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Clinical Recommendations for Non-Anesthesia Healthcare Providers Performing Emergency Airway Management Outside the Operating Room

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Clinical Recommendations for Non-Anesthesia Healthcare Providers Performing Emergency Airway Management Outside the Operating Room

by

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Abstract

Emergency endotracheal intubations occurring outside of the Operating Room (OR) are often performed by non-anesthesia providers. At a large, urban, level one trauma center, the current airway management policy for these non-anesthesia providers does not follow best practices based on the literature. Specifically, some non-anesthesia providers are not credentialed and/or privileged to administer neuromuscular blocking agents (NMBAs) during emergency endotracheal intubations. The purpose of this project was to develop evidence-based clinical recommendations for emergency airway management outside of the OR. The following objectives are framed using the Johns Hopkins Evidence-Based Practice (EBP) Model and were established to achieve the projects overall aim: 1) synthesize the evidence around the use of NMBAs during emergency airway management, 2) develop evidence-based recommendations for emergency airway management training, and 3) develop a comprehensive plan on how to enact and monitor recommendations for effectiveness. This project was significant because it provided a blueprint for clinical practice changes that could be adopted and implemented to improve patient outcomes. The project created evidence-based recommendations to optimize outcomes and enhance training for these providers requiring credentialing. In addition, the project included the development of a plan to monitor and measure the recommendations for effectiveness, as well as the development of a plan for adjusting/changing recommendations if identified as ineffective. These plans are outside the scope of the project's academic/curricular timeline and would be implanted by the facility.

Clinical Recommendations for Non-Anesthesia Healthcare Providers Performing Emergency Airway Management Outside the Operating Room

Introduction

Clinical Problem

At a large, urban, level one trauma center, emergent endotracheal intubations occur outside of the Operating Room (OR). These emergency airway intubations can be performed by anesthesia and non-anesthesia providers based on current policy. These policies allow or disallow the use of medications such as neuromuscular blocking agents (NMBAs) by providers, anesthesia vs. non-anesthesia. Based on a recent review of the facility's policies and reports from anesthesia and non-anesthesia provider stakeholders, it was determined the current guidelines for non-anesthesia providers performing emergency airway management are not consistent with the best evidence from the literature.

Currently, not all non-anesthesia providers are credentialed and/or privileged to administer NMBAs for emergency endotracheal intubation procedures. Despite this limitation, these providers are often responsible for responding to and intervening in emergency airway situations. As a result, there is potential for reduced intubation success rates and potential complications of improper airway management, which include, but are not limited to, multiple intubation attempts, airway trauma, failed airway, hypoxia, aspiration of gastric contents, or other airway associated complications (N. Smyke, personal communication, October 20, 2019). Conversations with key stakeholders at the level one trauma center revealed the biggest barrier to credentialing non-anesthesia providers to administer NMBAs is the perception that it would not be safe to do so based on lack of airway management experience (N. Smyke, personal

communication, October 20, 2019; S. West, personal communication, February 28, 2020; and S. Sellers, personal communication, June 18, 2020).

Significance to Nurse Anesthesia

At the large, urban, level one trauma center, when the initial non-anesthesia responding provider to an emergency airway event is unable to secure the airway, it is suggested that they contact an available anesthesia provider. Chrimes et al. (2020) noted although providers of different specialties and hospital locations often practice airway management independently, "they may be called upon to collaborate on short notice in the most challenging circumstances" (p. 1673). If the initial provider used techniques out of best practice in an attempt to secure the airway, the consulting anesthesia provider is left to operate at a disadvantage, placing the patient at a higher risk of experiencing potential airway complications. Chrimes et al. (2020) stressed the importance of standardized practice across all provider disciplines as a way of improving airway management performance and thus outcomes. Although all anesthesia providers at the large, urban, level one trauma center are credentialed and privileged to use NMBAs during airway management, the lack of permission by other providers may directly impact their ability to safely secure an airway when consulted and could result in adverse patient outcomes.

Project Question

The PICO format provides a framework for examining and answering a specific question related to a previously described problem (Melnyk & Fineout-Overholt, 2005). The PICO format was used to provide strategic key search terms to obtain the best evidence in this project. The four components of a PICO question include "population of interest [P], intervention of interest [I], comparison of interest [C], and outcome of interest [O]" (Melnyk & Fineout-Overholt, 2005, p. 29). Based on initial conversations discussing current policy and practice with key anesthesia

and non-anesthesia stakeholders at the large, urban, level one trauma center; the clinical practice-focused question (based on PICO format elements) guiding this project asked: [P] In patients who require emergency airway management outside of the OR how does the [I] use of NMBAs compared to [C] the non-use of NMBAs affect the [O] intubation success rates and potential complications?

Review of Literature

The literature review for this scholarly project focused on NMBA use and endotracheal intubation placement and complications. It was guided by key search terms and developed using the previously described PICO question. The OneSearch feature, available through the Otterbein University Library, was utilized to facilitate the literature search. The OneSearch feature retrieves article references available through OhioLink databases and provides the ability to select and search multiple databases at the same time. OneSearch includes 26 databases related to the subject of 'Medicine & Health', all of which were included for this review. These databases include Academic Search Complete, AHFS Consumer Medication Information, Alt HealthWatch, APA PsycINFO, BIOSIS Citation Index, CINAHL Plus, Cochrane Library, Consumer Health Complete, Consumer Health Reference eBook Collection, Food Science Source, Fuente Academica, Health Source: Consumer Edition, Health Source: Nursing/Academic Edition, Kanopy, MedicLatina, MEDLINE, Natural & Alternative Treatments, Oxford Reference Online, ProQuest Nursing and Allied Health, Psychology and Behavioral Sciences Collection, PubMed, Science Direct, Springer Nature Experiments, USP DI Advice for the Patient, Web of Science Core Collection, and Wiley Cochrane Library (*Onesearch: How to Use*, 2020). Patients requiring emergency endotracheal intubation are cared for by a multiple medical and nursing disciplines and the inclusion of many medicine and health

related databases was chosen to ensure adequate representation. In addition, the search was limited to scholarly (peer reviewed) journals to ensure the information obtained was subject to scrutiny from other medical and nursing experts. The specific terms used to guide the search included: (‘Protocol’ or ‘Guideline’ or ‘Best Practice’) AND (‘rapid sequence induction’ or ‘rapid sequence intubation’ or ‘RSI’ or ‘intubation’ or ‘endotracheal intubation’ or ‘insertion of an endotracheal tube’) AND (‘neuromuscular blocking agent(s)’ or ‘neuromuscular blockade agent(s)’ or ‘NMBA(s)’ or ‘paralytic(s)’).

The literature search yielded nine articles that were selected for review including: one systematic review of 34 randomized controlled trials (RCTs), one RCT, five prospective observational studies, and two published guidelines developed from literature review and consultation with airway experts. These nine articles were selected for inclusion due to their quality, content (direct comparison of using a NMBA vs. no use of NMBA, or general guideline for emergency endotracheal intubation), and content specific to out-of-OR settings. Literature was excluded if the information was published greater than 15 years ago.

Synthesis/Review of the Literature

Guidelines

The literature search identified two articles that provided general guidelines for emergent endotracheal intubation based on an extensive review of literature and consultation with airway experts. Quintard et al. (2019) consulted with nineteen airway management experts and determined that all were in strong agreement to recommend the use of a NMBA for emergency endotracheal intubation in Intensive Care Units (ICUs) as a standard practice guideline. Higgs et al. (2018) recommended the use of a NMBA for emergency endotracheal intubation in any setting in order to improve airway conditions, reduce the number of intubation attempts, and

reduce associated complications. Both of the identified guidelines incorporated data from the last decade and considered out-of-OR intubation settings in formulating the recommendation of NMBA use for endotracheal intubation. Both guidelines were published with the intent of helping to guide and inform clinical practice.

Use of NMBA vs. Non-use of NMBA

The literature search identified seven articles that compared the use of a NMBA and non-use of a NMBA for airway management. As noted above, the identified guidelines for emergent endotracheal intubation recommended use of a NMBA; and as such, these seven articles were reviewed in detail to determine if the literature indicates differences in patient outcomes when use or no use of a NMBA is utilized. The review identified difficult intubation and first attempt intubation success rates as the primary outcome measures for comparing use of NMBAs vs. no use for endotracheal intubation.

Difficult Intubation or Laryngoscopy

Various definitions or difficult intubation or laryngoscopy conditions exist and are individually defined within studies; however, common themes throughout the literature were identified. These themes include use of the Cormack and Lehane score, identification of intubation-related complications, poor jaw relaxation, and vocal cord closure noted during laryngoscopy. Lundstrøm et al. (2018) performed a systematic review of 34 randomized control trials (RCTs) comparing the use of NMBA versus no NMBA prior to intubation. The review concluded that in patients undergoing tracheal intubation without the use of a NMBA, 56.3% experienced a difficult tracheal intubation (DTI), versus only 4.7% of patients having DTI when a NMBA was used. DTI can cause serious soft tissue damage, hypoxic death, and brain damage in relation to anesthesia. Wilcox et al. (2012) noted use of a NMBA for induction of anesthesia,

as compared with no use of NMBA, resulted in a significantly better laryngeal view with lower Cormack-Lehane grade. In addition, it was identified that use of NMBAs were associated with a significant decrease in airway-related complication rate (3.1% vs. 8.3%), including esophageal intubations, traumatic intubations (visible blood), and aspiration noted during airway management. Nagelhout and Elisha (2018) detailed the Cormack and Lehane score is an objective grading system used by clinicians to assess view of pharyngeal and glottic structures during laryngoscopy. Grades I and II are associated with easier intubation, whereas grades III and IV indicate higher intubation difficulty. Higher difficulty with intubation can increase the amount of time it takes to obtain a secure airway and result in patient hypoxia. Jiao and colleagues (2014) compared the use of propofol and remifentanil, vs. the use of propofol, remifentanil, and succinylcholine (a NMBA) for anesthesia induction prior to intubation. The study concluded that with use of a NMBA, 3.7% of intubation conditions were graded as poor, which was significantly lower than the 44.44% of intubations graded as poor without use of a NMBA. Intubation conditions were graded as poor if the provider experienced difficult laryngoscopy with poor jaw relaxation, or if the provider noted the patient's vocal cords were closing or closed during the intubation procedure. Results consistently identified use of NMBA prior to intubation with creating a better laryngeal view and less difficult intubation conditions for the provider performing airway management, which also led to faster securement of an airway and less intubation related complications.

First Attempt Intubation Success

Several studies were identified that utilized first attempt intubation success rates as the primary outcome for comparing use of NMBA vs. no NMBA (sedation only) prior to intubation. One study identified an attempt as "a single insertion of the laryngoscope, which was successful

if it resulted in an endotracheal tube being placed through the vocal cords" (Sagarin et al, 2005). This definition was consistent others identified literature. First attempt success is important in preventing negative patient outcomes as it has been shown that each successive intubation attempt after the first increases the rate of intubation related complications. Sagarin et al. (2005) reviewed intubations performed in the Emergency Department (ED) setting and excluded those that were performed by physicians in anesthesia. Intubations performed with an NMBA were successful on the first attempt in 85% of cases versus the first-attempt success rate for intubations with sedation only were 72%. Additional studies observing non-anesthesia intubators in the ED were consistent with these findings; first-attempt success rates were higher with the use of an NMBA as compared to sedation only (Okubo et al., 2017; Brown et al., 2015). A separate study, specific to intubations performed in the Intensive Care Unit (ICU) found first attempt intubation success was significantly higher in patients intubated using an NMBA (80.9%) compared with those intubated without an NMBA (69.9%) (Mosier et al., 2015). The success of intubations on first attempt appears consistent across different out-of-OR settings.

A breadth of high-quality evidence was identified that indicated the use of a NMBA to facilitate endotracheal intubation results in better patient outcomes following the need for emergency endotracheal intubation. The collective literature suggested the use of a NMBA prior to endotracheal intubation created better views and less difficult intubation conditions for the provider performing airway management, which resulted in less intubation related complications for patients. Additionally, the summative findings suggested use of a NMBA prior to endotracheal intubation results in higher first attempt success rates, which reduces intubation related complications. Of note, none of the identified studies suggested the non-use of NMBAs to improve intubation success rates and/or reduce complications. Additionally, none of the

studies differentiated the use or non-use of NMBAs between provider types (e.g. anesthesia, non-anesthesia, advanced practice nurse, or physician).

Adverse Effects NMBAs

Although the collective identified studies did not find advantage in avoidance of NMBAs for emergent endotracheal intubation, there are notable adverse effects with the use of these medications. Nagelhout and Elisha (2018) detailed two NMBAs commonly used for emergent endotracheal intubation: 1) succinylcholine and 2) rocuronium. Both of these medications cause paralysis, including relaxation of the vocal cords, which renders the patient unable to protect their own airway. Following administration of succinylcholine, paralysis persists for 5-15 minutes. Side effects of the medication include hyperkalemia, myalgia, increased intracranial pressure (ICP), and increased intraocular pressure (IOP); additionally, no reversal agent exists. Following administration of rocuronium, paralysis persists for 30-60 minutes. Side effects of the medication include histamine release which can vasodilate, lower blood pressure, and potentially cause anaphylaxis reactions. Traditionally, anticholinesterase agents have been utilized to reverse rocuronium, however; they are unable to reverse deep blockade and are not effective when utilized for urgent or emergent reversal of large doses of NMBAs (i.e. doses utilized for endotracheal intubation). Based on discussions with anesthesia and non-anesthesia providers at the hospital site, it was noted that the lack of ability to immediately reverse the effects of NMBAs following administration is a common concern when determining the safety of credentialing non-anesthesia providers to administer these medications. If the airway was unable to be secured by the provider following administration of a NMBA, patients could suffer hypoxia due to lack of secure airway and inability to provide adequate ventilation (N. Smyke, personal

communication, October 20, 2019; S. West, personal communication, February 28, 2020; and S. Sellers, personal communication, June 18, 2020).

Sugammadex

Murphy (2016) described Sugammadex as a novel drug that can be used effectively and immediately reverse deep neuromuscular blockade produced by rocuronium. Sugammadex was approved for use in the US in December 2015 and was added to the formulary at the hospital site in the Spring of 2016; however, it was determined that not all intubation related policies have been reviewed or updated since this date. Also, not all hospital units stock the medication. The immediate reversal capability of Sugammadex could change the risk associated with administering NMBAs during emergent endotracheal intubation; however, further review of the literature is warranted.

Summary of Literature

In summary, NMBAs are medications that cause paralysis, including paralysis of the vocal cords and muscles of ventilation. When used, NMBAs may carry negative side effects, and leave patients unable to spontaneously ventilate and unable to protect their own airway. In situations where a NMBA is administered and the provider is unable to intubate or ventilate, the patient could suffer from hypoxia due to lack of secure airway. Despite the potential complications associated with NMBA use, the literature suggests use of a NMBA to facilitate endotracheal intubation results in increased first attempt success rates, decreased airway complications; and therefore, better patient outcomes following the need for emergency endotracheal intubation.

Project Purpose

Project Purpose

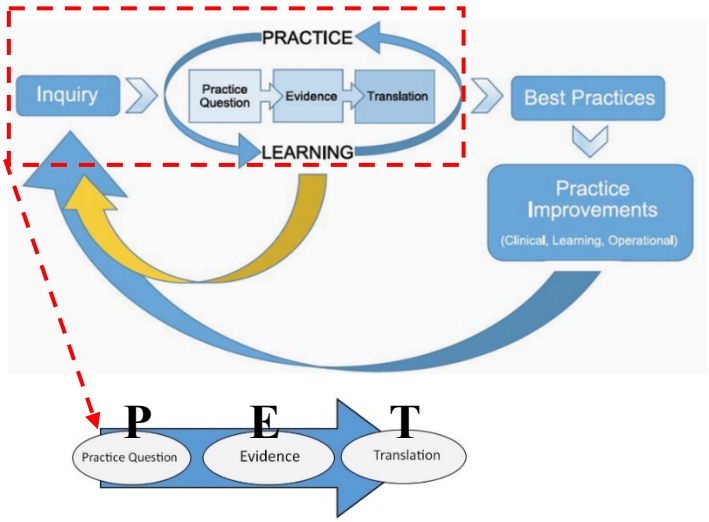
The purpose of this project (which was framed using the Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) model) was the development of clinical recommendations for emergency airway management. The recommendations address the concern of attempting intubation without the use of a NMBA despite substantial evidence from the literature indicating otherwise. When NMBAs are not used to facilitate endotracheal intubation outside of the OR setting, there is an increased risk for multiple intubation attempts, airway trauma, failed airway, hypoxia, aspiration of gastric contents, or other airway associated complications. The biggest barrier to credentialing and/or privileging non-anesthesia providers in the use NMBAs during emergency endotracheal intubation was determined to be the assumption that it is not safe due to lack of experience. The focus of this project was the creation of evidence-based recommendations to optimize outcomes and enhance training for these providers requiring credentialing. In addition, the project included the development of a plan to monitor and measure the recommendations for effectiveness, as well as the development of a plan for adjusting/changing recommendations if identified as ineffective. These plans would be implemented by the facility as they are outside of the project's academic/curricular timeline. Based on the proposal-type nature of this project, internal review board (IRB) exemption status was granted (refer to Appendix E).

Evidence Based Practice Framework

Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) Model. The Johns Hopkins Evidenced Based Practice Model served as the guiding framework for this project, and was used with permission obtained from the Johns Hopkins University School of Nursing

(Appendix A). The JHNEBP model is an approach to clinical decision making and problem-solving that involves utilizing an initial three step process called, 'PET' to facilitate the successful implementation of current evidence-based literature from inquiry into practice: 1) Practice question, 2) Evidence, and 3) Translation (Dang & Dearholt, 2017). The aim of this model is to help lead nurses and clinicians through a path of inquiry, development, and eventual translation of the best evidence into patient care practices (Johns Hopkins Nursing EBP, n.d.) Therefore, the JHNEBP Model PET process was selected as an appropriate fit to guide and support the purpose of this project. Figure 1 depicts and describes each step of the JHNEBP Model from Inquiry through the PET Process.

Figure 1. ***The Johns Hopkins Nursing Evidence Based Practice Model PET Process***



Note: © The Johns Hopkins Hospital/Johns Hopkins University School of Nursing. (2017). *Johns Hopkins Nursing Evidence Based Practice Model* [Image].

JHNEBP Model: Inquiry. Clinical inquiry is the starting point of the JHNEBP framework. As a conceptual foundation for nursing practice, inquiry involves a persistent effort to question, examine, and collect information about a problem, an issue, or a concern. Issues prompting inquiry can arise from a multitude of sources, including patient satisfaction, wide

variation in practice, and a lack of EBP (Dang & Dearholt, 2017). Inquiry is the process to identify the scope of the problem and opportunity for improvement. EBP inquiry includes knowing current practices, following steps to identify issues, and gathering evidence to address the issues (John Hopkins Hospital, 2017). Clinical inquiry was initiated by reports from key stakeholders at the hospital site. The initial inquiry revealed varied clinical practices surrounding medication administration to facilitate emergency airway management and endotracheal intubation. Discussions with stakeholders identified that varied practice stemmed from the inability of some providers to use NMBAs due to clinical credentialing and/or privileging practices. NMBA use has been shown to facilitate emergent endotracheal intubation, decrease complications associated with this procedure, and increase the rate of successful placement of the endotracheal tube on the first attempt. Due to the gap between clinical practice and best practice as evidenced within the literature, an opportunity to make recommendations to update current clinical practice existed.

JHEBP Model PET Process Step 1: Practice Question. Based on the literature, successful intubation with use of NMBAs is preferred for emergency airway management. Not all non-anesthesia providers responsible for performing emergency intubations were permitted to utilize NMBAs despite substantial evidence that this was best practice. As a result, patients may have been at increased risk for multiple intubation attempts, airway trauma, failed airway, hypoxia, aspiration of gastric contents, or other airway associated complications. The initial inquiry and the following practice question helped to define and focus the clinical problem. The first phase of the JHNEBP PET process began with the identification of a practice problem, from which a practice question was developed and refined to guide the search for evidence. The practice question phase of the JHNEBP model, utilized a six-step process that aided in the

development of the project's foundation. In this phase, an interprofessional team was recruited and the problem was defined. The practice question then helped guide the next step, the search for evidence (Dang & Dearholt, 2017). The following EBP question using PICO format was developed for use in phase one: [P] In patients who require emergency airway management outside of the OR how does the [I] use of NMBAs compared to [C] the non-use of NMBAs affect the [O] intubation success rates and potential complications? The interprofessional stakeholder team was identified and approached with questions during the inquiry phase in an attempt to better define the problem. This increase in clarity of the clinical problem helped develop a highly relevant practice question and search terms as previously described. The identified key stakeholder team comprised of anesthesiologists, Certified Registered Nurse Anesthetists (CRNAs), hospital medicine services (HMS) and family medicine services (FMS) attending physicians, and critical care nurse practitioners (NPs) who work in the Intensive Care Unit (ICU) and Emergency Department (ED). The inclusion of these types of providers across multiple disciplines and subspecialties promoted a more comprehensive understanding of the issue and development of the practice question. This helped guide the search, review, and synthesis of all available evidence within the organization and research literature. The development of recommendations for airway management outside of the OR, using the best evidence from clinical research literature, served as an opportunity to optimize patient care and reduce practice variations through interprofessional collaboration.

JHEBP Model PET Process Step 2: Evidence. Phase two, the evidence phase of the JHNEBP PET model, utilized a five-step process that aided in the facilitation of a thorough literature search. The step involved the project team searching for evidence and bringing the items back for review (Dang & Dearholt, 2017). Types of evidence that can be used are as

follows: “research studies; EBP practice guidelines; quality improvement data; position statement from professional organizations; opinions of internal and external experts; regulatory, safety, or risk management data; community standards; or patient survey and satisfaction data” (Dang & Dearholt, 2017, p 44).

Internal evidence. Following reports and information obtained during informal meetings with stakeholders, a search for internal evidence in the form of a hospital policy search was conducted using the search function within the Compliance 360 system. Compliance 360 is a cloud-based platform that helps organizations create, organize, and manage policies and procedures. All policies are stored in a unified repository, allowing employees to search for and access them at anytime from anywhere (SAI Global, 2016). The endotracheal intubation policy within the healthcare system for the hospital was located using Compliance 360.

The Rapid Sequence Intubation (RSI) policy for the large, urban, level-one trauma center was the policy that specified which providers can utilize NMBAs to facilitate intubation. The policy was created in April 2007 and last reviewed in May 2018 with the effective date in October 2018. The policy did not include physicians from Family Medicine Services (FM) and Hospital Medicine Services (HMS); however, discussions with key stakeholders indicated that these physicians are sometimes responsible for performing emergency airway management. Additionally, the policy indicated trauma and critical care NPs can only perform rapid sequence intubation with use of an NMBA with proper credentialing.

A separate policy existed detailing the requirements for trauma and critical care NPs to become credentialed in the use of NMBAs to facilitate endotracheal intubation. The policy specified that eleven (11) endotracheal intubations must be performed without the use of NMBAs first, under the direct supervision of an attending trauma surgeon, attending critical care

physician, or a currently credentialed resident physician (PGY4 or higher). Once these initial 11 endotracheal intubations were performed, an additional five intubations using NMBAs needed to be performed under this same direct supervision. Based on conversations with key stakeholders, it was noted that in addition to having trouble meeting these specific number requirements, another issue is the designated direct supervision individuals are not always present when trauma and critical care NPs are required to perform emergent endotracheal intubation (e.g. overnight hours). This created a situation where the NPs resort to performing the procedure without use of a NMBA and also miss out on an opportunity to move forward in the credentialing process.

The literature stated the best practice is to administer a NMBA to facilitate the procedure, but current policy prevented these providers from becoming credentialed to do so in an efficient manner. Additionally, the resources cited in the policy were outdated, published more than 10 years ago, and did not necessarily reflect the recommendations supported by current literature. As previously discussed, conversations with key stakeholders at the level-one trauma center revealed the biggest barrier to changing this policy related to credentialing was the fear of non-anesthesia providers lacking the appropriate experience to use NMBAs safely (N. Smyke, personal communication, October 20, 2019; S. West, personal communication, February 28, 2020; and S. Sellers, personal communication, June 18, 2020). This fear, coupled with the facility policies not aligning to the best practices evidenced in the literature, further compounded the potential unnecessary risk for airway complications and adverse outcomes.

External evidence. An extensive search of the current literature revealed compelling evidence that the use of an NMBA to facilitate emergent endotracheal intubation results in better patient outcomes. Collectively, the literature indicated that administration of a NMBA prior to endotracheal intubation creates better laryngoscopic views and easier intubating conditions for

the provider managing and attempting to secure the airway. Additionally, the findings suggested using a NMBA prior to endotracheal intubation results in higher first attempt success rates. All these factors are associated with a reduction of intubation-related complications. Furthermore, no identified studies suggested that the non-use of NMBA provided improved intubation success rates or reduced complications. Also, no identified studies differentiated outcomes of use of NMBAs by provider type (e.g. anesthesia vs. non-anesthesia). Lastly, the availability of Sugammadex, starting in 2016, significantly impacted the potential use of NMBAs because it is capable of rapidly and completely reversing the neuromuscular blockade produced by selected NMBAs.

The details of the evidence can be found in the literature review section. Published, peer-reviewed studies were appraised using the Johns Hopkins Nursing Evidence-Based Practice Synthesis and Recommendations Tool. Based on the appraisal of the external evidence, a Literature Synthesis Table was developed and is included for review in appendix B.

JHEBP Model PET Process Step 3: Translation. Phase three, the translation phase of the JHNEBP model, utilized an eight-step process that aided in the facilitation of project. In this third step of the JHEBP Model, the project team should study the feasibility of changes for the targeted setting to produce an action plan (Dang & Dearholt, 2017). The development of recommendations for emergency endotracheal intubation at a large, urban, level-one trauma center are outlined below and include plans to monitor and measure the recommendations for effectiveness. The development of a plan for adjusting/changing recommendations if identified as ineffective is also included. The collective evidence and developed recommendations were summarized in the form of a poster presentation for review by key stakeholders at the hospital site. The project team's successful execution of the third step of the JHEBP Model was then set

forth for recommending practice improvement and emergency airway management recommendations. The next phase, practice improvement, will be achieved by disseminating and implementing best practices to improve outcomes for people receiving services (Foreman-Hoffman el al., 2017). This final phase can be achieved in the future by the hospital site who has the authority to implement emergency airway management practice changes to improve provider practice in the use of NMBAs during situations requiring emergent endotracheal intubations.

Project Objectives

The following objectives were framed using the Johns Hopkins Model for EBP and have been established to achieve the project's overall aim:

1. Synthesize the evidence around the use of NMBAs during emergency airway management (refer to the literature review section)
2. Develop evidence-based recommendations for emergency airway management training
3. Develop a comprehensive plan on how to enact and monitor recommendations for effectiveness

Development and Implementation of Recommendations

As discussed in detail above, the literature suggested the use of a NMBA to facilitate endotracheal intubation potentially resulting in increased first attempt success rates, decreased airway complications; and therefore, better patient outcomes following the need for emergency endotracheal intubation. As such, the first recommendation for emergency airway management at the large, urban level-one trauma center was:

1. *Allow all non-anesthesia providers the opportunity to become credentialed in the use of NMBAs. This includes NPs, HMS, and FMS physicians.*

In order to ensure these non-anesthesia providers maintain the appropriate skillset to safely administer NMBAs and are able to become credentialed in their use in a timely manner; the following additional recommendations were created:

2. *All providers performing emergency endotracheal intubation outside of the OR should use video laryngoscopy*
3. *Providers should receive standardized emergency airway training with specific focus on use of video laryngoscopy and real-world experience that allows for timely credentialing*

The recommendations are summarized in a one-page bullet included in Appendix C.

Recommendation 2: Use of Video Laryngoscopy

A wide breadth of evidence was identified that the use of video laryngoscopy is the safest technique for emergency airway management. Similar to the various pharmacological options available to facilitate endotracheal intubation (NMBA vs. no NMBA), variability exists in methods available to properly place an endotracheal tube. Nagelhout and Elisha (2018) stated that the two most common techniques for placing endotracheal tubes are direct laryngoscopy and video laryngoscopy. Direct laryngoscopy involves placing a blade with a light at the tip into the patients mouth, and sweeping the tongue left and out of view. This technique allows for direct visualization of the larynx provided the oral, laryngeal, and pharyngeal axes are able to be aligned through neck flexion and head extension of the patient. Video laryngoscopy involves placing a specialized blade with a camera tip into the patients mouth, moving directly midline down the tongue. This technique involves the camera transmitting the live picture to a screen, where the provider can then visualize the larynx externally. This technique does not require oral, laryngeal and pharyngeal axis alignment in order to visualize the glottic opening.

Nagelhout and Elisha (2018) described the following:

- Video-assisted laryngoscopy provides improved visualization of the larynx over standard laryngoscopy. Video laryngoscopy can be learned quickly, and has several advantages:
    - Magnification of the airway allows the operator to visualize structures in greater detail.
    - Blade design and anterior angulation, along with placement of the video camera on the distal portion of the blade, permit the operator to visualize structures that would otherwise be difficult or impossible to see under direct laryngoscopy.
    - The external monitor allows other practitioners to visualize airway anatomy and understand current airway conditions.
    - The recording capabilities allow for education, documentation, and research (p. 429).

Rombey, Schieren, and Pieper (2018) performed a systematic review and meta-analysis of randomized controlled trials (RCTs) evaluating the use of video laryngoscopy as compared with direct laryngoscopy (direct laryngoscopy is the conventional method for securing the airway during endotracheal intubation). Video laryngoscopy was found to reduce the number of intubation attempts and the rate of esophageal intubation. Parmekar et al. (2017) noted in learners, direct laryngoscopy requires the teacher and trainee to rely on verbal feedback from each other, rather than the visual confirmation obtained when using video laryngoscopy. They observed that trainees taught to use video laryngoscopy versus direct laryngoscopy had higher success rates in endotracheal intubation. Arulkumaran, Lowe, Ions, Mendoza, Bennett and Dunser (2018) performed a systematic review and meta-analysis evaluating video laryngoscopy vs. direct laryngoscopy and did not note a significant difference between first-pass success rates, except with new trainees and more novice providers the first-pass success rate was higher. This

supports the use of video laryngoscopy by non-anesthesia providers, who by nature of their work do not gain as much experience in endotracheal intubation as compared with their anesthesia colleagues.

The main advantage of the video laryngoscope is increased first-attempt success by providing optimal visualization, particularly for new trainees and novice providers. This makes video laryngoscopy the ideal choice for intubation outside of the OR. Therefore, it was recommended that non-anesthesia providers at the large, urban, level-one trauma center performing emergency airway management outside of the OR utilize video laryngoscopy when using NMBAs to facilitate endotracheal intubation.

Recommendation 3: Standardized Training

Conversations with key stakeholders at the large, urban, level-one trauma center identified a main barrier to the credentialing of providers for the use NMBAs for emergency intubations was a lack of confidence in provider skillset due to lack of training and experience in advanced airway management (N. Smyke, personal communication, October 20, 2019; S. West, personal communication, February 28, 2020; and S. Sellers, personal communication, June 18, 2020). Renew et al. (2020) noted endotracheal intubation in the ICU, an out-of-OR location, was often more difficult as compared with the OR, a typically more controlled environment. Despite this increased challenge, it was reported that about 40% of intubating providers in the ICU do not feel proficient in the clinical skill, with 20% stating they only received basic training such as "lectures or observation" (p. 2-3). Brown et al. (2020) noted in pulmonary and critical care trainees, the number of procedures, types of experiences, and the training methodology for endotracheal intubations varies greatly between training programs across the United States (US).

Based on these findings, there is a need for standardized training for non-anesthesia providers performing endotracheal intubation with NMBAs and video laryngoscopy.

Conversations with key stakeholders at the large, urban, level-one trauma center revealed the Glidescope is the brand of video laryngoscope widely available within the hospital. Brown et al. (2020) noted "observation of expert demonstration of expected goal behaviors and performance" was identified as improving technical skills of trainees in neonatal resuscitation, and was proposed as an effective method for effectively teaching endotracheal intubation (p. 2). It is recommended that a video lecture be created detailing the process for induction of anesthesia with NMBAs and step-by-step instructions on video laryngoscopy as indicated by the Glidescope manufacturer operations manual. The key steps to be included in the developed lecture are included for review in appendix D (Verathon, 2018).

Sun, Pan, Li, and Gan (2017) performed a systematic review and meta-analysis comparing the effectiveness of simulation-based training for airway management versus non simulation-based training on learner and patient outcomes. The review determined simulation-based training was associated with improved behavior performance and increased trainees' interest and satisfaction. Bambini, Washburn and Perkins (2009) evaluated simulated clinical experiences as a learning method and determined students experienced a significant increase in confidence and identified simulation as a valuable experience. The airway management training program should include several simulated experiences where the trainee will perform endotracheal intubation with the glidescope, facilitated by pharmacologic agents that include the use of a NMBA.

Brown et al. (2020) noted "deliberate practice-intentional sequential experiences with expert observation and immediate feedback has been shown to improve learner and patient

outcomes in…as well as endotracheal intubation" (p. 2). Conversations with key stakeholders at other hospitals within the same health care system as the large, urban, level-one trauma center identified that non-anesthesia providers gain experience on endotracheal intubation in the controlled environment of the OR under the direct supervision of an anesthesiologist or CRNA. This should be implemented as part of the airway management training program and could be included in the credentialing policy to count toward experience numbers. This would assist non-anesthesia providers in becoming credentialed in a timelier manner, and provide real hands-on experience with direct feedback.

It was recommended that a combination of video lecture, simulation, and real-time experience be implemented as required airway training elements for non-anesthesia providers to become credentialed in the use of NMBAs to facilitate endotracheal intubation with a video laryngoscope. The combination of these methods would improve provider theoretical understanding and technical skillset in emergency airway management. Of note, opportunities exist in other areas of airway management training, such as optimizing patient status prior to intubation and use of other difficult airway adjuncts to secure the airway in emergency situations. While this review focuses on use of NMBAs and video laryngoscopy, there is potential to expand recommendations in the future to other areas of opportunity.

Updating hospital policy

At the large, urban, level-one trauma center; hospital policies need reviewed for non-anesthesia physicians and advanced practice providers. Existing policy should be updated to require use of the Glidescope to facilitate intubations outside of the OR. Standardized training should be a mandate and training intubations that occur within the OR should count towards experiences required as part of the credentialing process. In order to move hospital leadership

towards a policy change, a PPT presentation including an overview of the problem and current best evidence from the literature was created using the SWOT briefing format. According to Moran (2018), SWOT analysis is a process of identifying a company's Strengths, Weaknesses, Opportunities, and Threats. The analysis assessed internal and external attributes to the area of interest, in this case, emergency airway management outside of the OR. The analysis provided an overview of the current situation and potential outcomes that could occur if changes were not made. The SWOT briefing format was ideal because it has the ability to highlight potential poor patient outcomes and catastrophic events that may occur as a result of current policy not aligning with evidence-based best practice.

The audience for the presentation should include all stakeholders in emergency airway management and quality improvement team members that have the ability to review, refine, adopt, and implement policy changes. In addition, interactions with leadership during SWOT briefings should involve discussions of strategies for education and resource allocation to support the implementation of policy change (Foreman-Hoffman et al., 2017). At the large, urban, level-one trauma center, policy changes related to airway management are required to go through a formal review by the critical care process improvement team (CCPIT) and medical executive committee (MEC). With future implementation outside the scope of this project, the final step in enacting these recommendations would be to formally initiate the policy change process by presenting to both of these committees.

Monitoring Outcomes of the Recommendations

If the recommendations were enacted, a process for monitoring the effectiveness of recommendations must be enacted. Moran (2018) noted monitoring of data ensures safety to subjects and allows for further refinement and/or plan adjustment. Monitoring following

implementation of the aforementioned recommendations should include 1) tracking intubation data via chart audit and 2) assessing airway training effectiveness via surveys and yearly follow-up.

Tracking Data

Hickey and Brosnan (2016) noted chart audits help detect trends that warrant further study. In order to evaluate the effectiveness, or lack thereof, of the recommendations, the following data should be collected: neuromuscular blocking agent (NMBA) privileges of provider, medications and associated amounts given to patient to facilitate intubation, number of intubation attempts made, and identified airway related complications following intubation (airway trauma, failed airway, hypoxia, aspiration of gastric contents, or other). In addition, patient demographics such as age, height, and weight; and intubation event data such as time and location should also be included in the audit. All of this information would be collected from the electronic medical record (EMR). In order to collect data associated with airway related complications, chart data would need to be collected on a case-by-case basis. Patient vitals, orders during and after intubation, overall length of stay, and other relevant data would need to be identified individually depending on the patient's course of stay.

Data collected from patient EMRs would need to be continuously evaluated and should be summarized and presented to the CCPIT committee for continuous quality improvement. If, at any time, an increase in patient deaths or catastrophic events is noted through review of data, all implemented recommendations should be stopped and clinical practice should be reverted back to pre-implementation methods. Trends should be assessed with the following outcome goals in mind:

- Increase in first-attempt intubation success rates

- Reduction in airway trauma events
- Reduction in number of failed airways
- Reduction in hypoxic time during airway management
- Reduction in aspiration of gastric content events

If the opposite trend is noted for any of these outcomes (e.g. there is an increase in aspiration events), the CCPIT committee should meet to review the data and determine if the recommendations should continue, be modified, or stopped altogether. If the recommendations are implemented and maintained for a full year, the CCPIT committee should evaluate other outcomes that could be improved through additional changes to clinical practice.

Assessing airway training effectiveness

In order to assess the effectiveness of the airway training program, a combination of surveys and yearly interview follow-up should be implemented. For providers who participate in the airway training program, a focused assessment should be administered pre and post training to assess knowledge level. The outcome goal would be an increase in knowledge related to emergency airway management and use of the Glidescope. Knowledge assessment results should be analyzed using descriptive statistic tools available through Microsoft Excel, such as mean, median, range and standard deviation. This allows for evaluation of the percentage and frequency of respondents who answered questions correctly or incorrectly; and allows for comparison of answers pre and post training. Descriptive statistics offer the most informative picture of characteristics within a population (*Descriptive Statistics*, 2019). If it is determined that knowledge related to emergency airway management and Glidescope use did not improve, an evaluation of the program should be performed to determine what changes can be made to improve future outcomes.

In order to assess longevity and obtain feedback on the usefulness of training in applying it to real-time clinical situations, yearly follow-up and check-in with participants should be performed. Schneider et al. (1996) detailed high validity in employee reports of their own experiences and identified the experience data as useful in evaluating the success of new strategies for policy and practice change. This feedback should be included for discussion at CCPIT committee reviews, where stakeholders can use the information to make decisions about training going forward.

Project Timeline and Budget

Timeline

Implementation of the three proposed recommendations was estimated to take approximately six months. As previously discussed, a presentation using the SWOT briefing format was used to move hospital leadership towards a policy change to allow non-anesthesia providers to administer NMBAs, and to require the use of video laryngoscopy during emergency airway management. An estimated three months was required to develop and present the briefing to appropriate hospital leadership. An additional three months was estimated to allow hospital leadership to cycle policy changes through formal review by CCPIT and MEC. A six-month total period would allow for reviewed and approved changes to be implemented as new official policy.

The development of standardized emergency airway training with a focus on the use of video laryngoscopy was estimated to take approximately three months. As previously discussed, training should include a combination of video lecture, simulation, and real-time experience. An additional three months was estimated to plan and organize location, required training resources, and attendee list. A six-month total period would allow for appropriate content creation with a

planned and organized rollout for emergency airway management training. The processes for updating hospital policy and roll-out of standardized airway training could be performed simultaneously.

Figure 2. ***Sample Timeline.***

Budget

Costs associated with the implementation of recommendations include labor hours for training, simulation laboratory time for training, and purchasing of additional video

laryngoscopes. Labor costs include matching the established hourly pay for anesthesia providers creating and facilitating training, as well as hourly pay for non-anesthesia providers taking the training and gaining real-time experience inside the OR. The estimated hourly wage rate (excluding benefits) for each provider type is included in Table 1.

Table 1. ***Estimated Hourly Wage Rates.***

Provider Type	Estimated Hourly Wage Rate (www.salary.com)
CRNA	$93
Critical Care NP	$55
Non-Anesthesia Physician	$110

An estimated 20 providers from the trauma center would need to take the training once per year (10 Critical Care NPs and 10 non-anesthesia physicians). Estimated requirements for airway training include one hour of video lecture led by one CRNA, three hours of simulation training led by three CRNAs, and four hours of OR time to gain real experience. A breakdown of cost is included for review in Table 2. The estimated total for labor costs was expected to be around $14,000.

Table 2. ***Estimated Time and Labor Costs.***

Project Expense	Time and Labor	Estimated Cost
Video Lecture	*Leader:* One hour x one CRNA	$93
	Attendees: One hour x 10 NPs x 10 non-anesthesia physicians	$1,650
Simulation	*Leader:* Three hours x three CRNAs	$837
	Attendees: Three hours x 10 NPs x 10 non-anesthesia physicians	$4,950
OR Airway Experience	Four hours x 10 NPs x 10 non-anesthesia physicians	$6,600

Estimated Total Labor Costs	***$14,130***

As stated above, airway training would be estimated to include three hours of simulation time. The cost of reserving the medical simulation laboratory is $100/hour, with an additional $50/hour fee for airway specific mannequins and equipment (personal communication, January 26, 2022). Two sessions (three hours each) would be required to accommodate 20 providers (10 providers per session). The estimated total for renting the medical simulation lab is about $900.

Through conversations with key stakeholders, it was determined the intensive care units (ICUs) and the Emergency Department (ED) at the large, urban, level on trauma center previously purchased and maintained multiple GlideScope video laryngoscopes. It is estimated the hospital would need to purchase an additional five GlideScope video laryngoscopes for use in other care units to implement the suggested recommendations. Taylor et al. (2021) noted the cost of a full GlideScope unit (blade, stylet, video screen, and other equipment) is about $12,000. The estimated total for purchasing five new units is about $60,000. Using the aforementioned estimates, a total budget of about $75,000 would be required to implement the emergency airway management recommendations.

Conclusion

Endotracheal intubation is an advanced life-saving procedure performed in response to an airway emergency. The procedure may be performed with or without the administration of NMBAs. Current policy does not permit all non-anesthesia providers responsible for performing emergency intubations with the ability to utilize NMBAs despite substantial evidence that this is best practice for patient outcomes. As a result, patients may be at increased risk for multiple intubation attempts, airway trauma, failed airway, hypoxia, aspiration of gastric contents, or

other airway associated complications. Based on conversations with key stakeholders and a review of literature, the following recommendations were created in response to current policy:

1. Allow all non-anesthesia providers the opportunity to become credentialed in the use of NMBAs. This includes NPs, HMS, and FMS physicians.
2. All providers performing emergency endotracheal intubation outside of the OR should use video laryngoscopy
3. Providers should receive standardized emergency airway training with specific focus on the use of video laryngoscopy and real-world experience that allows for timely credentialing

Future review, adoption, and incorporation of recommendations into clinical practice could lead to an improvement in patient outcomes. This scholarly project served as a beginning point for a greater understanding of the importance of evidence-based practices, clinical knowledge, policy, multi-disciplinary collaboration, and the impact of these factors on the outcomes of patients requiring emergency airway management.

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Appendix A

Confirmation of Permissive Use of the Johns Hopkins Nursing Evidence Based Practice Model

Thank you for your submission. We are happy to give you permission to use the JHNEBP model and tools in adherence of our legal terms noted below:

- You may not modify the model or the tools without written approval from Johns Hopkins.
- All reference to source forms should include "©The Johns Hopkins Hospital/The Johns Hopkins University."
- The tools may not be used for commercial purposes without special permission.

If interested in commercial use or discussing changes to the tool, please email ijhn@jhmi.edu.

Appendix B

Citation	Design/ Method	Sample/Setting	Variables	Outcome Measurement	Data Analysis	Findings	Level of Evidence
Lundstrøm, L. H., Duez, C. H. V., Nørskov, A. K., Rosenstock, C. V., Thomsen, J. L., Møller, A. M., . . . Wetterslev, J. (2018). Effects of avoidance or use of neuromuscular blocking agents on outcomes in tracheal intubation: A cochrane systematic review, *British Journal of Anaesthesia*, 120(6), 1381-1393. doi: 10.1016/j.bja.2017.11.106	Systematic review	Thirty-four (34) randomized control trials (RCTs) of participants aged greater than or equal to 14 who underwent surgery and attempted tracheal intubation by direct laryngoscopy.	Intervention = avoidance of neuromuscular blocking agent (NMBA) Control = use of NMBA	Difficult tracheal intubation, one or more events of upper airway discomfort or injury, one or more major serious adverse events (SAE), difficult laryngoscopy.	Review manager for statistical analysis. Most often, a dichotomous outcome measure was used to assess whether an intubation was difficult or not.	Significantly increased risk of difficult tracheal intubation (DTI) when avoiding NMBA. Significant risk of upper airway discomfort or injury by avoiding NMBA. Significant association of difficult laryngoscopy with avoiding NMBA.	I
Jiao, J., Huang, S., Chen, Y., Liu, H., & Xie, Y. (2014). Comparison of intubation conditions and apnea time after anesthesia inductions with propofol/remifentanil combined with or without small dose of succinylcholine. International Journal of Clinical and Experimental Medicine, 7(2), 393–399.	Randomized control trial (RCT)	Sixty female patients with ASA I or II aged between 18 and 60 years old, undergoing selective gynecological laparoscopic operation under general anesthesia. Exclusion criteria = BMI > 30; mallampati airway grade 2 to 4; known allergy to propofol, egg, or opioids; alcohol or drug abuse; history of gastroesophageal reflux disease or neuromuscular disease, and history of upper respiratory tract infection or other airway hyperactivity diseases in the recent two weeks.	Group S = propofol 2mg/kg, remifentanil 1 ug/kg, and succinylcholine 0.6 mg/kg Group C = propofol 2mg/kg, remifentanil 1.5 ug/kg and normal saline Variables for each group = Age, weight, height, ASA Score, Intubation condition before intubation, Intubation condition post intubation, SpO2, Apnea time, HR, SBP, DBP	Intubation condition before intubation as defined by ease of laryngoscopy, vocal cord position and vocal cord movement. Intubation condition post intubation as defined by airway reaction and movement of limbs.	Normal distribution test for continuous variables and data present as mean ± SD. Differences between two groups were analyzed using Student's t test for continuous variables or Chi-square test for categorical variables. Statistical analysis was performed using SPSS version 21. $P < 0.05$ was considered statistically significant.	The group who received succinylcholine on induction had significantly lower instances of poor graded pre and post intubation conditions.	II
Okubo, M., Gibo, K., Hagiwara, Y., Nakayama, Y., & Hasegawa, K. (2017). The effectiveness of rapid sequence intubation (RSI) versus non-RSI in	Prospective Observational Study	All JEAN-1 database adults and children who underwent emergency intubation from Apr 2010 to Aug 2012 were eligible for inclusion in	Major variables included patient age, sex, primary indication for intubation, method of intubation, medications used to facilitate intubation,	The primary outcome measure was success on the first intubation attempt. Secondary outcome measures were success	Compiled data was first analyzed with simple descriptive statistics. Outcomes were compared between RSI and non-RSI methods in	Of 2,365 eligible patients, 761 (32%) underwent intubation with RSI and 1,604 (68%) with non-RSI. RSI intubations had higher FAS rates	II

emergency department: An analysis of multicenter prospective observational study. *International Journal of Emergency Medicine*, *10*(1), 1-9. doi:10.1186/s12245-017-0129-8		analyses. The following patients were excluded: those being intubated for cardiac arrest and without the use of medications; those intubated with paralytics alone (no sedation/induction agent used); those undergoing fiberoptic intubation, blind nasal intubation, or surgical cricothyrotomy. Patients requiring multiple intubation attempts with changes in intubation method (e.g., non-RSI to RSI) were also excluded.	devices, specialties and training level of the intubator, number of attempts, success or failure, and complications.	within the second attempt and intubation-associated complications.	patients undergoing intubation in the ED. 3 unconditional regression models were fit: unadjusted model, adjusted model for selected variables, and adjusted random-effects model for selected variables.	compared with non-RSI intubations (73% vs. 63%; P<0.0001). In the adjusted model, RSI intubation was associated with significantly higher FAS rates (OR, 2.3; 95% CI, 1.8-2.9;P<0.0001).	
Mosier, J. M., Sakles, J. C., Stolz, U., Hypes, C. D., Chopra, H., Malo, J., & Bloom, J. W. (2015). Neuromus cular blockade improves first-attempt success for intubation in the intensive care unit. A propensity matched analysis. *United States: American Thoracic Society*. doi:10.1513/AnnalsATS.201411-517OC.	Prospective observational study	664 consecutive patients intubated in the MICU of a university medical center between January 1, 2012 to June 30, 2014. All patients intubated using direct laryngoscopy (DL) or video laryngoscopy (VL) as the initial device were included. Excluded if intubated with fiberoptic bronchoscope or other alternative device.	Patient demographics, operator specialty, operator PGY, indication for intubation, paralytic agent, sedative agent, device(s) used, presence of certain difficult airway characteristics (DCAs), preoxygenation methods, Cormack-Lehane (CL) view, percentage of glottic opening (POGO) score of airway, number of attempts at intubation, and the outcome of each attempt, including complications. Rapid Sequence Intubation (RSI) indicates use of a paralytic agent. Intubations using sedation only or no medications did not include use of a paralytic.	First attempt success (FAS) at intubation with use of a paralytic vs. no paralytic. Intubation attempt defined as "insertion of the laryngoscope blade into the oropharynx regardless of whether an attempt was made to pass the endotracheal tube (ETT)". Successful intubation defined as "correct placement of the ETT in the trachea, as confirmed by capnometry, pulse oximetry, chest auscultation, observation of chest excursion, absence of epigastric sounds, and misting of the ETT.	Summary statistics were generated for patient, intubation, and operator characteristics using Fisher's exact test for categorical variables, Kruskal-Wallis test, and Student's t test. A propensity score for receiving an NMBA was generated from prespecified variables expected to affect the decision to use a paralytic using the "pscore" command with logistic regression in the State v.12.0.	First attempt success (FAS) was significantly higher in patients intubated using an NMBA (80.9%) compared with those intubated without an NMBA (69.9%).	III
Sagarin, M. J., Barton, E. D., Chng, Y., Walls, R. M., Sagarin, M. J., Barton, E. D., .	Prospective Observational Study	5,768 intubation attempts by EM residents	Patient age, sex, weight, indication for intubation, technique of airway	Success rates of intubation among emergency medicine residents.	95% confidence intervals for means and for proportions calculated using	Rapid sequence intubation was successful on the first attempt in 85% of cases	II

. . Walls, R. M. (2005). Airway management by US and canadian emergency medicine residents: A multicenter analysis of more than 6,000 endotracheal intubation attempts. *Annals of Emergency Medicine, 46*(4), 328-336.		Included data from the National Emergency Airway Registry (NEAR 2) which is a consortium of 31 academic EDs in the US, Canada, and Singapore. Excluded attempts outside of US & Canada, attempts with documented data inconsistencies, and attempts made by a non-resident.	management, names and dosages of all medications used to facilitate intubation, level of training and specialty of the intubator, number of attempts, success or failure, and adverse events. Data entry personnel verified that neuromuscular blockade was used whenever the designation "rapid sequence intubation" was indicated.	An "intubator" defined as a physician who attempted to pass an endotracheal tube through the vocal cords of a patient. Attempted intubation defined as a failure if another physician took over and performed a rescue attempt.	standard published formulae and Microsoft excel.	versus the first-attempt success rate for oral intubation with sedation only was 72%. Rapid sequence intubation (meaning a neuromuscular blocker was used) had higher success rates.	
Wilcox, S., Bittner, E., Elmer, J., Seigel, T., Nguyen, N. (2012). Neuromuscular blocking agent administration for emergent tracheal intubation is associated with decreased prevalence of procedure-related complications*. *Critical Care Medicine*, 40, 1808-1813.	Prospective, observational study	454 patients included who underwent emergent intubations via direct laryngoscopy in the hospitalized out-of-the-OR setting in two tertiary care centers (Massachusetts General Hospital and UCLA Ronald Regan Medical Center). Excluded 112 patients who were intubated during cardiopulmonary resuscitation and instances where fiberoptic intubation was used as the primary modality.	Reason for intubation, the Cormack-Lehane classification score, number of attempts required for successful tracheal intubation, failed tracheal intubation, and complications. Complications defined as esophageal intubation, traumatic intubation, aspiration, dental injury, and endobronchial intubation. Hypoxemia defined as oxygen saturation < 80% during or within the first 5 minutes after intubation.	Prevalence of hypoxemia during intubation when NMB's vs. no NMB's is used. Laryngeal view and number of intubation attempts when NMB's vs. no NMB's is used.	Data analysis performed using STATA 10. Continuous variables expressed as mean +/- SD. Baseline characteristics of the patients who did and did not receive paralytics were compared using the unpaired t test for normally distributed variables. The chi-square test was used to compare categorical variables. The p values of baseline characteristics, intubation data, and complications were calculated using two-sided analysis. Multivariate logistic regression analysis was used to evaluate the association between the primary endpoints (hypoxemia, procedure related complications) and NMB use.	Hypoxemia was significantly decreased in patients who received NMB's (10.1% vs. 17.4%, p = .022). Use of NMB's was associated with a significant decrease in airway-related complication rate (3.1% vs. 8.3%, p = 0.12). Patients who received NMB's has a significantly better laryngeal view and fewer intubating attempts were required.	III
Brown, III, C. A., Bair, A. E., Pallin, D. J., & Walls, R. M. (2015). Techniques, success, and adverse events of emergency department adult intubations.	Prospective Observational Study	21,374 patients intubated in EDs at 18 sites reporting to the National Emergency Airway Registry from July 1, 2002 to December 31, 2012; pediatric	Indication for intubation, method of intubation (DL vs VL), induction agent, paralytic drug used.	Success rate of emergency intubations in the EDs studied.	95% CI, 83-84%.	First-attempt success rate was 83%.	III

Annals of Emergency Medicine, *65*(4), 363-370. doi:10.1016/j.annemergmed.2014.10.036		patients (<15 years) and intubations with an attempt by a nonphysician were excluded.					

Appendix C

RECOMMENDATIONS FOR EMERGENCY AIRWAY MANAGEMENT

CURRENT PRACTICE

- Non-anesthesia providers are often responsible for responding to and intervening in emergency airway situations outside of the Operating Room (OR). Despite this, these providers are usually not credentialed and/or privileged to administer neuromuscular blocking agents (NMBAs) during emergency endotracheal intubation procedures.

RECOMMENDATION #1

Allow all non-anesthesia providers the opportunity to become credentialed in the use of NMBAs. This includes Nurse Practitioners (NPs) and non-anesthesia Physicians.

- The use of NMBA prior to intubation creates a better laryngeal view and less difficult intubation conditions for the provider performing airway management, which also leads to faster securement of the airway and less intubation related complications.
- Patients intubated without the use of a NMBA may be at increased risk for multiple intubation attempts, airway trauma, failed airway, hypoxia, aspiration of gastric contents, or other airway associated complications.

RECOMMENDATION #2

All providers performing emergency endotracheal intubation outside of the OR should use video laryngoscopy.

- Video laryngoscopy reduces the number of intubation attempts and the rate of esophageal intubation.
- In learners, direct laryngoscopy requires the teacher and trainee to rely on verbal feedback from each other, rather than the visual confirmation obtained when using video laryngoscopy. Trainees taught to use video laryngoscopy versus direct laryngoscopy have higher success rates of endotracheal intubation.
- Video laryngoscopy is the preferred method for performing endotracheal intubation in COVID-19 patients because it enhances safety for the provider.

RECOMMENDATION #3

Providers should receive standardized emergency airway training with specific focus on use of video laryngoscopy.

- A combination of video lecture, simulation, and real-time experience should be implemented as required airway training elements in order for non-anesthesia providers to become credentialed in the use of NMBAs to facilitate endotracheal intubation with a video laryngoscope.

Appendix D

1. Stabilize the patient's head
2. Look in the mouth, insert the blade midline, and then advance the tip into the vallecula.
3. Look at the screen, and then lift the epiglottis for a view of the larynx.
4. Look in the mouth, and then introduce an endotracheal tube alongside the blade.
5. Look at the screen, and then complete the intubation.
6. If using a stylet, remove it by pulling toward the patient's feet.

Appendix E

Otterbein University
IRB Exemption Statement

Conversation between IRB Chair, Dr. Noam Shpancer and Dr. John Chovan, Department of Nursing Chair.

From: Shpancer, Noam <nshpancer@otterbein.edu>
Sent: Wednesday, October 13, 2021 9:44 AM
To: Chovan, John <jchovan@otterbein.edu>
Subject: Re: IRB and DNP Projects

John: The way I see it, a project is not subject to IRB review unless and until it collects data from human participants. So, I agree with you that these projects will not need IRB approval until someone decides to implement them for data collection, at which point that person may apply for IRB approval.

Thanks, Noam.
From: Chovan, John <jchovan@otterbein.edu>
Sent: Wednesday, October 13, 2021 9:10 AM
To: Shpancer, Noam <nshpancer@otterbein.edu>
Subject: IRB and DNP Projects

Good morning, Noam,

I could use some advice -- maybe a conversation -- about the Doctor of Nursing Practice final scholarly projects and submitting for IRB approval. The projects parameters from our accreditors for some of the projects have changed. The list of acceptable projects now includes the option of writing a plan for a project that is not implemented. So, it can effectively stop at the proposal stage, and then these projects can be available for a future student to implement if someone has that interest. I have at least two questions.

1. The IRB Guidelines states "Research means a systematic investigation, including research development, testing, and evaluation, designed to develop or contribute to generalizable knowledge." Most of these projects are not intended to develop or contribute to generalizable knowledge. They are clinical change projects that are intended to eventually change a clinical practice of health care professionals (humans) in one identified setting. They have the possibility of contributing to generalizable knowledge in that each would be an instance of a clinical change that, if implemented in other places by others, could eventually be generalized. But that is not the primary intent of the projects. Would they be considered research? I think they would not.

2. If indeed they are considered research and should be submitted for review by the IRB, at what point in the process should IRB approval be obtained? I would think

> that although implementation is not part of the initial project, review by IRB would be helpful to the original team in shaping their project plan. Yet if this proposal is not going to be implemented, then the approval to move forward would be moot. But if a second team eventually reads the proposal and wants to implement it, would they be the ones seeking IRB approval?

If you would prefer that we talk in real time, I am open to that. Or perhaps you could visit one of our faculty meetings for a discussion?

Thank you.

Best,

John

John D. Chovan, PhD, DNP, RN, CNP, CNS, PMHNP-BC
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Chief Nurse Administrator
Otterbein University

"A comprehensive institution with a strong liberal arts base"
jchovan@otterbein.edu; 614-823-1526, voice; he/him/his
"The world is starved for grace. If we are going to work at restoring fellowship and reaching people, we need grace now more than ever."
- Pastor John Swadley, Forest Park Baptist Church, Joplin, Missouri