia, inadequate ventilation, esophageal intubation, gastric aspiration, airway trauma, and the need for an emergency surgical airway (Cook, Woodall, & Frerk, 2011; Yildiz et al., 2015). To create a systematic approach to airway emergencies, the ASA created a difficult airway algorithm. The last step in the algorithm is the performance of an emergency cricothyrotomy as a rescue technique during a CICO scenario (Caplan et al., 2013).

Front of neck access requires high technical skills as it is a low yield occurrence performed in approximately 1 of 50,000 general anesthetics (Scott-Herring et al., 2020). Most anesthesia providers will never encounter a CICO event requiring an emergency cricothyrotomy. However, they must be ready to perform this rescue procedure when other noninvasive measures of establishing an airway have failed (Cooper, 2019). Since the incidence requiring a cricothyrotomy is rare, providers must master this essential skill through frequent education and simulation training focusing on airway anatomy, correct cricothyrotomy technique, and emergency equipment familiarization (Hessert & Bennett, 2013; Hubert et al., 2014).

Military anesthesia providers at DGMC fall in line with the national picture requiring frequent cricothyrotomy training. Currently, there is no established cricothyrotomy training program or alternative methods to retain surgical airway skills within the DGMC anesthesia department. Without a training program, anesthesia providers will not be able to maintain proficiency in a procedure that is rarely performed and emphasizes the importance for the DGMC anesthesia team to receive effective training to mitigate the absence of this life-saving skill.

Relevance to Military Nursing

One of the most critical responsibilities of a military nurse anesthetist is the contribution made towards advancing battlefield trauma care. Recent conflicts in Iraq and Afghanistan have shown that combat trauma brings a unique and challenging component to advanced airway management. Retrospective studies showed that airway compromise is the third leading cause of preventable battlefield death accounting for 2% of total combat fatalities (Kotwal, 2011; Mabry & Frankfurt; 2012; Mabry et al., 2010). Due to the nature of combat injuries caused by explosions, gunshot wounds, and blunt trauma; surgical cricothyrotomies have an incidence rate of 0.62% in deployed settings compared to 0.36% in the civilian sector (Mabry & Frankfurt, 2012; Schauer et al., 2015). The establishment of a definite airway via an emergency surgical cricothyrotomy remains the gold standard procedure for any CICO scenario in all clinical settings. Therefore, the implementation of an evidence-based training program to ensure readiness when performing this critical skill is essential to battlefield anesthesia care. Furthermore, training programs and techniques utilized by anesthesia providers in a military setting can have far-reaching effects for the training of other military providers ranging from combat medics to emergency physicians.

System or Clinical Question

In anesthesia providers at David Grant Medical Center, how does the implementation of a cricothyrotomy training program compared to no training program affect performance of bougie-assisted cricothyrotomy procedure, provider confidence with the procedure, and provider comfort with the procedure?

Literature Review of Solutions

We utilized our clinical question to drive our literature search for solutions to address the desire for an emergency cricothyrotomy training program at DGMC. Our team utilized the Uniformed Services University of the Health Sciences (USUHS) Learning Resource Center to search for articles in PubMed, CINAHL, and Embase databases. The key search terms used included cricothyroid membrane, cricothyrotomy, front-of-neck access, ultrasound, palpation, cricothyroidotomy task trainer, training program, education, and simulation. Our initial literature search resulted in 685 potential articles. Exclusion criteria for all database searches included articles with abstract only, unrelated to design, and non-English language unable to be translated. A total of 438 articles were excluded and 247 articles were evaluated for possible inclusion based on pertinence to our clinical question. During this process, a total of 197 articles were excluded leaving 50 full-text articles. After screening these articles for quality, relevance, and credibility by abstract, 30 articles were selected (Appendix E). We then used the Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) Evidence Rating Scale to assign a level of evidence category and evaluate the quality of each article (Appendix F).

The articles evaluated included six randomized control trials (level 1A [2], level 1B [2], level 3B [2]), two quasi-experimental studies (level 2A [1], level 2B [1]), one non-experimental study (level 3A), 13 observational studies (level 2A [1], level 3A [4], level 3B [7], level 4A [1]),

one prospective crossover study (level 3A), one randomized crossover study (level 2B), one narrative review (level 4A), one letter to the editor (level 4A), one editorial (level 4A), two educational articles (level 4A [2], and one teaching session (level 3B). Our literature review supported the use of cricothyrotomy to gain airway access via the CTM during CICO airway emergencies, a stance that is supported by the American Society of Anesthesiologists and the American Association of Nurse Anesthetists (Bribiesco & Patterson, 2018; Cooper, 2019; You-Ten et al., 2015). The literature also showed that the use of ultrasonography as an adjunct teaching aid significantly improves the ability to identify neck landmarks and localize the CTM using external palpation (You-Ten et al., 2015). The literature also supported the need for anesthesia providers to perform regular cricothyrotomy simulation training to maintain the knowledge, decision-making, and procedural skills needed to perform this high-risk, low-frequency, life-saving procedure (Biron et al., 2013; Frerk et al., 2015; Hessert & Bennet, 2013; Hubert et al., 2014; Wong et al., 2003). These studies also supported the use of a low cost, high-fidelity task trainer for teaching and assessing cricothyrotomy training as it provides an opportunity to develop teamwork, cognitive, and motor skills (Cooper, 2019; Hughes et al., 2018; Kei, Mebust, & Duggan, 2019). Additionally, our review showed that when a cricothyrotomy is learned and practiced on an airway simulation model, anesthesia providers show greater compliance with the ASA difficult airway algorithm (Cooper, 2019; Hubert et al., 2014; You-Ten et al., 2015). Overall, the literature supports the use of simulated cricothyrotomy training on airway models conducted at regular intervals of at least every six months to improve provider performance in advanced airway procedures.

Focus Areas

To accomplish our evidenced-based project (EBP), we identified four focus areas. First, we performed an extensive literature search to identify the best methods for cricothyrotomy training. Second, used the best evidence to implement effective emergency cricothyrotomy training. Third, we developed a comprehensive sustainment plan to ensure the continued success of this implementation. Finally, we disseminated results at the local and national levels and maintain skills readiness.

Organizing Framework

Our team has elected to use the Iowa Model of Evidence-Based Practice for the organizing framework for this initiative. After following the steps of the model, this project was born out of the problem-focus trigger of not having a training modality for a cricothyrotomy. Upon an informal polling of staff, it was found that no providers had performed a cricothyrotomy on a live patient and knowledge of the procedure only came during simulation training before deployments or during residency. Because of the lack of training for this high-risk procedure, this project was considered a priority of the department. Continuing through the steps, our team performed a literature search to determine the best way to place a cricothyrotomy as well as teaching methods for performing high-risk low-frequency procedures. Following careful analysis and criticism of the literature, we concluded there was enough evidence to a pilot training program. Following the implementation of this program, we evaluated the results and assessed if the training program can be implemented for annual training. We designated a staff member to take over the bi-annual training and will have the responsibility to observe, evaluate, and analyze the training and make changes from new literature as needed.

Project Design

General Approach

This was an evidence-based project that utilized a pre-training assessment, followed by an educational training program for bougie-assisted cricothyrotomy, followed by a post-training assessment in the same manner as the pre-assessment.

Setting and Population

DGMC is home to the 60th Medical Group and is located at Travis AFB in Fairfield, California. DGMC is a Joint Commission-accredited teaching hospital and the Air Force Medical Service's flagship medical treatment facility in the United States. DGMC provides full healthcare services to more than 130,000 active duty, retirees, and beneficiary dependents in the immediate region of San Francisco and Sacramento. DGMC also provides quality healthcare coverage to more than 377,000 Department of Veterans Affairs Northern California Health Care System beneficiaries (Air Force Medical Service, 2019). This project took place within the Anesthesia Department at DGMC. The anesthesia department provides services to over 3,300 surgical patients annually. It is important to note that 10-15% of anesthesia providers are deployed at any given time during the year (Travis AFB, 2016). This educational training targeted 32 anesthesia providers directly involved in airway management including 12 active duty (AD) anesthesiologists, two contractor anesthesiologists, 14 AD Certified Registered Nurse Anesthetists (CRNAs), and four contractor CRNAs.

Procedural Steps

Our first step was to conduct a pre-education assessment to determine baseline knowledge and skills competency. The pre-training assessment began with a hands-on simulation where the clinician was evaluated on the performance of a bougie-assisted cricothyrotomy after being read a scripted patient scenario (Appendix L). To perform the simulation, we used a high-fidelity

bleeding cricothyrotomy task trainer that was affordable, easy to replicate, reusable, and provided a more realistic experience in cricothyrotomy training (Hughes et al., 2018; Wray et al., 2019). The scenario was completed in one of the operating rooms at DGMC and the skills were graded in real-time using a 17-step procedural checklist tailored to a BAC technique (Dharmasi et al., 2019; Appendix H). Although there were 17-steps in the simulation checklist, there were only 12 mandatory steps the participant had to complete to successfully place a BAC. Step 1, step 2, step 3, step 5, and step 17 were not graded.

The participant was graded based on a point system with 1 point given for each step completed in the correct order. If the participant completed the step but did so in the incorrect order, no points were given. The maximum number of points a participant could receive was 12. The participant was timed individually during the procedure, starting from the moment the participant placed a hand on a tool used to perform the cricothyrotomy or attempted to palpate the cricothyroid membrane. Timing was performed using a stopwatch by one of the investigators and was recorded in total seconds. In the event the stopwatch did not start, the participant was instructed to stop until an alternate form of timing could be obtained. Once this was completed, the scenario was restarted, and timing began as previously described. The simulation ended when the BAC had been placed and timing was stopped once ventilation was confirmed via bilateral chest rise and fall, auscultation of lungs, and/or verbalization of a chest radiograph being ordered (Appendix I).

Our next step was to survey participants on their comfort and confidence level after the pre-training simulation, which was supported by Kirkpatrick's Model of Four Levels of Training Evaluation (Kirkpatrick & Kirkpatrick, 2016). This survey was based on subjective ranking asking participants to rate their comfort level on a Likert scale of 1 through 5 as follows: (1) very

uncomfortable, (2) somewhat uncomfortable, (3) neutral, (4) somewhat comfortable, and (5) very comfortable. Likewise, their confidence level was assessed using a similar 1 to 5 scale: (1) not confident at all, (2) not too confident, (3) neutral, (4) somewhat confident, and (5) very confident (Appendix J).

After the pre-education assessment, we immediately provided a BAC training course. The components of the training program were taught via a pre-recorded video lecture that demonstrated performance of the BAC procedure step-by-step using a standardized training video script (Appendix K). Participants were given the option to practice on their own without supervision on an identical airway task trainer. According to Wong et al. (2003), proficiency in cricothyrotomy performance requires repeated practice of at least five times and a clear mental algorithm of the procedural steps. For efficiency and sustainment, we provided participants with a video lecture and self-guided practice attempts.

Following instruction and practice, we conducted a post-education assessment to evaluate the effectiveness of the training events. The post-training assessment was performed in the same manner as the pre-training assessment. Participants were required to perform a cricothyrotomy using the same airway task trainer and were graded using the 17-step BAC procedural checklist. Each participant was timed utilizing the same timing protocol and were evaluated using the same point system as the pre-education assessment. After completing the simulation, participants were asked to complete a post-education survey to rate their comfort and confidence level, and if they used the airway task trainer for cricothyroidotomy practice before they completed their final evaluation (Appendix J).

Data Analysis Plan

Since DGMC anesthesia providers were allowed to opt-out of our project, we were unable to predict our sample size for data collection. For this reason, we used descriptive

statistics to analyze our data and evaluate our training platform. During pre-training and post-training simulations, we collected the time required to complete the cricothyroidotomy procedure and the number of correct steps completed on the procedural checklist. We then used a survey to assess provider comfort and confidence level using a Likert scale. The data collected was operationally measured using descriptive statistics STATA/SE 14.2 for Windows. In addition, we collected the following demographic data: age, the number of years since graduating initial anesthesia training, previous surgical airway training, surgical airway training in the past year, the performance of a surgical airway in a real clinical scenario, and average hours spent in the operating room weekly.

Potential Barriers

We identified two barriers that had a potential impact in our implementation. First, we had difficulty coordinating this assessment and training with the staff work schedule. To overcome this barrier, we utilized the monthly training day reserved the 3rd Thursday of each month to complete the training. The second barrier that we anticipated was the possibility that the anesthesia providers may feel judged or graded on their ability to perform and would elect not to participate in the training program. Therefore, all pre-training and post-training evaluations were conducted with one provider at a time in isolation of other providers. This barrier was also mitigated by the fact that only those conducting the EBP project had access to the evaluation scores. In addition, we did not collect provider type in our demographics, leading to the inability to compare between provider types (CRNA vs MD). We also made it clear to the participants that cricothyrotomies are high-skill, low-yield procedures and that their participation would greatly assist identifying future program needs and/or modifications.

Sustainment and Dissemination Plan

Current literature shows that cricothyrotomy training should occur at least yearly using high-fidelity simulation (Boet et al., 2011). However, training every six months is preferred because it has shown to be superior for skill maintenance in advanced airway management (Hessert & Bennett, 2013; Kuduvalli, 2008; Wong et al., 2003). To meet current evidence-based guidelines and professional organizational standards on this high-risk low-frequency procedure, we plan to create a cricothyrotomy training simulation program to be carried out every six months. The final sustainment plan was based on the end-results of our evidence-based project. Our team evaluated whether the implementation of a cricothyrotomy training program at the DGMC anesthesia department successfully improved the following areas: performance of bougie-assisted cricothyrotomy procedure, provider confidence and comfort level with the procedure. The staff member in charge of the Comprehensive Medical Readiness Program (CMRP) will provide initial cricothyrotomy training followed by bi-annual competency training and practice. Our goal was to incorporate cricothyrotomy training as a career competency requirement for all anesthesia providers. We disseminated project findings, limitations, and strengths to committee stakeholders, DGMC leadership, and anesthesia personnel through oral and poster presentations in the spring of 2021. We shared project findings with our peers and professors during the annual USUHS research week in May 2021.

HIPAA Concerns/Ethical Considerations

We submitted this project for review to the Institutional Review Board (IRB) and received an exemption because this project is not a research study. This EBP did not collect any patient data, therefore there was no risk of inadvertent release of personally identifiable information (PII). We collected participant's demographic data that was de-identified from anesthesia staff via a pre-survey and post-survey. There were no concerns for compliance with the Health

Insurance Portability and Accountability Act (HIPAA). Although the information that was collected was de-identified from individual staff members, we stored all electronic data on a common access card (CAC) password-protected computer behind a locked door. Additionally, paper data was stored in a locked cabinet behind a locked door and all requests to view or access collected data will be routed to the chief investigator for approval.

Project Results

Our project did not reach the initial sample size of 32 anesthesia providers due to military separations and permanent change of stations. At the time the cricothyrotomy training took place, there were a total of 25 anesthesia providers employed at DGMC. Of this pool, 14 (56%) providers were present during training day, 13 elected to participate, and one declined participation. There were 11 providers unavailable during training day, three were deployed, four were on leave, and four had scheduled time off. Providers who were not present during training day were given the option to participate at a later date (excluding deployed members), but all providers declined. Participant demographics were collected immediately after the first simulation attempt. Of the clinicians that participated, 61% (n=8) were under the age of 40 and one participant did not specify their age. Fifty-three percent (n=7) of providers had not had surgical airway training in the past year. Sixty-one percent (n=8) of providers reported they had participated in an academic session on surgical airway training in the last two years. None of the providers reported having performed a surgical airway on a live patient.

For the pre-training assessment, the mean time to perform the cricothyrotomy was 106 seconds (range 47-224 seconds). The mean procedural steps completed was 8 (range 7-11). For the post-training assessment, the mean time to perform the cricothyrotomy was 74 seconds (range 27-123 seconds). The mean procedural steps completed was 11 (range 9-12). The level

of comfort and confidence was surveyed after both simulation attempts. After the pre-training assessment, 61% of providers (n=8) had a comfort level of 4 or greater. After the post-training assessment, 84% (n=11) of providers had a comfort level of 4 or greater. Confidence levels showed a slight increase, with 69% (n=9) of providers having a confidence level of 4 or greater after the pre-training assessment compared to 76% (n=10) of providers having a confidence level of 4 or greater after the post-training assessment.

Analysis of Results

Our results show that there was a mean decrease in time to perform the procedure by 32 seconds from the pre-training assessment to the post-training assessment. Providers completed a mean of three more steps during the post-training assessment compared to the pre-training assessment. Providers self-rated themselves as more confident and more comfortable after the post-training assessment compared to the pre-training assessment. These results show that routine cricothyrotomy training can be used to decrease time to perform the procedure as well as increase confidence and comfort level among anesthesia providers.

Organizational Impact / Implications to Practice and Policy

As previously discussed, cricothyrotomy training should occur at least yearly but preferably every 6-months to optimize skill maintenance. Based on our demographic data collection, over 50% of the DGMC anesthesia providers had not received cricothyrotomy training in over a year. This finding further emphasized the need for a uniform training platform on difficult airway management in this department. With the improvements in time to perform the procedure, comfort, and confidence level, we plan to implement a cricothyrotomy training program to be completed every six months. A staff member in charge of the CMRP will be responsible for bi-annual cricothyrotomy competency training for the anesthesia department.

Future Directions for Research and Practice

The first suggestion for future evidence-based projects would be the re-evaluation of participant training at different time intervals. This would then be used to guide the need for frequency of training and assessing skill degradation. A future project might entail having participants be timed and assessed on steps completed one month after completing cricothyrotomy training and again at three months after completing the training.

The second recommendation for future implementation would be to add different techniques to assist with cricothyrotomy performance. The BAC method was chosen for this project due to the consistent availability of the necessary supplies in both the operating room environment and in the austere environment. However, there are many different techniques used to perform a surgical cricothyroidotomy, such as the Seldinger technique, for which there are numerous kits from multiple manufacturers available for use. There are also various tools used to assist the clinician in the successful placement of a cricothyrotomy, such as the use of ultrasound to identify the CTM. It may be beneficial to add these tools and techniques in future training to evaluate their benefit to the training platform.

The third recommendation would be to critically analyze the speed, technique, comfort, and confidence level of the providers that did use the airway task trainer to practice the BAC technique before the final evaluation. It was noted that there were a large number of providers who elected not to practice the BAC after watching the training video. It is hypothesized that if it were mandatory for each clinician to practice the BAC after watching the training video, there would be a significant improvement in the final skills evaluation.

Our final recommendation for future research would be to investigate different cricothyrotomy trainers or investigate utilizing animal models for practice. Although we used a

bleeding cricothyrotomy trainer, some providers felt their fidelity could be improved. The creation of the trainers was impractical because they took time and money. A different airway task trainer may be available which would be more cost-effective and provide more realism than our trainer. The ideal airway trainer would be cost-effective, create a realistic feel when performing the cricothyrotomy procedure, and elicit a similar emotional response akin to performing one on an actual patient.

Conclusion

Surgical access to the airway is the last rescue attempt to secure the airway when other measures have failed. Due to the severity of complications associated with a CICO event and improper placement of a surgical airway, it is imperative that all anesthesia providers learn and practice how to perform an emergency cricothyrotomy through repeated simulation training. Our pre-implementation surveys indicated that anesthesia providers at our facility were not consistently training or maintaining any advanced surgical airway skills due to lack of a training platform. After conducting extensive literature review and analysis, we implemented an evidence-based practice project to incorporate this key skill as part of regular training at DGMC anesthesia department. Our analysis of results and post-implementation surveys indicated that BAC simulation training improved skill performance, increased provider confidence, and comfort level performing the procedure. Additionally, BAC training can benefit providers deployed in remote locations, as it is an ideal emergency technique for performing front of the neck access and has applicability in both the OR setting in military treatment facilities as well as in austere deployed environments (Hessert & Bennett, 2013).

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Appendix A



Completion Date 25-Aug-2018
Expiration Date 24-Aug-2021
Record ID 28287519

This is to certify that:

Gregory Caliwag

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

Responsible Conduct of Research (RCR)
(Curriculum Group)
Responsible Conduct of Research (RCR)
(Course Learner Group)
1 - Basic Course
(Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)



Verify at www.citiprogram.org/verify/?w0260e328-031d-4ad9-aa88-21452b963ff7-28287519



Completion Date 25-Aug-2018
Expiration Date 24-Aug-2021
Record ID 28287518

This is to certify that:

Gregory Caliwag

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

Good Clinical Practice (U.S. FDA Focus)
(Curriculum Group)
GCP for Clinical Trials with Investigational Drugs and Medical Devices (U.S. FDA Focus)
(Course Learner Group)
1 - GCP
(Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)



Verify at www.citiprogram.org/verify/?w4a28855b-d147-4d22-8f18-61669d087aa6-28287518



Completion Date 23-Aug-2018
Expiration Date 22-Aug-2021
Record ID 28287517

This is to certify that:

Gregory Caliwag

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

OUSD P&R Human Research
(Curriculum Group)
Biomedical Investigators and Research Study Team
(Course Learner Group)
1 - Basic Course
(Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)



Verify at www.citiprogram.org/verify/?wf03b7d25-b394-4c33-90f6-477ed5c1ef64-28287517



Completion Date 28-Aug-2018
Expiration Date 27-Aug-2021
Record ID 28340361

This is to certify that:

Susie Chairez-Rincon

Has completed the following CITI Program course:

Responsible Conduct of Research (RCR) (Curriculum Group)
Responsible Conduct of Research (RCR) (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)



Verify at www.citiprogram.org/verify/?wcb2a5aa9-6274-4688-a60a-7d2fcb4f488d-28340361



Completion Date 28-Aug-2018
Expiration Date 27-Aug-2021
Record ID 28340360

This is to certify that:

Susie Chairez-Rincon

Has completed the following CITI Program course:

Good Clinical Practice (U.S. FDA Focus) (Curriculum Group)
GCP for Clinical Trials with Investigational Drugs and Medical Devices (U.S. FDA Focus) (Course Learner Group)
1 - GCP (Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)



Verify at www.citiprogram.org/verify/?w854f31d2-a217-4512-9cc3-832516dc2d08-28340360



Completion Date 28-Aug-2018
Expiration Date 27-Aug-2021
Record ID 28340359

This is to certify that:

Susie Chairez-Rincon

Has completed the following CITI Program course:

OUSD P&R Human Research Biomedical Investigators and Research Study Team (Curriculum Group)
1 - Biomedical Investigators (Course Learner Group)
1 - Biomedical Investigators (Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)



Verify at www.citiprogram.org/verify/?wf2fa8108-c7e7-442e-a41d-54d730f52bd2-28340359



Completion Date 23-Aug-2018
Expiration Date 22-Aug-2021
Record ID 28242649

This is to certify that:

Neil Murray

Has completed the following CITI Program course:

Responsible Conduct of Research (RCR) (Curriculum Group)
Responsible Conduct of Research (RCR) (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)



Verify at www.citiprogram.org/verify/?w7be06f7e-40ce-4c0b-b0e8-91a3d82e2ed5-28242649



Completion Date 23-Aug-2018
Expiration Date 22-Aug-2021
Record ID 28242648

This is to certify that:

Neil Murray

Has completed the following CITI Program course:

Good Clinical Practice (U.S. FDA Focus) (Curriculum Group)
GCP for Clinical Trials with Investigational Drugs and Medical Devices (U.S. FDA Focus) (Course Learner Group)
1 - GCP (Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)



Verify at www.citiprogram.org/verify/?wbd8511f4-d7cb-4638-b5c1-0543b918e240-28242648



Completion Date 23-Aug-2018
Expiration Date 22-Aug-2021
Record ID 28242647

This is to certify that:

Neil Murray

Has completed the following CITI Program course:

OUSD P&R Human Research (Curriculum Group)
Biomedical Investigators and Research Study Team (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)



Verify at www.citiprogram.org/verify/?wb0baff14-3c99-4da3-b0d6-84c9d2b83878-28242647

Appendix B



OFFICE OF RESEARCH
 4301 JONES BRIDGE ROAD
 BETHESDA, MARYLAND 20814
 PHONE: (301) 295-3303; FAX: (301) 295-6771

NOTICE OF PROJECT APPROVAL

Change Number: Original

VPR Site Number: GSN-61-11170
Principal Investigator: Callwag, Gregory
Department: Graduate School of Nursing
Project Type: Student
Project Title: Implementation of a Bougie-Assisted Cricothyrotomy Training Program
Project Period: 3/19/2020 to 5/14/2021

Assurance and Progress Report Information:

<u>Name</u>	<u>Sup</u>	<u>Approval Type</u>	<u>Status</u>	<u>Approved On</u>	<u>Forms Received</u>
Progress Report	0			To be Submitted	N/A

Remarks:
 This Notice Of Project Approval has been reviewed and approved. Please remember that you must submit a final Progress Report (Form 3210) upon completion of this project.

Questions regarding this approval should be directed to the following person in the Office of Research:
 Sharon McIver, (301) 295-9814.



Toya V. Randolph, Ph.D., MSPH Date
 Acting Vice President for Research
 Uniformed Services University of the Health Sciences

cc: File
 Radford, Kennett
 Taylor, Laura

Appendix C



DEPARTMENT OF THE AIR FORCE
59TH MEDICAL WING (AETC)
JOINT BASE SAN ANTONIO - LACKLAND
TEXAS

July 27, 2020

FINAL DETERMINATION –NON-HUMAN RESEARCH

Determination Date: 07/18/2020

Project Lead: Julie Petsche/USAF - 60th Medical Group Clinical Investigation Facility (60th MDG)

Reference Number: FWH20200154N

Project Title: Implementation of a Bougie-Assisted Cricothyrotomy Training Program

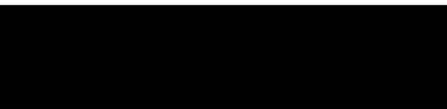
You may begin your project, as you would any other clinical or operational activity, with the approval and sponsorship of your leadership.

Your project was determined on 18 Jul 20 to be considered **not human research** as defined by DoD regulation 32 CFR 219 and FDA regulation 21 CFR 56. Continued IRB oversight for this activity is not required. The proposed project does not include non-routine intervention or interaction with a living individual for the primary purpose of obtaining data regarding the effect of the intervention or interaction, nor do the researchers obtain private, identifiable information about living individuals.

Since the IRB does not have regulatory oversight for your study, it is the investigator's responsibility to validate the study's scientific merit and research design and to ensure the conduct of the study is upheld by the highest ethical standards, as required by the Wing. Should you require assistance in reviewing the scientific merit and research design of your study, please contact the Protocol Office. Protection of subjects' rights safety and welfare and responsibility for protecting PHI/PII and research data now fall on the investigator and their commander.

In accord with DoDI 6000.08 any intramural funding of this study as research or as a clinical investigation may continue to be received or sought regardless of this IRB determination.

Your study has received a one-time research determination. If the goals and/or activities of the project change during the course of the project, or if new activities are proposed that would constitute human subjects research, re-contact the Protocol Office, so that a regulatory expert may determine whether or not the revised plan involves human subject research activities.



Thomas Gibbons, PhD
Designated Exempt Reviewer

Appendix D

DEPARTMENT OF THE AIR FORCE
60TH MEDICAL GROUP (AMC)

15 March 2021

MEMORANDUM FOR CAPTAIN GREGORY CALIWAG; ET. AL.

SUBJECT: Approval for Submission / Presentation/ Publication

1. On 15 March 2021, the Clinical Investigation Facility Publications Monitor received clearance/approval for your manuscript, poster, and PowerPoint submissions titled: **"Implementation of a Bougie-Assisted Cricothyrotomy Training Program"**.
2. Please contact our office if your submission is published and provide a printed version for our records.
3. If you have any questions, I can be reached at 707-423-7316 / DSN 799 or e-mail at eileen.m.foster4.civ@mail.mil.

[REDACTED]

EILEEN M. FOSTER, CIV, DAF
Gifts and Grants Technician

1st Ind, 60 AMW/PA

MEMORANDUM FOR CAPTAIN GREGORY CALIWAG; ET. AL.

PA Security and Policy Review was conducted IAW 35-102 and there were not any issues.

Approved/~~Disapproved~~ for publication.

3/16/2021

X [REDACTED]

TONYA A. RACASNER, GS-12, USAF
Deputy Chief, Public Affairs
Signed by: RACASNER.TONYA.A.1231677131

Appendix E
Table of Evidence

1st Author Name	Study Purpose/Aims	Research Questions/Hypotheses	Study Design	Total Sample Size	Sampling Plan	Independent Variables	Dependent Variables	Statistical Analyses	Results	Strengths (how promoted internal/external validity)	Weaknesses (biases; poorly controlled threats to internal/external validity)	LEVEL OF EVIDENCE - using JHNEBP tool
Basaran, 2018	Determine the ability for anesthesiologists to identify the cricothyroid membrane (CTM) in obese and non-obese children.	Obesity would decrease identification succes.	Non-experimental	83 children, 20 anesthesiologists	Convenience	None	Ease of palpation, time taken to palpate, total number of attempts, ultrasound to digital palpation vertical distance, accuracy of digital palpation	Chi-square, Mann-Whitney U or t-test, logistic regression analyses, p<0.05 was statistically significant	CTM correctly palpated in 44 of 80 patients (55%). 17 obese, 27 non-obese. Anesthesiologist subjectively found obese pts to be more difficult to palpate. No correlation for the accuracy of CTM assessment with the following parameters: BMI, neck circumference, CTM length, time to palpate the landmarks, and anesthesiologists' years of experience.	Adequate sample size. Assessed obese vs non-obese in identifying CTM.	US assessment completed by 1 physician. Didn't compare US vs palpation. Age of sample was 7 to 12 so cannot be applied to other population	Level 3A
Barbe, 2014	Evaluate whether ultrasound can help locating the CTM by comparing palpation and US evaluation	Is US more effective than palpation in identifying the CTM	Quasi-experimental	2 participants, 12 interns	Convenience	Use of ultrasound	Time to localize the CTM, identification of CTM	MANOVA, chi-square	Failure rate of 54% by palpation vs 0% with ultrasound. Mean locating times were longer with ultrasound but no statistically significant. After reassessment at 6 months, palpation had a failure rate of 67%; US had a failure rate of 22%.	Multiple providers. Reassessment after 6 months.	Only 2 participants. Despite multiple providers, still a small number. Protocol included rapid training on US technique but no training on palpation technique	Level 2B
Yildiz, 2015	To compare ultrasonography and surface landmark techniques for detecting the cricothyroid membrane to perform a cricothyroidotomy on healthy volunteers	How does ultrasound compare to surface landmark techniques for detecting the cricothyroid membrane to perform a cricothyroidotomy	Prospective observational study	24 participants and 5 providers/operators	Convenience	Use of ultrasound	Accuracy of detecting the CTM and time to localize the CTM	Medians, Kolmogorov-Smirnov test, Mann-Whitney U test, chi-square	CTM detected accurately in 80 (66.7%) attempts with palpation and 83 (69.2%) with ultrasound. Mean time to find CTM via palpation was 8.25 sec and with US mean time was 17 sec.	Multiple providers were in study. Live patient scanning. Assessed palpation vs ultrasound	Most patients were healthy with normal BMI. Small sample size of 24 patients (although a total of 120 encounters). Providers were residents who have limited experience with airway anatomy on US.	Level 3A
Altun, 2019	To investigate the success rates of ultrasound and palpation methods in identifying the cricothyroid membrane and compare the results to CT scan (gold-standard)	Is ultrasound and finger palpation accurate in identifying the cricothyroid membrane against the gold-standard method of CT scan	Quasi-experimental	110 patients with 1 investigator who had experience in managing difficult airway and ultrasonographic evaluation	Convenience. Any patient aged 18-65 who received general anesthesia for any kind of neck surgery and had previous neck CT images present	Use of ultrasound	Time localize CTM, accuracy of localizing CTM	Mean, standard deviation, median, Mann-Whitney U test, chi-square test or fisher exact test, bland-altman analysis.	Cricothyroid membrane was accurately detected in 50 (45.5%) patients with palpation and 82 (74.5%) with US. Time to assess cricothyroid membrane was shorter with ultrasound than with palpation. Difficulty scores for palpation were 5.13 and with ultrasound 3.32.	Adequate sample size. Compared palpation to ultrasound for identifying cricothyroid membrane.	Single investigator with experience in difficult airways. Investigator performed palpation and US under elective conditions when patient had already been intubated. US-guided identification based on experience and competency.	Level 2A

IMPLEMENTATION OF A CRICOTHYROTOMY TRAINING

Camobel I, 2014	To compare the CTM identification via palpation in females and males	Clinicians will have a more difficult time identifying the CTM via palpation in females	Observational study	44 subjects, 23 anesthetists	Convenience	None	Identification of CTM	Chi-square, Fischer exact test, student t test, ANOVA, mean, median	Incorrect identification was more common with females(30.5%) compared with males (80.5%).	Adequate sample, multiple study participants, assessment of incorrect CTM localization	No randomization, unlimited amount of assessments providers could make, failure rate may be higher when equipment is included, no time limit for providers to assess	Level 3B
Mandel, 2019	To evaluate the effectiveness of using a porcine training model with ultrasound to identify the the CTM vs digital palpation.	Will the use of the ultrasound guided approach to identify the CTM on a porcine model be superior to the palpation approach when training for cricothyrotomy.	Observational study	23 Anesthesia residents	Convenience	The use of ultrasound	Ease of identifying CTM , total number of attempts, cricothyrotomy success	N/A	23 of 25 residents were able to perform the open cricothyrotomy by digital palpation on the airway model on the first attempt. With the more challenging model, all 25 residents were able to locate the cricothyroid membrane by ultrasound and successfully perform open and percutaneous cricothyrotomy.	Results imply that this simple training method may assist in safely completing a low frequency/low volume task during an emergency.	Small sample size. Results were based off subjective data.	Level 3B
Nicholls, 2007	To develop a standardized US technique to identify the CTM.	Will a standardized technique for cricothyrotomy improve visualization of the CTM	Observational study	50 subjects	Convenience	The use of a standardized ultrasound technique	Time to visualization of CTM, perception of landmark difficulty	SPSS version 11.0 statistical software. Independent samples t test.	The mean time to visualization of the CM was 24.32 ± 20.18 seconds (95% confidence interval, 18.59-30.05 seconds).	Well organized multi phase study design. Many different patient subjects including increased BMI to more accurately represent the population	Correlation of results as well as statistical significance was weak in some aspects of the study	Level 3B
Siddiqui, 2015	To evaluate the effectiveness of US in the identification of the CTM	Will the use of US reduce complications associated with cricothyrotomy.	Randomized control trial	47 trainees, 23 using digital palpation and 24 using US	Convenience	The use of ultrasound	Laryngeal and tracheal wall injuries during cricothyrotomy, insertion time, failure of CT, identifying correct landmarks	SAS version 9.01 statistical software.	Ultrasound guidance significantly decreased the incidence of injuries to the larynx and trachea (digital palpation: 17 of 23 = 74% vs. ultrasound: 6 of 24 = 25%; relative risk, 2.88; 95% CI, 1.39 to 5.94; P = 0.001) and increased the probability of correct insertion by 5.6 times (P = 0.043) in cadavers with difficult and impossible landmark palpation (digital palpation 8.3% vs. ultrasound 46.7%). Injuries were found in 100% of the grades 3 to 4 (difficult-impossible landmark palpation)cadavers by digital palpation compared with only 33% by ultrasound (P < 0.001). The mean (SD) insertion time was significantly longer with ultrasound than with digital palpation (196.1 s [60.6 s] vs. 110.5 s [46.9 s]; P < 0.001).	Well organized randomized control trial	Study was conducted on cadavers which does not fully correlate to live tissue conditions.	Level 1A
Mallin, 2013	To evaluate the accuracy of using US to premark the CTM before attempted intubation	To determine the feasibility of US-guided marking of the CTM before attempted simulated intubation so that this marking may be used as the location for the initial incision after failed intubation.	Observational study	23 models and operators were used for data collection	Convenience	The use of ultrasound	Identification of the CTM	N/A	The average CTM sagittal length was 13.9 mm (95% confidence interval [CI], 13.4-14.4). The average sagittal and axial differences before and after simulated intubation were found to be 0.91 mm (95% CI, 0.35-1.47) and 1.04 mm (95% CI, 0.38-1.7), respectively. The sagittal variability is 1/15 the total length of the CTM.	Wide variety of experience among medical providers being evaluated, representing the population well	Small sample size with healthy volunteers	Level 3B

Alerhan d, 2018	Summarize prospective studies evaluating CTM identification, demonstrate the inaccuracy of the landmark palpation technique, and describe the use of ultrasound (US) as a superior tool for CTM identification.	N/A	Narrative review	21 sources (articles) were used	A literature review of the PubMed and Google Scholar databases was performed with search date from 1980 to December 2017. Search terms included "cricothyroid membrane + ultrasound OR point-of-care ultrasound", "airway + ultrasound OR point-of-care ultrasound", and "cricothyrotomy + ultrasound OR point-of-care ultrasound."	N/A	N/A	N/A	Physicians are not sufficiently accurate in using landmark palpation to locate the CTM. Evidence reveals the superiority of US compared to landmark palpation.	N/A	N/A	Level 4A
Aisharee f, 2018	Assess the accuracy of CTM identification by junior/senior emergency trainees by identification of surface anatomy landmarks.	Assess the accuracy of CTM identification by junior/senior emergency trainees by identification of surface anatomy landmarks.	Observational study	80 patients. 16 emergency trainees (8 junior and 8 senior level).	Convenience	Palpation technique.	The accuracy of correct location of the CTM.	χ^2 test/Fisher's exact test if the count in a cell was <5. Success was reported using proportion (95% CI) Statistical significance was defined by a P value of <0.05.	160 assessments performed, CTM surface anatomy was correctly identified in 31.2% (95% CI 24.2% to 39%) cases. Proportion of correct localisation by juniors was 30% (95% CI 20% to 41%), correct localisation by seniors of 32.5% (95% CI 22% to 44%); P=0.73. Median time to identification of the cricothyroid membrane of 3.6 (IQR = 1.9 to 15.3) seconds and a median time to endotracheal intubation of 26.2 seconds (IQR = 10.7 to 50.7 seconds).	The providers being evaluated are more likely to be in the situation where they will be faced with a airway needing a surgical approach to airway management, meaning through the CTM.	Use of patients who were relatively stable and scenario may not reflect real life. ED providers may not represent accurately the ED doctors in the country.	Level 2A
Curtis, 2012	Develop/describe an US-guided technique for emergent open cricothyroidotomy Also to evaluate the time to completion and failure rate of US-guided technique.	At the time of publication for this journal article there was not a discription of how to perform an US guided cricothyroidotomy in the literature. Hence why the authors want to develop a US technique for cricothyroidotomy.	Laboratory observational study design.	21 cadavers (12 female and 9 male). 2 independent operators of US.	Convenience	The use of ultrasound	Time to identification of the cricothyroid membrane and time to completion of the procedure (cricothyroidotomy).	Used medians with interquartile ranges (IQR). Data was plotted on a x-y graph for comparison.	Median time to identification of the cricothyroid membrane of 3.6 (IQR = 1.9 to 15.3) seconds and a median time to endotracheal intubation of 26.2 seconds (IQR = 10.7 to 50.7 seconds).	Proved that US-guided cricothyroidotomy is a technique that may assist cricothyroid identification in populations seen in other ED.	Used cadavers which does not translate to live models/people, meaning US will be more difficult with live human patients. Study may not be reproducible if the physician does not have previous US experience. Used only two operators for the US, more operators should be evaluated.	Level 3A
Lamb, 2015	Determine the rate of successful identification of the cricothyroid membrane by anesthesia residents and staff.	Are anesthesiologists challenged when attempting to locate the cricothyroid membrane? They hypothesized that obesity would decrease identification success.	Observational study	12 subjects (half were non-obese the other half were obese). 61 anesthesia staff and residents who palpated.	Convenience	Palpation technique.	The accuracy of correct location of the CTM.	Data was analyzed using the statistical software R-3.0.3. Used a mixed-effects logistic regression model to account for the within-subject and within-participant correlations.	Of the 186 participant attempts to identify the cricothyroid membrane in 12 subjects. The overall success rate was 42% (79/186). Success rates for the demographic subgroups: non-obese men 72% (95% CI: 59 to 85%); obese men 39% (95% CI: 26 to 54%); non-obese women 24% (95% CI: 12 to 36%); obese women 35% (95% CI: 21 to 49%).	Data confirmed the findings of other studies that anesthesiologists have a low success rate for identifying the cricothyroid membrane.	They were not able to delineate with accuracy the borders of the CTM with US due to the skin folds found on obese subjects. They found that the height of the cricothyroid membrane in their study was less than average observed in many other studies.	Level 3A

Aslani et al., 2012	Determine the accuracy of clinical identification of the cricothyroid membrane (CTM) using the traditional palpation technique by a group of physicians.	The authors hypothesized that the CTM would be more likely to be misidentified in obese patients than in normal weight patients on the basis that anatomical landmarks might be obscured.	Observational study	56 female patients of childbearing age participated in the study. The assessors were 24 physicians of whom 17 were anesthesiologists and 7 were OB/GYN trainees between 1 and	Convenience	Palpation technique with the patient in supine position and then with head extended. Participants were also asked to assess the ease of CTM palpation using a 10-cm visual analog	Accurate localization of the CTM	Data was analyzed using Sigma Stat (version 2.0). Categorical data presented as numbers and percentages was analyzed by the Fischer exact test. Continuous data was analyzed by the Student t-test and/or ANOVA, as appropriate. Associations were made by multiple linear and logistic regression analyses as indicated.	56 patients participated of whom 15 were obese (BMI > 30). A correct CTM estimation was defined as a mark made between the upper and lower limits of the membrane and within 5 mm of midline. In the supine neutral neck position, the CTM was identified in 10/41 vs 0/15 (P=0.048) in non obese vs obese, respectively. Of the incorrectly identified CTM in the supine position, 24 were above (maximum 3 cm) and 22 below (maximum 3 cm) the actual level. Similar results were observed when the patients were placed with the neck in the extended position; the CTM was identified correctly in 12/41 vs	Adequate sample size. Study assessed obese vs non-obese in identifying CTM via palpation.	The study did not compare the accuracy of clinical identification of the CTM using ultrasound vs traditional palpation technique by the group of physicians. Additionally, the sample only included women of childbearing age therefore it cannot be applied to general adult population.	Level 3A
Beir et al., 2015	To compare three different methods of identifying the cricothyroid membrane (CTM) and assess their individual overall accuracy to include palpation of the thyroid cartilage as a key landmark vs approximation based on four finger widths (patient's sized) to estimate the CTM location relative to the sternal notch vs estimation based on overlying skin creases of the neck.	N/A	Prospective randomized trial.	50 adult subjects who met inclusion criteria. 49 physician assessors participated of whom 23 were emergency attending or fellows, 12 were 3-year emergency residents and 14 were 2-year emergency residents.	Convenience sample with inclusion and exclusion criteria. Physician assessors had a randomly assigned technique on an individual patient selected from a convenience sample of patients waiting for care in the emergency department (ED).	General palpation technique, the four-finger technique, and the neck crease technique.	Accurate localization of the CTM	All statistical analyses were performed using STATA software version 12. Descriptive analysis were reported with means, ranges, and 95% confidence intervals (CI).	50 adult patients participated, 52% female, mean body mass index was 28 kg/m ² . The general palpation method was successful 62% of the time (95% CI = 48% to 76%) and took an average of 14 seconds to perform (range 5-45 seconds). In contrast, the four-finger technique was successful 46% of the time (95% CI = 32% to 60%) and took an average of 12 seconds to perform (range 6-40 seconds). The neck crease method was successful 50% of the time (95% CI = 36%-64%) and took an average of 11 seconds to perform (range = 5-15 seconds). Conclusion: all three methods performed poorly overall and might be less accurate where superficial anatomy is not palpable due to body habitus.	Adequate sample size, patients had to meet inclusion criteria. Exclusion criteria included unable to lay supine, patients undergoing evaluation for cervical spine injury, prior neck surgery or radiation, or younger than 18 years old. ED physician assessors were eligible to participate if they had been formally trained in surgical airway techniques. For the residents it involved a formalized airway curriculum that included cadaver-based training with multiple invasive techniques.	Study only included emergency physicians with formal training in surgical airway techniques. Results might not be sufficiently representative among other providers outside the ED who are likely to be called to perform this emergency procedure (e.g. anesthesia staff, anesthesia residents, and surgeons). This study was performed under optimal circumstances in a nonrushed, non-timed critical setting which hinders internal and external validity.	Level 3B
Siddiqui et al., 2018	To compare the accuracy of ultrasound versus external palpation in localizing the cricothyroid membrane in patients with poorly defined neck landmarks.	The authors hypothesized that ultrasound is more accurate than external palpation in identifying the cricothyroid membrane when compared to the accepted standard, computed tomography scan	Prospective, single-center, single-blinded, randomized clinical trial	340 subjects were scheduled for a neck computed-tomography scan, 117 were excluded from the study after randomization. A total of 223 ASA I to ASA III patients with poorly defined neck landmarks completed the study.	Convenience sample with inclusion and exclusion criteria. 109 patients were randomized to the external palpation group and 114 patients to the ultrasound group. Two anesthesia fellows were the assessors.	Palpation technique vs ultrasound	Accurate localization of the CTM	The characteristics of each group were presented with frequencies and percentages for categorical variables and compared using the chi-square test. Continuous variables, means and SDs were presented and compared using independent two-sample t tests. Normal distribution was checked by examining histograms. The statistical model was changed from a logistic regression model to a Poisson regression model to examine the rate of successful identification of the cricothyroid membrane and to calculate risk ratios. The distance from the target location was compared between groups using a t-test. SAS version 9.3 was used for the statistical analysis. All P-values were two-sided, and a value of P < 0.05 was considered statistically significant.	The percentage of accurate attempts was 10-fold greater in the ultrasound group (81% vs 8%; 95% CI, 63.6-81.3%; P < 0.0001). The mean (SD) distance measured from the external-palpation to computed-tomography point was five-fold greater than the ultrasound to the computed-tomography point (16.6 ± 7.5 vs. 3.4 ± 3.3mm; 95% CI, 11.67-14.70; P < 0.0001). Analysis demonstrated that the risk ratio of inaccurate localization of the cricothyroid membrane was 9.14-fold greater with the external palpation than with the ultrasound (P < 0.0001). There were no adverse events observed. Conclusion: In subjects with poorly defined neck landmarks, ultrasonography is more accurate than external palpation in localizing the cricothyroid membrane.	Adequate sample size, patients recruited had neck pathologies including previous neck surgery, irradiation, and/or neck mass. Exclusion criteria included inability to lie flat, inability to maintain a neutral neck position, and refusal to participate in the study.	The cricothyroid membrane was assessed on patients in the neutral neck position making it less than ideal. This position may have affected the accuracy of the cricothyroid membrane during the palpation technique skewing results. Additionally, there were only two assessors in this study increasing the risk for bias through learning with repeated assessments.	Level IA

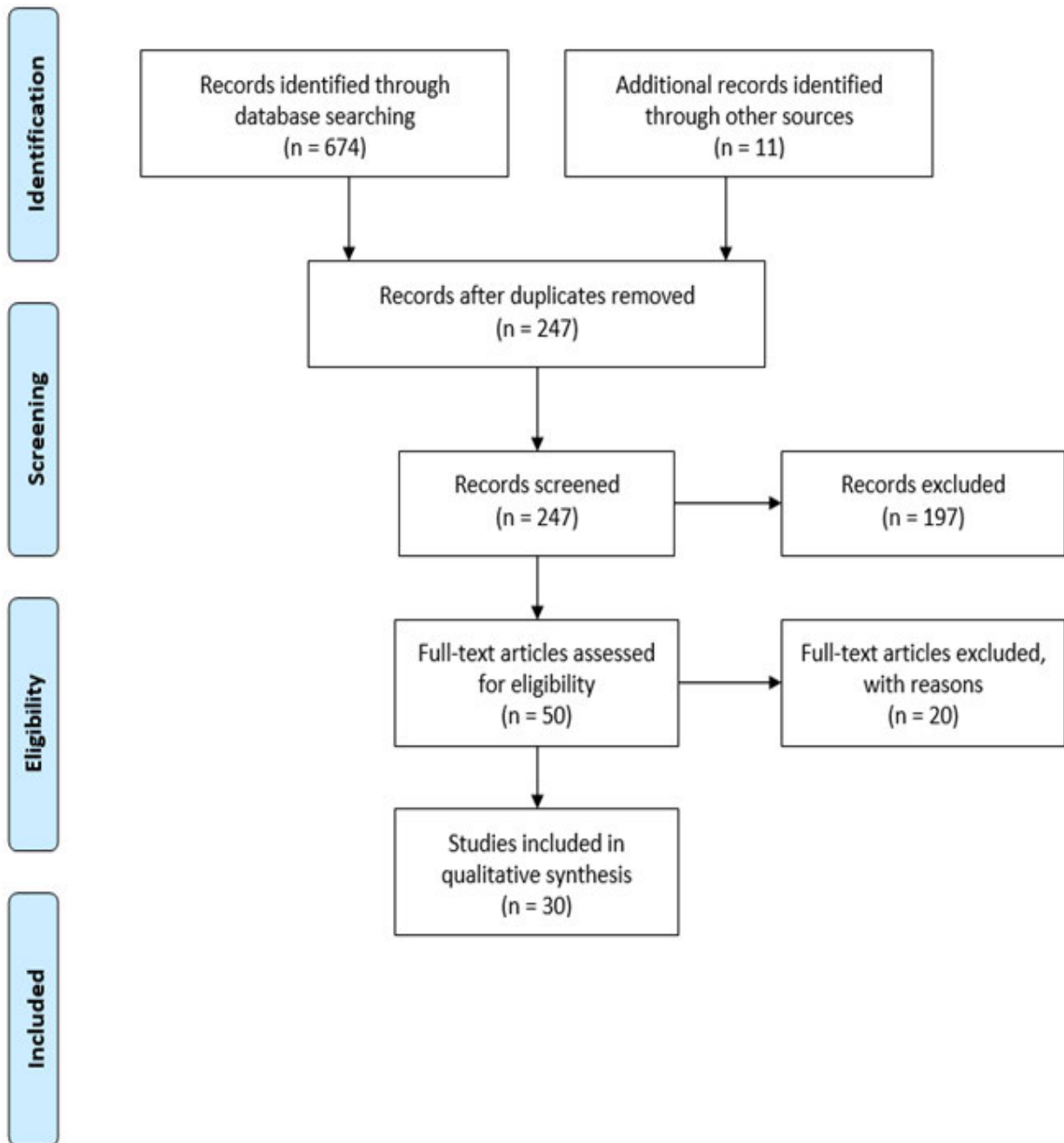
You-Ten et al., 2018	To compare the effects of practice with ultrasound (US) and non-ultrasound (NUS) guided palpation of neck landmarks on the subsequent accuracy of cricothyroid membrane localization using external palpation	Does practice with ultrasound-guided of neck landmarks improve the subsequent accuracy of blind localization of the cricothyroid membrane? The authors hypothesized that practice with ultrasound-guided palpation of the cricothyroid membrane would improve subsequent blind localization of the cricothyroid membrane without ultrasound.	Prospective randomized trial	18 volunteer models for cricothyroid membrane localization. Participants included 15 anesthesia residents in postgraduate years 1 and 2, anesthesia fellows, and practicing anesthesia assistants.	Convenience sample. 8 anesthesia participants were randomized to the ultrasound group and 7 to the non-ultrasound group after receiving a 15-minute didactic PowerPoint presentation on the anatomy of the neck, landmarks, and cricothyroid membrane.	Ultrasound guided palpation of the neck landmarks and cricothyroid membrane; non-ultrasound guided palpation of the neck landmarks and cricothyroid membrane	Accuracy of cricothyroid membrane localization using only external palpation	The data management and all statistical analyses were performed using SAS 9.4. A 2-sided P value of < 0.5 was used to determine statistical significance. Participant characteristics were compared descriptively between NUS and US groups. Accuracy rate and palpation point ultrasound distance at participant level were compared between the 2 groups using Wilcoxon rank sum test. The Wilcoxon rank sum test was used to estimate sample size using 300 Monte Carlo samples from assumed normal distributions.	15 anesthesia participants were randomized to ultrasound (n = 8) and non-ultrasound (n=7) groups. A total of 80 and 61 attempts were performed by the ultrasound group and non-ultrasound groups, respectively. The median accuracy rate in the US group was higher than the NUS group (65% vs 30%; P=0.25), and the median palpation point ultrasound distance in the ultrasound group was shorter than in the NUS group (4.0 vs 8.0 mm; P = 0.04). The adjusted mean [95% CI], 3.6 [2.9-4.6] vs 6.8 [5.2-8.9] mm; P < 0.001.	The study had inclusion and exclusion criteria for volunteer models to include age older than 18 years old, no previous history of neck surgery, neck irradiation, known neck deformity or abnormality.	The volunteer models were relative healthy individuals therefore results are not representative of the general adult population.	Level 3B
Cho, 2008	Compare usefulness of porcine vs manikin model for cricothyrotomy training	Is the porcine model compared to the manikin model better for cricothyrotomy training	Prospective crossover study	49 participants	Convenience	Porcine model vs manikin model	visual analogue scale of 0-10 on difficulty of skin penetration, landmark recognition and procedure, reality of skin turgor	Paired t test, mean	Visual scores were higher in the porcine model for reality of skin turgor, degree of difficulty with skin penetration, and degree of difficulty with landmark recognition.	Compared 2 different models to assess which one participants preferred for training. Porcine model closely resembles human anatomy.	No pre-test or post-test. Hands on time was limited and each participant only performed two cricothyrotomies	Level 3A
Duggan, 2017	N/A. This was a letter to the editor describing the use of a 3D cricothyrotomy model overlayed over a human neck to create the novel feeling of cutting open another human's neck.		Letter to the editor									Level 4A
Duggan, 2018	N/A. This was an editorial describing a checklist creation from the CICO (Cannot intubate, cannot oxygenate) mnemonic. Checklist is Call it, communicate it (C), Incision (I), Cut vertically (C) and Over Bougie Technique (O).		Editorial									Level 4A
Friedman, 2008	To compare an inexpensive model to a high fidelity simulator for cricothyrotomy skill training	Does the use of a high fidelity vs low fidelity training tool for cricothyrotomy transfer equally when applied to a human cadaver	Observational	22 participants	Convenience	High fidelity simulation (full-scale simulator) vs low fidelity simulation (corrugated tubing)	Post-test cricothyrotomy	T-test, Mann-Whitney U test	No significant difference in change from pretest to posttest cricothyrotomy performance between the high-fidelity and low-fidelity groups. Training on both models improved cricothyrotomy performance as evaluated through a three-point task specific checklist, a global rating scale, and time.	Appropriate outcomes assessed. High and low fidelity models were truly big differences	All participants did a cricothyrotomy on a cadaver before training. Graders may lead to subjectivity. Time after post-test was only 11 days.	Level 3A

Huges, 2018	To evaluate the realism of their trainer compared to other models	Will a realistic CTM model combined with a 1 hour didactic lecture improve the comfort with performing a cricothyroidotomy	Observational	43 Participants	Convenience	CTM trainer with 1 hour didactic lecture	Post test survey	N/A	Forty-three EM residents completed the survey (82.7%, 43/52). The mean realism rating of the trainer was 3.81 (95% CI = 3.54-4.1). The participants reported previous training on cadaver (62.8%, 27/43), porcine (45.5%, 20/43), and manikin (67.4%, 29/43) models prior to using this trainer. The bleeding cricothyrotomy trainer was rated higher than other models (4.45, 95% CI = 4.28-4.63). Participants noted improved comfort with performing the cricothyrotomy after the educational lab (average improvement of 1.23±0.75). Participants specifically commented on the realism of the bleeding and skin texture	Appropriate outcomes assessed.	Participants felt that the CTM was too obvious and suggested decreasing the size	Level 3B
Hubert, 2014	To assess the impact of a short training course on the ability of anesthesiology residents to comply with current difficult airway management guidelines	Will a training course affect the ability of anesthesiology residents to comply with current difficult airway management guidelines	Observational	27 Anesthesia residents	Convenience	Pretest and seminar	Performance during a CICV scenario	McNemar test, SAS/STAT software version 9.2, Wilcoxon signed-rank test, Kruskal-Wallis one-way ANOVA	After training, all 27 residents (100%) complied with the airway management guidelines, compared with 17 (63%) in the pretest (P < 0.005). In the pretest and the 3-, 6-, and 12-month posttests, the median [range] duration of cricothyrotomy was respectively 117 s [70 to 184], 69 s [43 to 97], 52 s [43 to 76], and 62 s [43 to 74] (P < 0.0001 vs. in the pretest), the median [range] checklist score was 3 [0 to 7], 10 [8 to 10], 9 [6 to 10], and 9 [4 to 10] (P < 0.0001 vs. in the pretest) and the median [range] global rating scale was 12 [7 to 22], 30 [20 to 35], 33 [23 to 35], and 31 [18 to 33] (P < 0.0001 vs. in the pretest). There were no significant differences between performance levels achieved in the 3-, 6-, and 12-month posttests.	The training session significantly improved the residents' compliance with guidelines and their performance of cricothyrotomy. Post test was randomized	Limited sample size	Level 3B
Heymans, 2016	compare the performance of medical personnel, naive to surgical airway techniques, in establishing an emergency surgical airway in cadavers using three commonly used cricothyrotomy techniques.	Which of the three cricothyroidotomy airway techniques are superior	Randomized crossover study	20 Medical students	Convenience	The use of the surgical technique, Melker set, and QuickTrach for cricothyrotomy	Time, successful placement, and complications of cricothyrotomy	generalized estimating equations (GEE) with an identity link, analysis was carried out with the IBM SPSS version 22	The success rates were 95, 55, and 50% for surgical cricothyrotomy, QuickTrach, and Melker, respectively (P = 0.025). The majority of failures were due to cannula misplacement (15 of 20). In successful procedures, the mean procedure time was 94 ± 35 s in the surgical group, 77 ± 34 in the QuickTrach II group, and 149 ± 24 in the Melker group (P < 0.001). Few significant complications were found in successful procedures. No cadaver biometric parameters were correlated with success of the procedure.	Randomized study with statistical significance	Limited sample size	Level 2B
Aho, 2015	To develop and validate a novel and inexpensive cricothyrotomy task trainer that can be constructed from household items.	Does a low-cost, easy-to-prepare neck model be used to effectively teach and assess the performance of EC?	Observational	54 Students	Convenience	A model constructed using a toilet paper roll (trachea and larynx), Styrofoam (soft tissue), cardboard (thyroid cartilage), zip tie (cricoid), and fabric (skin).	10-point checklist (5 points total). Anonymous survey rating the educational value and the degree of enjoyment regarding the model.	Mean (standard deviation; range).	Trainee scores varied significantly by group (p < 0.001): mean (standard deviation; range) scores were 1.8 (1.2; 1-4) for medical students, 3.5 (1.2; 1-5) for interns, and 4.9 (0.5; 4-5) for postgraduate year 3 residents.	Allow the student to go through the steps of a cricothyrotomy as if it would be done on a real life patient.	Not realistic, difficult to apply this training to the actual procedure.	Level 3B

Bribiesco, 2018	Educational article about cricothyroid approach for emergency access to the airway. Entails the anatomy, who would need a cricothyroidotomy, preparation, and the 3 methods to complete the procedure. Specifies that experience/ training of the provider performing the cricothyroidotomy are the crucial factors for establishing emergency surgical airway access.	N/A	Educational article	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Level 4A
Biron, 2013	Purpose of our study was to develop, administer, and evaluate the effectiveness of a multisensory model used to teach cricothyrotomy to fourth-year medical students.	Since cricothyrotomy is a technical skill using a Multisensory model is the right method for teaching.	Observational	120 students	Convenience	Multisensory model used to teach cricothyrotomy to fourth-year medical students.	Students' confidence was assessed with pre and post-session confidence-level questionnaires. 30 randomly selected students assessed with a post-session objective skill assessment test. Multiple choice examination to test knowledge.	Pre- and post-session CLQ mean scores were calculated using a paired t-test. Mean and standard deviation was calculated for MCQ scores and OSATS. A Mann-Whitney U Test was used to compare differences in OSAT scores.	Comparing pre- and post-CLQ scores, significant improvement in CLQ after the teaching sessions (p less than 0.001). OSATS score converted into percentage was 88% for students overall. Post-session MCQ, mean score of 3.68 / 0.58 (92%), demonstrating a high level of knowledge retention. Qualitative feedback from students indicated that this session was highly applicable to medical training and teaching an essential skill required of physicians.	cricothyrotomy OSATS described in this study is a valid assessment tool of technical skills required to perform this procedure. OSATS was adapted specifically for cricothyrotomy, they verified its construct validity and inter-rater calculations. 3 board-certified otolaryngology-head/neck surgeons and 2 otolaryngology-head/neck surgery residents assessed the content validity of this CLQ and found it to be appropriate. Content validity of this MCQ was assessed by a focus group of 5 otolaryngologists.	Could not consider into the study that some students had recently had learned the skill of cricothyrotomy, placing a potential bias on the scoring. No separate control cohort to compare the effectiveness of the intervention. Confidence and skill were measured shortly after the teaching session, meaning it may not correlate to a clinical scenario several months later.	Level 3B	
Kei, Mebust, & Duggan, 2019	Educational article describing the REAL CRIC Trainer set up with detailed instructions. The goal was to develop an inexpensive, reusable cricothyrotomy simulator that is easy to replicate and that provides a realistic experience for its learners.	N/A	Educational article	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Level 4A
You-Ten et al., 2015	To determine whether training in cricothyrotomy technical skill has an impact on adherence to the ASA difficult airway algorithm (ASA-DAA) and non-technical behaviours.	The authors hypothesized that hands-on cricothyrotomy training would enhance adherence to the ASA-DAA as a result of improved decision-making.	Randomized controlled trial	26 postgraduate year two anesthesia residents were recruited. Participants who had performed a cricothyrotomy in a clinical or simulated setting within	Convenience sample randomized into one of two groups using a computer algorithm: the Non-Trained (control) group (n=11) or the Trained (intervention) group (n=10).	Hands on cricothyrotomy training in the Trained (Intervention) group.	Adherence to the ASA difficult airway algorithm (ASA-DAA)	Primary outcome measures were analyzed using Fisher's exact test. Primary outcome measures included (1) failure to insert an oral airway; (2) failure to call for help; (3) bypassing the LMA; and (4) attempted fiberoptic intubation. Secondary outcome measures were analyzed using the Wilcoxon test. Participant characteristics were analyzed using the Mann-Whitney test for ordinal data and Fisher's exact test for nominal data.	Significantly more participants in the Non-Trained group than the Trained group (6/11 vs 0/10, P = 0.012) committed at least one major ASA-DAA deviation, including failure to insert an oral airway, failure to call for help, bypassing the laryngeal mask airway, and attempting fiberoptic intubation. ANTS scores for all four categories of behaviours were similar between the groups.	Two strengths that promoted internal validity to this study was that participants were randomized into one of two groups using a computer algorithm and the staff anesthesiologist who taught the didactic review to all participants was blinded to group allocation.	Modification to the scenario is a major limitation to this study because it may have affected the participants performance. Participants in Scenario A had the opportunity to anticipate the development of a 'cannot intubate-cannot oxygenate' (CICO) situation and mentally rehearse management strategies during the "can oxygenate" period. In	Level 1B	

<p>Wray et al., 2019</p>	<p>To determine if the bleeding CRIC task trainer demonstrated non-inferiority to the current standard of teaching (SimMan task trainer).</p>	<p>N/A</p>	<p>Randomized controlled trial</p>	<p>20 volunteer participants were recruited. 3 participants opted out of study. A total of 17 participants completed the study.</p>	<p>Convenience sample, 15 emergency medicine residents and 5 fourth year medical students in which 3 students/residents opted not to participate. A total of 17 participants were randomized into two groups using block randomization, to receive cricothyroidotomy instruction on either the bleeding CRIC or SimMan task trainer. 9 participants were randomized into the Bleeding CRIC Group and 8 participants were randomized into the SIM Man Group.</p>	<p>Sim man task trainer and Bleeding CRIC task trainer</p>	<p>Objective Structured Assessment of Technical Skills (OSATS), completion time, post-comfort levels</p>	<p>The collected data was tabulated and coded by a research assistant not involved in any teaching aspects of the study. The means/SD were calculated for OSATS scores and visual analog scores and then compared between groups using a t-test. ANOVA was performed to analyze the realism scores among the three task trainers. A power calculation was performed based on a previously shown novice mean of 3.2 points per minute with a SD of at least 1 point per minute. Using a two-sided t-test with an alpha of 0.05 and a power of 90% required a sample size of 43 therefore it was not performed due to the small sample size.</p>	<p>There were no statistically significant differences between the groups in assessment scores, time to completion, or comfort levels pre-and post-intervention. There was a statistically significant difference in that the participants gave higher realism scores in post-test analysis to the Bleeding CRIC compared to the SimMan. Both groups demonstrated that they had significantly improved comfort levels from baseline post-intervention.</p>	<p>Strengths of this study include the following: a single instructor taught the participants how to perform a cricothyroidotomy on their assigned task trainer, a single evaluator, who was blinded to the method of instruction, tested the participants on a pig trachea and evaluated them using a validated OSATS score. All participants crossed over and practiced performing a cricothyroidotomy on the task trainer they were not randomized to allowing all participants to experience performing a cricothyroidotomy on the SimMan, the bleeding CRIC and the pig trachea model.</p>	<p>Potential biases to this study include conflict of interest. The Bleeding CRIC task trainer was produced by the current study's lead author. This study was also limited by small sample size making it difficult to determine whether the bleeding CRIC task trainer can be a viable model to implement in cricothyroidotomy training.</p>	<p>Level 1B</p>
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Appendix F
Prisma Flow Diagram



Upload Completed Milestone Checklist			X									
Upload Signed DNP Project Senior Mentor Approved Abstract/Impact Statement			X									
Upload Project Completion Verification Form			X									
Upload Electronic Version of Senior Mentor Approved Poster				X								
Print Final Approved Poster				X								
Upload Public Affairs Office Clearance Letter				X								
Register for USU Research Days				X								
Oral Presentation to GSN/USU					X							

Appendix H 17-Step BAC Technique

Steps to performing a Bougie-assisted Cricothyroidotomy

1. Identify necessary materials for BAC: bougie, scalpel, size 6 ETT, larger ETT options, 10cc syringe
2. Provide supraglottic oxygenation, if time permits
3. If space allows, position yourself on the same side of the patient as your dominant hand (Right hand dominant, stand on Right side patient)
4. Palpate up from sternal notch to find cricoid cartilage, and palpate down from mandible to identify the superior margin of thyroid cartilage. Palpate for the cricothyroid membrane (CTM)
5. If time allows, clean neck with sterilizing solution or swabs
6. With your non-dominant hand, stabilize the larynx using thumb and middle finger and palpate CTM with index finger.
7. With scalpel in dominant hand, make a vertical incision from thyroid cartilage to bottom of cricoid cartilage. If no palpable anatomy, extend incision toward sternal notch
8. Palpate through incision to confirm CTM
9. Extend CTM incision laterally in both directions without removing blade
10. Remove blade & insert non-dominant index finger into transverse incision confirming with palpation of tracheal rings
11. With dominant hand, slide bougie into incision space
12. Railroad ETT over bougie until cuff is no longer visible above cricothyroid membrane
13. Remove bougie
14. Inflate Cuff
15. Attach ETT to ET CO₂ and then BVM to confirm tube placement
16. Assess for appropriate tube placement: auscultate both lungs, X-ray if time allows
17. Secure the tube

Appendix I
17-Step BAC Simulation Checklist

Action (1 point per step)	Completed	Not Completed
1. Identified necessary materials: bougie, scalpel, ETT, 10 cc syringe (Not graded)		
2. Provided supraglottic oxygenation (Not graded)		
3. Positioned self on same side of patient as dominant hand (right hand dominant = stand on right side of patient) (Not graded)		
4. Palpated up from sternal notch to find cricoid cartilage and palpated down from mandible to identify thyroid cartilage. Palpated cricothyroid membrane (CTM)		
5. Cleaned neck with sterile solution (Not graded)		
6. Stabilized larynx using thumb and middle finger, palpated CTM with index finger		
7. Made vertical incision from thyroid cartilage to bottom of cricoid cartilage. If unable to palpate, extended excision towards sternal notch		
8. Palpated through incision to confirm CTM		
9. Extended CTM incision laterally in both directions without removing blade		
10. Removed blade, palpates tracheal rings through incision		
11. Slides bougie into incision space		
12. Railroads ETT over bougie until cuff is no longer visible above CTM		
13. Removes bougie		
14. Inflates cuff		
15. Attaches ETT to ETCO2 and BVM to confirm tube placement		
16. Assessed appropriate tube placement: auscultates lungs, ETCO2 waveform, x-ray		
17. Secures tube (Not graded)		

Total Time:

Points (Max 12):

Appendix J
Pre-Education Questionnaire

Hello and welcome to our bougie-assisted cricothyrotomy training video. In this video, we will go over the step-by-step process to perform a bougie-assisted cricothyrotomy. In total there are 17 steps with 3 optional steps which are dependent on time and space. You will be given the option to practice on your own after watching this video.

Step 1: Ensure you have all the necessary supplies. You will need a bougie, scalpel, size 6 ETT with larger ETT options, and a syringe to inflate the cuff.

Step 2: If time permits, provide supraglottic oxygenation.

Step 3: If space allows, position yourself on the same side of the patient as your dominant hand. If you are right hand-dominant, you will stand on the right side of the patient.

Step 4: Palpate up from the sternal notch to find the cricoid cartilage and palpate down from the mandible to identify the superior margin of the thyroid cartilage. Palpate the cricothyroid membrane.

Step 5: If time allows, clean the neck with a sterilizing solution.

Step 6: With your non-dominant hand, stabilize the larynx using your thumb and middle fingers. Palpate the cricothyroid membrane with your index finger.

Step 7: With the scalpel in your dominant hand, make vertical incision from thyroid cartilage to bottom of cricoid cartilage. If you are unable to palpate or differentiate anatomy, extend the incision toward the sternal notch.

Step 8: Palpate through the incision to confirm the cricothyroid membrane

Step 9: Extend cricothyroid incision laterally in both directions without removing blade

Step 10: Remove blade and insert your non-dominant finger into the transverse incision. Palpate the tracheal rings to confirm accurate placement.

Step 11: With your dominant hand, slide the bougie into the incision space.

Step 12: Railroad the endotracheal tube over the bougie until the cuff is no longer visible above the cricothyroid membrane.

Step 13: Remove the bougie

Step 14: Inflate the cuff.

Step 15: Attach the endotracheal tube to end tidal CO₂ and then the bag valve mask to confirm tube placement.

Step 16: Assess the appropriate tube placement; auscultate both lungs and if time allows, obtain an x-ray.

Step 17: Secure the endotracheal tube.

The patient is a 55/M ASA 2 who recently was prescribed an ACE inhibitor. He presented to the ED with angioedema including profound oral swelling/tongue swelling, which has now progressed to total occlusion of the airway. The swelling in the oropharynx and larynx has progressed rapidly and is now preventing tracheal intubation attempts. LMA placement has also failed. The patient is rapidly desaturating with a SpO₂ now at 70%. Two-handed mask ventilation has become impossible. The situation is now at the point where a cricothyrotomy is the best option for a primary airway maneuver for achieving a definitive airway.

**DOCTOR OF NURSING PRACTICE PROJECT
Completion Verification Form**

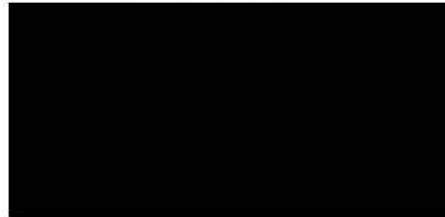
The DNP Project titled: Implementation of a Bougie-Assisted Cricothyrotomy Training Program

was completed at David Grant Medical Center, Travis AFB, CA by the following student(s):

(Student Name)

(Digital Signature)

Gregory Caliwag
Susie Chairez-Rincon
Neil Murray



The DNP Practice Project Team verifies that the following components of the DNP project, accomplished by the above students, is of sufficient rigor and demonstrates doctoral level scholarship to meet the requirements for USUHS GSN graduation:

- Presentation of DNP project to the leadership/stakeholders at the Phase II Site,
- Abstract/Impact Statement (*Appendix F*), and
- DNP Project written report (*Appendix E*).

Verified by:

(type name)

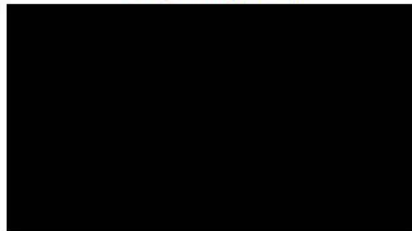
(Digital Signature)

Laura Ransom

Senior Mentor

Julie Petsche

Team Mentor
& Phase II Site Director



For RNA Students only - add the following additional signature for final verification of project completion:

CDR Ken Radford

RNA Project Director *(type name)*

(Digital Signature)

