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Evidence-Based Cognitive Aid on Rapid Sequence Induction for Non-Anesthesia Care Providers Outside of the Operating Room

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EVIDENCE-BASED COGNITIVE AID ON RAPID SEQUENCE INDUCTION FOR NON-ANESTHESIA CARE PROVIDERS OUTSIDE OF THE OPERATING ROOM

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Abstract

Rapid Sequence Induction (RSI) outside of the operating room has been associated with life threatening complications, such as pulmonary aspiration, acute hypoxemia, and hemodynamic instability that can lead to cardiac arrest. Adverse events related to RSI occur due to inadequate knowledge surrounding airway emergency management strategies, induction medications, emergency airway equipment, and effective communication. This Doctor of Nursing Practice project intends to recommend important additions to cognitive aids for non-anesthesia providers to utilize in the intensive care unit (ICU) and emergency department (ED), with the goal of reducing complications that occur during rapid sequence induction.

Keywords: Intubation, rapid, intensive care unit, emergency department, nursing, respiratory therapy, airway management

An Evidence-Based Cognitive Aid on Rapid Sequence Induction for Non-Anesthesia Care Providers Outside of the Operating Room

Background

Rapid sequence induction (RSI) is an intubation technique utilized by anesthesia providers to prevent the aspiration of gastric content into the lungs and manage emergent airway situations (Avery et al., 2021). RSI technique involves denitrogenation of the lungs with 100% inspired oxygen without bag-mask ventilation (BMV) (Avery et al., 2021). The intent of RSI is to secure a definitive airway as quickly as possible utilizing fast-acting medications and techniques (Birenbaum et al., 2019).

Induction of anesthesia with RSI leads to loss of protective airway reflexes; anesthesia providers may or may not apply manual pressure to the cricoid cartilage, known as Sellick's maneuver, to prevent aspiration of gastric content (Birenbaum et al., 2019). Utilization of fast acting multimodal drug therapy, including sedative hypnotics and muscle relaxants, yields patient unconsciousness and ideal intubating conditions (Birenbaum et al., 2019). Indications for RSI are traumatic injuries, non-fasted patients, active vomiting, gastric ileus, gastrointestinal obstruction, inadequate airway protective reflexes, and pregnant patients after the first trimester or in labor (Klucka et al., 2020).

As anesthesia and intubation techniques continue to develop, so does utilization of RSI in healthcare settings outside of operating rooms where a lack of ideal intubating conditions exists. Operating rooms are outfitted with vital tools and skilled staff to handle airway challenges. Anesthesia providers in the OR are able to assess patients' airways and modify anesthesia plans accordingly. Conversely, non-anesthesia providers in the intensive care unit (ICU) and emergency department (ED), namely bedside registered nurses and respiratory therapists, are often confronted with emergency situations, such as a distressed patient with a difficult airway. Registered nurses and respiratory therapists in this environment must have a solid foundation of the knowledge and skills needed to manage these scenarios until additional help arrives.

RSI has increased in the ICU and ED, one study examined 21 hospitals and found 28.1% of intubations were RSI (Cordier et al., 2019). Another study concluded that RSI was utilized in over 62% of 2,777 intubations outside of the operating room (Russotto et al., 2012). Sakles et al. (2019) examined 5,229 intubations in EDs, of which 4,362 were RSIs; researchers identified that nearly 23% of patients experienced an adverse event. Adverse events were defined as the development of hypoxemia, hypotension, cardiac dysrhythmia, pulmonary aspiration, cardiac, arrest, and death (Asai, 2018). Hypoxemia was identified as the most frequent adverse outcome, occurring in 76% of intubations in the ED, while pulmonary aspiration remains the most common reason for death associated with anesthesia (Klucka et al., 2020; Sakles et al., 2019).

Patients undergoing RSI in the ICU and ED differ from patients intubated in the OR; they are frequently critically ill, hemodynamically unstable, more sensitive to induction medications, and present with stomachs full of gastric content which increases risk of aspiration (Cabrini et al., 2018). Out-of-OR intubations may lack equipment such as pulse oximetry, wall suction, end-tidal CO2 capnography, and other anesthesia airway experts to act as assistants. Nursing staff inexperienced with drugs for induction of RSI and lack of familiarity with rescue airway devices cand lead to delay of care when seconds matter most (Asai, 2018; Gupta et al., 2022; Mosier et al., 2020). Additionally, high stress situations are more likely to impeded communication between anesthesia providers and non-anesthesia providers, increasing the risk of poor patient outcomes (Toy et al., 2020).

Negative sequelae and death related to airway complications is mainly attributed to lack of appropriately skilled support staff, equipment, inadequate planning, and absence of structured strategies for handling emergency airways (Cook, 2018). There is a high probability that nursing will be the first to respond to a patient in distress and will need to manage the situation until more help arrives. Nurses play an essential role in airway management and RSI by preparing equipment, medications, and supplies such as adequate intravenous access (IV), oxygen, and establishing oropharyngeal suction. A survey of 80 nurses reporting on self-efficacy surrounding emergency airway management including RSI, medications used, airway devices, and management of patients' peri-intubation revealed a need for education on this topic (Han et al., 2018).

One study looked at 102 nurses working in an ED with varying years of experience; 20.75% were certified in advanced cardiovascular life support (ACLS) and 13.2% in advanced trauma life support (ATLS). The study used a 16-question test on airway skills. The study found that 54.9% of participant nurses scored below the median regarding airway management (Nigatu et al., 2022). Nigatu et al. (2022) also looked at nurse demographics related to job training and experience and reported that nurses who had received education and training on airway management were 2.72 times more knowledgeable than those who did not have related training.

Another study of 946 bedside nurses revealed that only 35% felt confident acting as an airway assistant during intubation, while 34% strongly doubted their abilities to assist with the airway (Gupta et al., 2020). Additionally, only 41% felt confident in drug preparation for RSI and 29% were familiar with an airway management plan (Gupta et al., 2020). Despite 58% of nurses in the study being trained in life support, 78% of participants exhibited significant deficits in airway management planning, knowledge of drugs necessary for RSI, equipment for intubation such as video laryngoscopy, and the intubation process (Gupta et al., 2020).

It is not uncommon for anesthesia providers to arrive at airway emergencies where interventions have already ensued. Respiratory therapists are typically charged with delivering oxygen therapy and sometimes ventilation via a bag valve mask (BVM). Although ventilation is contraindicated in the RSI scenario, respiratory therapists may begin ventilation interventions as trained in advanced life support courses. Delivering excessive tidal volumes and pressure via BVM may lead to detrimental lung damage, hemodynamic compromise, and gastric insufflation that can increase risk of pulmonary aspiration. Nagelhout & Elisha (2018) identifies lung protective tidal volumes to be between 6-8 ml/kg; this equates to a tidal volume of 420ml-560ml for the 70 kg patient. Peak mean airway pressures above 15-20 cmH2O have shown to be unsafe and can cause gastric insufflation, which can lead to pulmonary aspiration in the RSI situation (Bouvet et al., 2014; Nagelhout & Elisha, 2018).

A study by Culbreth et al. (2021) examined 98 respiratory therapists with varying years of experience regarding bag valve mask ventilation. This study compared mean tidal volumes, peak airway pressure, peak flow rate, inspiratory time, and inspiratory rise time via a simulation model. Culbreth et al. (2021) reported that respiratory therapists in the study delivered a mean tidal volume of 599.79 mL, and the highest group were those with 10 or more years of experience who delivered a mean tidal volume of 631.43 ml. Bouvet et al. (2014) examined adult anesthetized patients and found that a pressure of 15 cmH2O provided less gastric insufflation while still providing adequate ventilation to the lungs when compared to a pressure of 20 cmH2O. Culbreth et al. (2021), found the mean pressure delivered by all respiratory therapists was 26.25cmH2O, with the highest group delivering 30.55cmH2O, well exceeding safe parameters of ventilation. Although ventilation is contraindicated in traditional RSI to reduce risk of pulmonary aspiration, it may be an intervention utilized in response to a distressed patient by nurses or respiratory therapist; appropriate technique is essential to prevent gastric insufflation and aspiration. Modified RSI is an alternate version of RSI where the patient is ventilated prior to an intubation; however, the lack of equipment needed to measure limited hand ventilation paired with the stress of an emergency leaves a large margin for error in this environment.

Team dynamics and communication are imperative throughout emergency management, especially in relaying essential patient information prior to intubation. Following critical events in anesthesia, Arriaga et al. (2019) examined the effectiveness of a debrief. Critical events included cardiac arrest, difficult airway requiring an urgent surgical airway, period of significant or prolonged hypotension and/or hypoxemia, and urgent re-intubation. Of the 89 critical events examined, 10% occurred in the intensive care unit, 18% on the inpatient floor, and 15% occurred in other out-of-OR locations (Arriaga et al., 2019). Of these 89 critical events, greater than 50% were found to have a significant breakdown in communication (Arriaga et al., 2019). Furthermore, of the events found to have breakdowns in communication, 80% had more than one type of breakdown in communication. Breakdowns in communication were defined as audience failure: key person missing from a clinical conversation, occasion failure: a key discussion became futile due to poor timing, content failure: insufficient or inaccurate information was relayed regarding critical details, and systems failure: lapse in communication at the organizational level (Arriaga et al., 2019).

The University of Pittsburgh emergency department developed a multidisciplinary intubation algorithm in response to the COVID-19 pandemic, to reduce exposure to the virus and improve first pass intubation success. This algorithm optimizes deliberate use of appropriate equipment, specifies an emergency plan in case of a difficult airway, and enhances teamwork through improved communication and patient safety principles. The developed algorithm was implemented and utilized as an intubation timeout read by a bedside nursing team member to ensure necessary equipment was readily available, skilled personnel were ready, and a backup plan was in place in the event of a failed intubation (Trembley et al., 2020).

Results of a survey of doctors, registered nurses, and respiratory therapists that participated in the algorithm initiative and training program showed a positive improvement in the level of confidence with their role in the intubating process, and 93.75% reported enhanced team communication (Trembley et al., 2020). Although this algorithm provided many essential elements of a high risk RSI outside of the OR, it lacked a section encompassing pertinent patient information that should be part of the team communication; for example, specific laboratory values, any known medical history such as neurodegenerative disorders, etiologies that increase serum potassium such as kidney injury or failure, conditions of the spine that would be impacted during laryngoscopy, or known tracheal pathologies/surgeries, such as a history of a tracheostomy, that may impede the passing of an endotracheal tube.

Asai (2018) noted that anesthetists intubating patients in emergency situations are often unfamiliar with underlying patient conditions that can lead to peri-intubation adverse events, especially when using medications for RSI such as succinylcholine. Although anesthesia providers autonomously select paralyzing and induction agents according to patient condition, it is difficult to identify at-risk-patients in emergency situations warranting RSI (Russotto et al., 2021). When selection of medication is made with inaccurate or missed information relayed from bedside nursing staff assigned to the patient, the patient becomes predisposed to adverse events.

For example, Wilson et al. (2020) noted that of 36,059 intubations in the ED, succinylcholine was utilized 75.39% of the time. At this high rate of succinylcholine administration, the risk for negative patient outcomes may increase due to lack of awareness regarding patient conditions and specific medication side effects. Succinylcholine is linked to increased extracellular potassium levels that can lead to life-threatening hyperkalemia which predisposes patients to cardiac arrhythmias. In addition, succinylcholine is linked to malignant hyperthermia, and persistent muscle relaxation associated with pseudocholinesterase deficiency that results in prolonged intubation (Nagelhout & Elisha, 2018). When key information regarding the patient is accurately relayed from non-anesthesia providers to anesthesia providers, appropriate medications and techniques can be implemented that result in better outcomes. This emphasizes the importance of strong team dynamics and communication between non-anesthesia providers acting as airway assistants and the intubating anesthetist. Lack of awareness of patient conditions in emergency events were responsible for 30% of preventable errors and are a root cause of sentinel events every year (Toy et al., 2020). According to The Joint Commission, breakdowns in communication during emergencies were associated with 64% of sentinel events (Toy et al., 2020). Twenty-three percent of patients have experienced an adverse outcome due to RSI outside of the OR; this finding strongly supports the need to adapt RSI cognitive aids, so they are focused on the non-anesthesia care providers to improve the RSI process. Through the use of a cognitive aid for non-anesthesia care providers patient risk can be minimized and adverse events linked to RSI can be prevented.

Clinical Problem Statement

The number one cause of death related to anesthesia is pulmonary aspiration, making knowledge and skills surrounding RSI imperative for all care providers, including nursing and respiratory therapy (Klucka et al, 2020). RSI in the ICU and ED are associated with significant risk of adverse events leading to long-term injury or death, largely due to lack of appropriately skilled staff, inadequate planning, and availability of equipment, drugs, and rescue devices. Patients in these settings are high-risk for peri-intubation events due to underlying conditions such as shock, metabolic acidosis, electrolyte imbalances, and other physiologic conditions compared to those undergoing intubation in the OR. Of the critically ill, 28% require intubation and encounter life-threatening events such as hemodynamic instability and hypoxemia with 2.7% resulting in cardiac arrest (Russotto et al., 2021). A lack of self-efficacy and a gap in knowledge surrounding airway management, RSI medications, and equipment has been identified by nursing and respiratory therapists caring for critically ill patients in ICU and ED settings. Additionally, poor communication among all care providers regarding patient conditions has been identified as a leading cause of sentinel events in the United States (Toy et al., 2020; Trembley et al., 2020). Diagnoses, medical history, and laboratory values are crucial for anesthesia providers to consider when choosing induction agents to be used in RSI. The absence of appropriate equipment, specifically, capnography, video laryngoscopy, and rescue devices, is a compounding issue (Asai, 2018; Mosier et al., 2020; Russotto et al., 2020; Trembley et al., 2020).

Purpose Statement

The purpose of this project is to identify and validate communication points for inclusion in cognitive aids surrounding rapid sequence induction for non-anesthesia providers outside of the OR, specifically in the ICU and ED. A cognitive aid embraces communication between team members, reduces cognitive overload, and endorses use of appropriate equipment. The addition of communication specific recommendations may enhance the effectiveness of a cognitive aid, and contribute to reducing negative patient outcomes.

Project Question

What are the evidence-based communication points of a cognitive aid for non-anesthesia care providers in the ICU and ED to prepare for rapid sequence induction and intubation by anesthetists?

Conceptual Definitions

Tracheal intubation is defined as the passing of a breathing tube via the nasopharyngeal or oropharyngeal cavity, through the vocal cords, and into the trachea to provide oxygenation and ventilation (Nagelhout & Elisha, 2018). Tracheal intubation is the foundation of airway management and can be achieved by various techniques, including rapid sequence induction.

Rapid sequence induction (RSI) is a multi-step process consisting of sedating, paralyzing and intubating a patient presenting with a stomach full of gastric content at risk for aspiration, or a patient emergently in need of a secure airway (Klucka et al., 2020). RSI is an attempt to reduce risk to patients while achieving the goal of intubation. RSI increases first-pass success when intubating (Mosier et al.,2020). First-attempt success is an important factor, because subsequent attempts of intubating a critically ill patient are associated with higher rates of morbidity and mortality (Mosier et al., 2020).

Anesthesia providers are individuals or teams that provide specific medications, supportive breathing techniques, and other specialized care to patients across the healthcare continuum. They have specialty training in the field of anesthesia. For the context of this paper, an anesthesia provider is either a medical doctor or doctor of osteopathic medicine with specialty training in anesthesia known as an anesthesiologist, or a certified registered nurse anesthetist (CRNA). A CRNA is a registered nurse with an advanced practice degree and specialty training in anesthesia.

For the purpose of this paper, non-anesthesia providers are recognized as registered nurses and registered respiratory therapists who provide care to patients in the emergency department and intensive care units, or other out-of-OR areas where anesthesia providers may respond for RSI. Additionally, it refers to others, who are not RNs or RTs that may act as airway assistants during RSI. A registered nurse is defined by the National Council of State Boards of Nursing as an individual who has graduated from a state-approved school of nursing, passed the NCLEX-RN examination, and is licensed by a state board of nursing to provide patient care (National Council of State Boards of Nursing [NCSBN], 2023). According to the National Board of Respiratory Care handbook, there are different domains of respiratory therapists; this paper refers to both certified and registered respiratory therapists who have graduated from an accredited respiratory program and are licensed to provide patient care through a state licensing body (The National Board of Respiratory Care [NBRC], 2023).

Airway management includes basic assessment of patient breathing and skills that include positioning, maneuvers to open the airway (head tilt-chin lift and jaw thrust), clearing secretions, oxygen therapy, and the use of bag valve masks and other airway devices to control ventilation.

A cognitive aid is a tool designed to improve the flow, or speed of a task that must be completed by a person or group with the fewest number of errors or omissions from the standard procedure (Marshall, 2013). A cognitive aid can exist to be used while the task at hand is being completed. Forms of cognitive aids include algorithms, checklist, posters, flowcharts, or even mnemonics (Marshall, 2013). In reference to this paper, evidenced-based cognitive aid refers to the development of a tool aimed at reducing errors and preventing omissions from standard procedure based upon recommendations for best practice from critical appraisal of current peer-reviewed literature. An evidenced-based cognitive aid for RSI outside of the OR, pertains directly to the development and use of a tool designed to reduce errors and prevent omissions during RSI.

Review of Literature

Search Strategy

An original La Salle University Summons search yielded 557 articles. Subsequent searches through the databases CINAHL, PubMed, Medline, ProQuest Dissertations & Theses Global, and Cochran Library generated 681 articles. Keyword terms and phrases utilized during the literature search included: rapid sequence induction, intubation, airway management, checklist, and self-efficacy. The Boolean operators "AND" and "OR" were used to associate terms together for the search, and to better identify relevant articles according to abstract and inclusion criteria. Inclusion criteria for articles required publication between 2018 and 2023, full text, English language, and peer reviewed. Foreign studies were included for review. Duplicate research articles were excluded. La Salle Summons yielded 1 article of which 4 duplicates were excluded from the Table 2 review matrix. The database CINHAL produced 2 articles, of which 3 duplicates were omitted from the matrix; PubMed produced 2 articles, of which 3 duplicates were excluded. The final literature review provided 4 articles to be appraised using the Johns Hopkins Nursing Evidence-Based Practice Model for Nursing and Healthcare Professionals Level and Quality Guide. Please see Table 1 for the search process review of literature.

Appraisal of Empirical Literature

Nigatu et al. (2022) performed a cross-sectional survey of 102 emergency room nurses in three randomly selected hospitals to evaluate the knowledge and expertise associated with airway and breathing management strategies. Four nurses were unavailable through the entire surveying process, which provided a 96.2% survey response rate. Nurses in the three selected emergency rooms volunteered to participate in the survey but had to have at least six months of experience to be included. Socio-demographic characteristics of the participants were sorted by age, sex, educational level, and work experience in years. Data was collected from the group of participants using a standardized self-administered questionnaire which was separated into three categories: nurse socio-demographics, 16 multiple choice questions regarding knowledge of emergency airway management, and 10 multiple choice questions on skills of airway and breathing management. The mean value for the knowledge section was determined to be 9.44 (59%), scores greater than the mean were considered knowledgeable, while descriptive statistics were utilized to review data from the skills section. Validity and reliability of the survey were examined, a data collector was assigned at each hospital which was overseen by a lead investigator. Data collected was entered into Epi Data version 3.1 prior to being transferred into The Statistical Package for Social Science (SPSS) version 25 for analysis. The link between dependent and independent variables was established through bivariable and multivariable logistic regression. Strength of connection of variables associated with knowledge and practice were measured using crude odds ratio (COR) and adjusted odds ratios (AOR) with a 95% confidence interval. Multivariable regression factors were statistically significant with a p-value <0.05.

The results revealed 45.1% of emergency room nurses that participated were knowledgeable in emergency airway management. Areas of high achievement were identification of chin lift (59.8%), jaw thrust (73.5%), and patient positioning (96.1%) as a basic maneuver for airway management; however, only 36.3% of nurses identified intubation as a non-basic airway device and use of a bag valve mask as a manual ventilation method that delivers high concentration of oxygen for patients without adequate ventilation. Additionally, only 29.4% of participants correctly answered the question regarding the use of a face mask for oxygen delivery for a patient in distress. In a bivariate logistic regression, the two variables with statistical significance in emergency airway management were those nurses who received training and those with 1-5 years of experience, $p=0.029$ and $p=0.075$ respectively. Training was distinguished as job-related training, Advanced Trauma Life Support (ATLS), Basic Life Support (BLS), Advanced Cardiac Life Support (ACLS), and other training. These variables were included in a multivariable regression which showed that only those nurses who had received training related to airway management were significantly associated with knowledge regarding emergency airway management, $p<0.05$. Nigatu et al. (2022) report that nurses that had received related training were 2.78 times more informed than nurses who had not received training [AOR=2.78, 95% CI (1.01-7.64)]. Limitations to this study identified by the authors were the cross-sectional design that does not demonstrate cause and effect relationship. The authors also stated that the perspectives of the participants regarding airway management was not included, nor did the study include observation for applied assessment. This study helped to identify some common knowledge gaps concerning emergency airway management by ED nurses. Identifying these gaps is the first movement in implementing strategies to address the knowledge deficit and empower care providers to have a sense of self-efficacy in emergency airway management.

Gupta et al. (2022) conducted a prospective, observational study to assess the efficacy of an interactive computer-based training course for nurses to improve knowledge of airway management in critically ill patients and enhance personal confidence. The study was performed via a dedicated online course taken by groups of 30 nurses, three times a week for four months. The content was assembled to cover information related to COVID-19 preparation, personal protective equipment, signs of respiratory distress and airway assessment, indications for intubation, difficult airway predictors, management guidelines and sequence of events, airway equipment, medications, the process of rapid sequence induction, mask ventilation, video laryngoscopy, supraglottic airway devices and placement of these devices, and front of neck access. The courses were held through one hour Google meet training sessions entailing live audio-visual lectures, case scenarios, and presentations. Additionally, 1-hour skills stations with demonstrations via mannequin video clips that included preparation of induction equipment and drugs, team dynamics, airway management plans, airway adjuncts and video laryngoscopy, use of supraglottic airways, bag- mask ventilation, and last resort surgical airway options. Participants were able to ask questions in the moment and could chat via a chat window and a debriefing session followed each teaching session where nurses could discuss successes and areas of uncertainty. A convenience sample of 946 nurses completed the pre- and post-test and were included in the study with an average work experience of 4.01± 3.16 years. Prior to any teaching sessions, nurses were provided with a pre-test and skills assessment exam through a Google form link. The same 20 question multiple choice post-test questionnaire was provided following the online course as well as the 10-question objective structured clinical exam (OSCE). Clinical skill performance was individually assessed by two experienced instructors based on OSCE response. The course was considered successfully completed when participants scored a 70% on the post-test and 80% in the OSCE assessment. An 8-question Likert scale feedback survey was provided to all participants following the post-test. Data were collected and examined by an investigator blinded to study protocols and entered into SPSS for statistical evaluation. Results were presented using descriptive statistics mean and standard deviation. Student's t-test was used to analyze inter- and intra-group comparisons and the Likert scale was averaged to the total number of points; statistical significance was reached when $p<0.05$.

Results from this study revealed a mean pretest score of 8.47 ± 4.2 out of 20 and a post-test mean score of 17.4 ± 1.8, indicating statistical significance ($p<0.001$). 92% of nurses correctly answered specific questions regarding airway management on the post-test and OSCE skills assessment improved with all participants scoring >80% following teaching sessions. Additionally, nurses were asked to provide feedback given the Likert survey. After the teaching session, 79% of nurses in the study reported feeling more familiar with airway management strategies, while 63.3% and 74.3% reported confidence in the role of airway assistant and drug preparation respectively. Participants indicated the most helpful portions of the course were video demonstrations of airway procedures and preparation of airway equipment and medications. Limitations acknowledged in this study were that courses were online instead of conducted in person due to COVID-19 which gave way to internet connectivity problems and overcoming first time online course learning for some participants. The study population was heterogeneous with varying levels of airway experience which provided another limitation to the study. Even with these limitations, this study was able to assess the effectiveness of online learning modules completed by nurses in the management of airway scenarios. Further research and training can equip care providers in the ICU and ED with adequate information and boost confidence in their airway management strategies that can be lifesaving and enrich interdisciplinary team dynamics.

Han et al. (2018) conducted a quasi-experimental study of ICU nurses to assess the effects on self-efficacy and clinical performance of a simulation emergency airway management education program. Before the education program was established, 80 ICU nurses from a tertiary hospital were surveyed to determine needs for education in the emergency airway scenario. Nurses reported needing education in rapid sequence intubation, types of medications used, assessment and nursing care of a difficult airway patient, and rescue devices/interventions for failed intubation. Based on this information, the education program consisted of a 50-minute lecture portion with videos, descriptions, and airway management algorithms. Topics in the discussion portion were assessment of the airway, sequence of RSI, dose and administration of induction drugs, airway anatomy and the importance of positioning for airway manipulation. Failed intubation management was discussed with pictures and examples of other airway devices available. The simulation portion consisted of two 45-minute sessions in a training room resembling the ICU setting and contained standard emergency airway supplies, devices, and medications. Nurses worked in teams of 5-6 per suite, rotating through the simulation portion. Suite 1 simulated training for difficult airway management including demonstration by the educator, hands on video laryngoscopy practice with a mannikin, airway exchange catheters, and ended with an airway management simulation situation and debriefing. Suite 2 simulated failed intubation management strategies and RSI, assessment of the airway, preparation of supplies and medications, vital sign monitoring, and preparation of other devices in case of failed intubation such as supraglottic airways and bag mask ventilation. This simulation was again followed by debriefing. A pre- and post-training evaluation of self- efficacy (10 questions) and clinical performance (27 questions) was measured using a validated Likert scale questionnaire; Cronbach’s alpha was 0.90 and 0.97, respectively. Power analysis determined for a significance level of $p<0.05$ and a power of 0.8, there should be a minimum of 34 nurses in the sample size. Seventy ICU nurses volunteered for training, so to minimize selection bias, 36 nurses were randomly selected for inclusion. One nurse did not complete the evaluation; therefore, 35 nurses were considered in the analysis.

Prior to the education session and simulation, the nurses' mean self-efficacy score was 3.40 ± 0.33. Self-efficacy after education sessions and simulation experience improved to 3.98 ± 0.38, providing statistical significance ($t = 6.79$, 95% CI: 0.45-0.71, $p<0.001$). Clinical performance also showed statistically significant differences ($t=3.09$, 95% CI:0.21-0.45, $p=0.003$) in pre-test scores (3.90 ± 0.47) and post-test scores (4.23 ± 0.45). Subdomains of assessment, intubation, rescue devices, and surgical airway all showed statistically significant improvement in post test scores; confirmation of intubation was the only domain without statistical significance ($p=0.219$). The greatest improvement was seen in the rescue device subdomain, where post-test scores were 1.09-fold higher than pre-test scores ($p<0.001$). Additionally, 87% of the nurses in this study reported a desire for continued education in the area of rescue devices and preparation for surgical airway, as they felt it would allow them to become leaders in airway emergencies in the unit. The study limitations were that it was conducted in a single-center and therefore, it is unclear how results could be generalized. Another limitation is that because post-training assessments were conducted only 1 week following education, it is uncertain if the training had a lasting effect. Internal validity may be threatened with use of self-report questionnaires, the use of objective assessments would strengthen this study. Lastly, because this study was quasi-experimental with one group of pre-post design, it was recommended by researchers to conduct a random control with a pre-post control group to associate causality and produce more generalizable results.

Ben-Haddour et al., (2021) sought to determine if a cognitive aid focusing on pre- and post-intubation items utilized in the emergency department would improve adherence to guidelines during emergency intubations; a secondary objective was to measure procedure times. This study was a single-blind randomized control trial with manikin-based simulation in two medical center emergency rooms. Participants in the study were volunteer physician and nurse pairs from the two emergency room centers randomized into a control group and the cognitive aid (CA) group. The required number of participants to meet a 90% power with alpha value of less than 5% was 30 pairs; 34 pairs of physician-nurse teams were planned in order to account for exclusions. The cognitive aid was formed using national guidelines and current literature and encompassed five domains: equipment and patient positioning, hemodynamics, respiratory optimization, drug preparation, and post-intubation checks. Both groups completed the same emergency scenario, the CA group discovered the aid posted on the crash cart during the scenario to keep them unaware that they were being tested on adherence to guidelines. The pairs were instructed that they were free to organize their workflow, tasks, and equipment as they chose and that there is access to all equipment and drugs normally allocated to the ED. Outcomes were measured by physician-nurse pair adherence to the 30-item guideline grid. Binary scoring was used for each item as done or not done. A post simulation evaluation form filled out by participants included specialty, seniority in ED, and previous simulation experience. Additionally, a Likert scale survey asked participants to rank the cognitive aid based on usefulness, ease of use, and realism of the scenario. The mean score was estimated to be 70% and a 20% gain would indicate clinical significance of the cognitive aid. Adherence to guideline scoring and duration were conveyed in median with interquartile range (IQR) and compared using Wilcoxon test. The CA group and control group were compared by Fisher exact test and statistically significant results yield $p<0.05$.

Results showed that adherence to guidelines were significantly higher in the CA group compared to the control group (median = 28 of 30, IQR = 25-28 vs median = 24 of 30, IQR = 21-26, $p<0.01$). The five essential items on the CA determined by four expert physicians in ED medicine and anesthesiology were determined to be suction connected to vacuum and catheter, quantitative capnography, difficult intubation kit readily accessible, preoxygenation, and endotracheal tube placement confirmation via capnography. Items with low completion rates between both groups, without statistical significance, were face mask checked, sedation maintenance arranged, intubation head pad modified, hemodynamic maintenance prepared following procedure, and endotracheal tube placement checked (via chest x-ray ordered). The four items included in the guidelines which were performed significantly more in the CA group than the control group were: oral airway ready for use ($p=0.024$), ventilator prepared ($p=0.005$), quantitative capnography prepared ($p=0.024$), and difficult intubation kit accessible/requested ($p=0.0002$). Median preparation time in the control group was 11.8 minutes while the CA group was 13.8 minutes but was not statistically significant. Additionally in the CA group, the Likert rating for ease of use and usefulness was 4 out of a possible 5. Researchers determined via video analysis of the scenario that the aid was most often used in a step-by-step fashion and rarely was utilized as a final check, or timeout, prior to intubation; even more rare was the use of the CA following tube placement. A limitation of the study is that participants in the CA group were left to discover the aid on the crash cart and were unfamiliar with the aid itself. If bedside providers are subjected to the aid prior to emergency situations and trained in its use, they might be more efficient in implementation. Additionally, generalization may be limited due to volunteer samples and the implementation of a CA in only one simulation situation suggests the need for a variety of levels of difficulty. Physicians using cognitive aids have conveyed difficulty in reading the aid while gathering pertinent clinical information and maintaining essential communication with the team and the authors write that a reader for the checklist could attenuate this.

Related Literature

Culbreth et al. (2021) conducted a study to examine manual bag mask ventilation performance by respiratory therapists (RT) to evaluate mean tidal volume, peak pressure, peak flow rate, inspiratory time, and inspiratory rise in a simulation model. The authors hypothesized that therapists of varying years of experience would deliver high peak pressures, tidal volumes, and flow rates measured against recommended guidelines. One hundred and ten therapists at the American Association for Respiratory Care Congress were asked to manually ventilate a manikin, simulated to represent a healthy adult male 5'10" and 200 pounds, while observing chest rise for 18 breaths over 90 seconds. The target tidal volume based on ideal body weight (between 6-8mL/kg) for this experiment was 440-580ml, respiratory rate of 12 breaths/minute, yielding a minute ventilation of 5.28-6.96l/min. During the exercise, to serve as distraction, participants were asked socio-demographic questions including sex, years of experience, frequency of use of BVM, and confidence level of using BVM on a scale of 1-5 with 5 being most confident. Of the 110 therapists that volunteered, 98 were included in the study with 30% having 0-5 years of experience, 15% having 6-10 years, 13% having 11-20 years, and 42% having more than 20-years of experience. 59% reported using a BVM 0-5 times per month, while 32% used one ≤10 per month. Descriptive statistics were analyzed to determine mean ventilation performance by level of experience. Fisher test and one-way ANOVA were used to determine differences in the mean and a multivariable linear regression was used to determine statistically significant characteristics accompanying delivery of tidal volume, peak pressure, and peak flow rate.

The mean ventilation results across all participants included a tidal volume of 599.70mL, pressure of 26.35cmH2O, flow rate of 26.35l/min, inspiratory time of 0.75 second, and an inspiratory rise time of 0.49 seconds. RTs with >21 years of experience had the highest peak pressure, 26.94cmH2O ($F=3.03$, $p=0.02$), and flow rate, 79.31 l/min ($F=3.13$, $p=0.02$). RTs with more than 10 years of experience demonstrated higher mean tidal volumes compared to those with less than 10 years of experience, 619.84 mL vs. 574.09mL; while not a statistically significant difference, the clinical significance is important as large tidal volumes contribute to barotrauma and potentially gastric insufflation. When compared to all participants, therapists with >10 years of experience and who had rated their confidence with BVM the highest (5/5) provided the most unsafe ventilation with the highest mean volumes (631.43mL), peak pressure (30.55cmH2O), and flow (86.10l/min). Multiple linear regression results were statistically significant ($p=0.01$) for peak pressure delivered via BVM and confidence level. These results were compared to “safe” parameters identified using Z-vent and the Smart Lung 20000 2L test lung and previous literature on safe ventilation. Per the authors, it has been reported that inspiratory time for a breath should be between 1-2 seconds; breaths delivered faster than this can result in increased peak pressures and flow rate, which can lead to gastric insufflation. Authors also acknowledge that pressures above 15-20cmH2O can be unsafe, again leading to gastric insufflation. Researchers utilized literature from Bouvet et al. (2014) that studied anesthetized adults and concluded that 15cmH2O pressure provided the best equilibrium between adequate pulmonary ventilation and absence of gastric insufflation; results from this study showed a mean pressure of 26.35cmH2O, with those having >10 years of experience and rating themselves most confident delivering 30.55cmH2O, far exceeding safe ventilation parameters. Limitations to this study were that RTs were from a convenience sample attending the AARC conference and therefore results may not be generalizable; also, training factors, work setting, and other characteristics were not included. Additionally, the study was conducted on a simulation model rather than in the clinical setting, therefore it is difficult to determine variation. Lastly, 12 participants were excluded from the total sample size based on exclusion criteria to reduce bias; however, exclusion of these RTs may have introduced bias. Although ventilation is omitted in the RSI sequence, in the patient with respiratory distress and apnea, this intervention may be started while additional help arrives. This study shows that experience does not impact ventilation performance and underlines the need for supportive information to enable non-anesthesia providers to deliver safe care.

Theoretical Literature

Karamchandani et al. (2021) performed a narrative review of airway emergencies occurring outside of the operating room. Areas outside of the operating-room included the ICU, ED, radiology procedural areas, and medical-surgical nursing floors (Karamchandani et al., 2021). The intention of this narrative review is to discuss contributing factors associated with increased morbidity and mortality during emergency airway management outside of the OR, following intubation. In addition, evidenced-based practice recommendations to decrease morbidity and mortality of the critically ill patient postintubation were made. A focus was placed on three types of difficult airways during airway emergencies outside of the OR: physiologically difficult airways, anatomically difficult airways, and the situationally difficult airway (Karamchandani et al., 2021).

Reported by Karamchandani et al. (2021) contributors to the physiologically difficult airway include patient uncooperativeness, presence of respiratory compromise such as respiratory shunt or ventilation-perfusion mismatching, decreased physiological status of the patient (hemodynamic instability, critical illness, drug selection for intubation), and decreased functional residual capacity. Anatomically difficult airway elements were related to patient anatomy, the presence of physiologically stressors creating anatomical difficult airways, and the inability to identify patients at risk for a difficult airway due to poor sensitivity and specificity of bedside screening tests during airway emergencies (Karamchandani et al., 2021). Situationally difficult airways occur due to limited space, inadequate patient access, missing monitoring equipment, and limited availability of adjunct airway equipment (fiberoptic equipment, video-laryngoscopy equipment, and invasive and noninvasive airway supplements) (Karamchandani et al., 2021). Other issues with managing emergency airways outside of the OR are related to operator factors such as limited training, lack of experience, and other human factors (stress, cognitive overload, and inadequate communication amongst team members) (Karamchandani et al., 2021).

Per Karamchandani et al. (2021), drug selection and intubation technique are significant contributing factors to hemodynamic and respiratory compromise when intubating the critically ill patient and is a factor associated with increased morbidity and mortality. Karamchandani et al. (2021) discusses findings from an observational study of 2964 critically ill patients and reports that of these patients 45.2% experienced an adverse event following intubation. Adverse events were defined as cardiovascular instability, severe hypoxemia, and cardiac arrest; these adverse events occurred in patients 42.6%, 9.3%, and 3.1% of the time respectively (Karamchandani et al., 2021). The rate of difficult airways during intubation outside of the OR is reported as ranging from 11%-50% of the time (Karamchandani et al., 2021).

Karamchandani et al. (2021) recommends the use of a checklist to decrease the impact of the previously defined difficult airway contributors and reduce the incidence of adverse events. This recommendation comes with the acknowledgement of a recent study which failed to report a statistically significant impact on mortality with the use of checklists; however, the limitations of the study were acknowledged as relying on observational studies and recommends keeping checklists succinct to increase compliance and utilization. The recommendation of the PREPARE checklist in the form of a cognitive aid such as an algorithm, as part of an intubation bundle is made; this checklist was developed for out-of-OR airway emergencies (Karamchandani et al., 2021). This checklist was specified due to its inclusion of both patient and airway team members. Encompassed in this checklist are the processes before, during, and after intubation of the critically ill patient outside of the OR. Beginning with identification of need for patient intubation outside of the OR, an algorithm works in a stepwise fashion to check airway supplies (BVM, ETT of different sizes, supraglottic airways, ETT stylets, bougie, different DL blades, VL, suction equipment, EtCO2 detectors, oxygen supplies, drugs, and invasive airway kits), followed by assessment of the three difficult airway contributors (anatomic, physiologic, and situational), plan development (choosing drugs, team communication, role assignments and responsibilities), patient pre-oxygenation via varying techniques (high-flow nasal cannula, passive oxygenation via BVM, or non-invasive ventilation), patient positioning, and finally tracheal intubation (Karamchandani et al., 2021). Following successful intubation ETT placement is confirmed, ETT is secured, and patient hemodynamic status is assessed. If failure to intubate the patient after the first attempt occurs, optimization of laryngoscopy technique is performed (technique or operator change), while limiting intubation attempts to a maximum of three (Karamchandani et al., 2021). Continued failure to intubate the patient progresses to other backup-techniques including rescue oxygenation and finally invasive airway techniques. At the planning phase of this checklist, it is noted to call for additional help if needed. Failure to intubate after the first attempt triggers a mandatory call for help (Karamchandani et al., 2021).

Of additional importance this review provides a dedicated section of information on the technique of rapid sequence induction, noting there is significant variability in the utilization of drug choice and performance of cricoid pressure during intubation (Karamchandani et al., 2021). RSI is recommended for all out of OR intubations (Karamchandani et al., 2021). The application of cricoid pressure is left to the operator's discretion. It is recommended to use BVM ventilation in patients with high-risk for desaturation and noted that BVM ventilation can be a life-saving maneuver should intubation fail, or benefit of patient oxygenation outweighs the risk of patient aspiration (Karamchandani et al., 2021).

Toy et al. (2020) provides a case report documenting a breakdown of communication surrounding a patient presenting with acute respiratory distress as a result of Guillain-Barre syndrome (GBS) requiring emergent intubation, ultimately resulting in hyperkalemic cardiac arrest. Following an 18-day hospitalization for GBS, a 63-year-old female patient developed respiratory distress and anesthesia was subsequently consulted for intubation. RSI was performed utilizing appropriate doses of etomidate and succinylcholine; shortly after medication administration, the patient deteriorated from sinus rhythm to pulseless ventricular tachycardia.

Although a recent serum potassium level was reported by bedside nursing to anesthesia prior to medication administration, Toy et al. (2020) confirms a breakdown in communication occurred when the reason for hospitalization was omitted from the report and succinylcholine was administered to a patient with GBS. Severe hyperkalemia can occur when succinylcholine is given to patients with demyelinating diseases, upper or lower motor neuron injuries, burn injuries, crush injuries, or massive spinal cord trauma (Toy et al., 2020). It is reported that breaches in communication are responsible for 30% of preventable medical errors and are one of the foremost root causes of sentinel events in the US (Toy et al., 2020). Toy et al. (2020) writes that handoff, due to a lack of standardization, is a key period for communication errors to occur and that the stress of emergencies is more likely to impact breakdown in communication leading to poorer patient outcomes. Other components potentially impacting communication breakdowns are variances in each discipline's culture and goals of care, and hierarchical relationships such as those between nursing and advanced care providers or physicians (Toy et al., 2020).

A root-cause-analysis following the presented case resulted in the development of an emergent intubation algorithm for communication similar to SBAR (situation, background, assessment, recommendation) but with specificities aligned to one scenario: intubation. Toy et al. (2020) reports that of the 378 rapid assessment team (RAT) pages on the telemetry floor and 88 RAT pages to the ICU and ED, no adverse events have been related to airway management communication breakdowns since implementing the communication tool. Lack of communication between care providers, especially during emergencies, continues to be a significant patient safety hazard; tools such as checklists, algorithms, and guides reduce cognitive overload and aid in an all-encompassing preparation (Toy et al., 2020).

Critical Summary

Nigatu et al. (2022), Gupta et al. (2022), and Han et al. (2018) all examined the need for education in airway management by staff other than anesthesiologists and CRNAs. Of these studies, areas of focus included identification of techniques, equipment, patient signs and symptoms of respiratory compromise, indications for tracheal intubation, and rapid sequence induction techniques. These studies suggest, in a similar fashion, that care providers in areas such as intensive care units and emergency departments lack the knowledge, skills, and self-efficacy to care for patients effectively and confidently during airway emergencies, and rapid sequence induction and intubation rescue methods. The findings of these studies suggest that the implementation of either in-person or remote education training sessions, combined with in-situ training had a statistically significant impact on non-anesthesia providers comfort level in dealing with emergency airway maintenance, the equipment needed to care for these patients, and an overall improved knowledge and self-efficacy levels.

Limitations of these studies include the quasi-experimental or non-experimental nature of the studies, as well as the quality of the studies only being good. It is difficult to conduct experimental studies on patients undergoing emergency treatments, as care being withheld or not maintained to the standard of usual care is unethical. Furthermore, the smaller sample size of these studies brings into concern the generalizability of their findings. The longevity of effect following training was not studied, therefore this could be considered an additional limitation.

The general theme indicates that years of experience does not translate to improved knowledge in the delivery of RSI, nor does it improve non-anesthesia providers ability to identify indications for RSI or the equipment's and technologies needed to safely conduct an RSI intubation. A cognitive aid such as an RSI checklist can reduce cognitive overload for non-anesthesia care providers and aids in the correct drug selection, allocation of equipment for an RSI scenario, and ensures pertinent communication is relayed to the intubating provider. Cognitive aids reduce stress and help decrease the human factor during airway emergencies requiring RSI.

Conceptual Framework

The Systems Engineering Initiative for Patient Safety (SEIPS) is an adaptation of Donabedian's Structure-Process-Outcome model (Carayon & Wood, 2010). This adaptation offers a more thorough framework for healthcare settings and specifically identifies the people, task, tools and technology, environment, and organizations and how they affect patient outcomes (Lumley et al., 2020). Per Fitzsimons (2020), the SEIPS model aids in the recognition that improved patient outcomes stem from numerous sources such as interactions between people, tasks and physical environments, and the organization characteristics and culture. SEIPS framework also includes requisite respect to other perspectives and involves authentic participation (Carayon et al., 2020).

Carayon et al., (2020), describe SEIPS as a model anchored in human factors and ergonomics (HFE) which places the person at the center of work systems and emphasizes that work system elements should be devised to aid safety and avoid negative outcomes such as patient harm. In order of the domains originally described by Carayon & Wood (2010), the first step in improving patient outcomes related to RSI outside of the OR is to identify the people involved. Regarding RSI outside of the OR, the people of greatest concern in improving outcomes are both non-anesthesia and anesthesia providers as previously defined. In addition to providers, and of equal importance, is identifying the people who receive care - the patient (Lumley et al., 2020).

Next, defining the task is important. The task of the anesthesia provider may have multiple levels; with the most important task of RSI outside of the OR being intubation. Other secondary tasks such as medication selection and preparation, patient assessment, and identification of patient risk related to anesthesia care hold an important role in generating either a positive or negative patient outcome.

Tools and technology can be directly connected to the tools that anesthesia providers use for intubation and medication administration. In addition, the technology that anesthesia providers typically have available may not be available in areas outside of the OR. Recognizing the importance of proper tools, technology, and processes as it relates to RSI outside of the OR again impacts patient outcomes.

In the context of RSI outside of the OR, the environment is the location where anesthesia providers must perform their task of RSI. This paper examines the environment of ICUs and EDs and how it impacts the performance of anesthesia providers during RSI. The environment of RSI contributes to the success or failure of first attempt patient intubation. Environment also contributes a great deal to the available communication tools and technology during these high stress and often critical situations. Technology may be inadequate or missing and coupled with a lack of communication, puts patients at risk for negative outcomes.

Lastly, the organizational impacts of RSI outside of the OR as it relates to patient outcomes should be examined. Organizations must foster the culture to develop and implement interventions that will help care providers improve patient outcomes during RSI outside of the OR.

In summary, the five domains of the SEIPS model have a connection to RSI outside of the OR in ICUs and ED. This conceptual framework helps shape the important of examining RSI, and how it can impact patient outcomes, providing content for recommendations to adapt existing cognitive aids, which helps support the critical aspects of RSI that may be missed.

Method

Design

These recommendations to adapt existing cognitive aids is a mixed-method quality improvement initiative focused on the intensive care unit and emergency department. Evidence based quality improvement (EBQI) organizes evidence from patient outcomes to methodically improve healthcare delivery and improve the outcomes of a targeted group (Melnyk et al., 2019). Following identification of major communication points using content analysis, an expert panel of anesthesia providers determined the quality of these communications points, and were provided the opportunity to make recommendations to a cognitive aid to improve RSI. Furthermore, a conceptual framework was identified to guide the development of these recommendations. Qualitative data in the form of expert comments obtained from a content analysis was requested for every response rated as not important in order to make modifications for future implementation.

Sample and Setting

This quality improvement initiative took place at Jefferson Einstein Montgomery Hospital in Pennsylvania, which serves local residents with one medical-surgical intensive care unit and an emergency room.

A non-random, convenience sample of 24 full-time anesthesiologists and certified registered nurse anesthetists in the inpatient clinical setting comprised the sample for this project. Of the 24 participants in which the anonymous questionnaire was dispersed to, 16 completed the survey. Inclusion criteria for participation in the survey was by voluntary participation, survey completion, and must meet the criteria of anesthesiologist or certified registered nurse anesthetist. The sample was collected through electronic dissemination via email, with respondents completing the survey via Qualtrics Survey Software Program.

Ethical Considerations

Subsequent to successful proposal defense, the project was submitted to La Salle University institutional review board (IRB). Following project approval as an exempt proposal (Appendix B) a survey through Qualtrics Surveys Software Program was utilized to collect data. As explained in a disclaimer prior to survey completion (Appendix C), it was noted that participation was completely voluntary, the respondent held the right to stop at any time and/or chose not to respond to any question. Furthermore, the collected survey information is deidentified and stored within the Qualtrics Survey Software Program; access to survey results were limited to individual DNP project team members and password protected.

Instrumentation

A content analysis matrix (Table 2) was used to identify common communication topics which should be included in the development of recommendations to be used to adapt existing RSI cognitive aids for use by non-anesthesia care providers outside of the operating room, specifically the ICU and ED. An expert content validity survey (Appendix C) allowed reviewers to rate 6 communication points during RSI outside of the operating room identified from the literature review to be included as recommendations for adaptation to existing cognitive aids. Experts were asked to score the importance of each content point (Table 3) and numerical data were entered into Microsoft Excel (1= *not important*, 2 = *somewhat important*, 3 = *important*, 4 = *very important*). Project team members asked that experts scoring any item not important leave a comment to be included in data collection. Item content validity index (I-CVI) scores were calculated along with survey content validity average (S-CVI/Ave). These results are valuable to the inclusion of pertinent communication points for adaptations of existing cognitive aids regarding RSI outside of the operating room for use by non-anesthesia care providers.

Procedures for Data Collection

Data collection was based on review of current literature spanning years 2018-2023, regarding topics of rapid sequence induction being performed outside of the operating room. Common themes from literature review were identified prior to content analysis and utilized as the key items to be included in the content analysis. A conceptual framework was utilized as the basis of the project; the SEIPS framework allows for identification of major areas during RSI outside of the OR which contribute to negative patient outcomes and overall patient safety. General themes for the development of a communication category to be added to an RSI cognitive aid were derived from a critical analysis of literature. Directed content analysis allows for validation of the major themes identified and provides a direction on which to expand research for cognitive aid development. Following project proposal defense, the Expert Content Validity Form (Appendix C) was distributed via email to 24 expert anesthesia providers at one hospital setting. Additionally, the email contained a brief explanation of the project topic and specified a 2-week timeline for survey completion. After 1 week, a reminder email was sent to experts to ensure participation.

Data Analysis

Plans for Data Analysis

At the conclusion of the 2-week timeline for data collection, 16 respondents completed the survey and results were entered into Microsoft Excel. An item content validity index (I-CVI) analysis was conducted, and scores were calculated for each of the 6 items on the survey, as well as a scale content validity index average (S-CVI/Ave) (Table 6). Prior to calculating the I-CVI degree of relevance (Table 4) was established (Polit et al., 2021). Survey responses with a degree of relevance of 3 (quite important to the measured domain) or 4 (highly important to the measured domain) were assigned a relevance rating of 1, while items with a degree of relevance of 1 (not important to the measured domain) or 2 (somewhat important to the measured domain) were assigned a relevance rating of 0 (Table 5). For each survey item, the relevance ratings were totaled to sum the number of experts in agreement. The number of experts in agreement was divided by the number of expert respondents to determine the I-CVI. The goal I-CVI was 0.78 per Polit et al. (2021); this indicated excellent quality of the communication point. S-CVI/Ave was calculated by totaling I-CVI scores and dividing by the number of survey items. Survey content validity index average (S-CVI/Ave) of 0.80-0.90 is the standard for establishing excellent content validity (Polit et al., 2021).

Additionally, a comment was requested for any item an expert deemed not important. This qualitative input would serve to modify survey content constructs or language in order to align expert experience with current literature.

Results

Expert Content Validity Index

The survey was sent to a total of 24 content expert anesthesiologists and Certified Registered Nurse Anesthetists at Jefferson Einstein Medical Center Montgomery. Sixteen experts completed the survey, yielding a 66% response rate. Of the 16 respondents, one was an anesthesiologist, while 15 were CRNAs. All experts were employed as clinical anesthesia providers in the in-patient setting with varying years of experience. Expert content validity survey responses were anonymous and contained no identifiable information. Demographic data revealed that 0 experts had 0-5 years of experience in the field of anesthesia, one expert indicated having 6-10 years of experience, 2 experts indicated 11-15 years of experience, while 13 respondents indicated having greater than 15 years of anesthesia experience. Additionally, experts were asked how many times per month they intubated outside of the operating room. Fifteen experts answered they intubate outside of the operating room 0-5 times per month, 1 expert indicated intubating outside of the OR 6-10 times a month, while 0 respondents indicated intubating greater than 11 times per month.

I-CVI scores ranged from 0.31 to 1. Survey question 7, length of hospitalization, received the lowest I-CVI of 0.31 with 5 experts out of 16 in agreement that this item was significant. Question 4 regarding knowledge of patient age and weight received an I-CVI score of 0.63. All other survey question I-CVI scores were greater than 0.78; patient allergies, most recent potassium, brief history of illness, and history of difficult airway or history of tracheostomy received scores of 0.81, 0.88, 1, and 1 respectively. The S-CVI/Ave score was 0.76. See table 4 for results.

One provider scored question 7, knowledge of length of current hospitalization, as not important. Project leaders specified that a comment be made by experts scoring any survey item as not important. However, the provider did not leave a comment that would be useful qualitative data for modifying the survey question based on provider experience. Failure by the anesthesia expert to leave a useful comment resulted in no qualitative data regarding survey response of not important being collected. There were no requirements for comments to be made for survey responses greater than not important; therefore, no other qualitative data was collected. Please see Table 6 for full I-CVI and S-CVI/Ave scoring.

Discussion

Summary of Major Findings

Many of the aspects of a controlled induction and intubation are abolished outside of the operating room. Rapid sequence induction in areas with limited equipment and knowledgeable personnel can yield poor outcomes for patients. While cognitive aids are helpful in allocation of necessary equipment and drugs, they should also serve to reduce cognitive overload in high stress situations.

Through a literature review, project leaders identified gaps related to the inclusion of pertinent communication in current cognitive aids and clinical practice that are a crucial part of determining anesthetic drug selection and a technique tailored to each patient's needs in these unstable scenarios. These themes were identified across the literature and served to configure items presented on the Expert Content Validity Survey. Four of six content areas had a calculated I-CVI equal to or above 0.78, indicating the significance of communication points identified from literature. Patient age and weight had a calculated I-CVI of 0.63, which can be interpreted as good, and although this content area was outlined in the literature as important, experts may not deem this point as necessary to explicitly communicate. The lowest I-CVI was 0.31 and was assigned to the question regarding length of current hospitalization. While this point was identified in the literature as important for choice of anesthetic agent, experts rated it as not important. The location of this question follows question 6, "how important is it to know a brief history and presenting illness," could be the reason experts scored it as not important. One key aspect of a cognitive aid is that it is succinct and easy to follow. For this reason, and given this question's validity feedback, project developers recommend a modification to remove question 7 and include this information within question 6 (brief history and presenting illness), reducing the total content areas to 5 points of communication.

Limitations

One limitation identified was that the study was conducted at Jefferson Einstein Medical Center Montgomery. This facility is a small community hospital serving residents with one medical-surgical ICU and one ER with no trauma or high acuity capabilities. Facility size mall affect generalizability of results. This impacts the frequency of out of operating room intubations and influences the awareness of all providers in these scenarios. Additionally, the sample size was a small convenience sample of 24 anesthesia providers. A larger institution serving trauma patients and higher acuity patients would provide a larger anesthesia group that may have more experience outside of the operating room. Experts also did not leave comments for content areas they deemed not important. Expert participants may have felt that questions 6 and 7 were similar and could have influenced their answers. Lastly, the types of research being conducted in the years searched for literature was impacted by the COVID-19 pandemic, specifically surrounding airway management in the critically ill and prevention of viral spread.

Implications

Literature review indicates that items with I-CVI below 0.78 remain important, this shows a gap in awareness of the literature regarding the importance of communication during high stress situations and should be used to guide future projects. The goal of identifying and validating communication points is to incorporate a communication aspect into an existing cognitive aid to be used in high stress rapid sequence inductions outside of the operating room. This would serve to ensure vital aspects of patient information is verbalized to anesthesia providers in order to tailor anesthetic plans accordingly, while reducing cognitive overload for non-anesthesia providers. Utilizing the expert validated communication points, a cognitive aid should be modified, and a repeat survey conducted at a larger institution with more frequent RSI outside of the operating room.

Communication points validated in this project should act as a guide for a future doctoral project to construct and implement a visually appealing, easy to follow cognitive aid to be used by non-anesthesia providers in the ICU and ED. A pre-survey/post-survey by nursing and anesthesia staff utilizing the cognitive aid could serve to validate the importance of inclusion of communication and aid in reduction of cognitive overload. Finally, patients use of weight loss drugs, such as Ozempic, that results in gastroparesis should be considered as a future modification to cognitive aid communication points.

Conclusion

Rapid sequence induction and airway management outside of the operating room has proven to have poorer patient outcomes. Following a literature review, variability between RSI in the OR and ICUs or ED were identified as sources contributing to poor patient outcomes. While a cognitive aid exists for drugs, equipment, and optimization of patient conditions prior to anesthetic induction outside the operating room, there lacks a specific aspect that allows non-anesthesia providers to communicate appropriate information to anesthesia providers during these high stress times. Furthermore, existing cognitive aids are typically geared towards the anesthesia provider, or lack general indication as to which party is responsible for use of the cognitive aid. Following identification of key communication points from literature, an expert panel was identified, and the communication points were validated. It is recommended these communication points be utilized to adapt existing cognitive aids, enabling non-anesthesia providers guidance on proper communication of patient status to the anesthesia provider. Future implications include the recommendation to repeat this project at a larger institution, creation of a modified cognitive aid utilizing the validated communication points, and implementation of the cognitive aid in the ICU and ED The goal of this project was to identify and validate communication content areas that would be used to modify or adapt existing RSI cognitive aids to be used in the ICU and ED by non-anesthesia providers in order to reduce perceptive burden and improve patient outcomes.

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Table 1

Search Process for Review of Literature

N					
Database	Total Articles	Articles Remaining After Title Review	Articles Remaining After Abstract Review	Articles Retrieved and Examined	Articles that fit Inclusion Criteria
La Salle Summons	557	9	1	1	1
CINAHL	28	6	2	2	2
PubMed	145	7	2	2	2
Medline	305	10	2	0	0
ProQuest Dissertations & Theses Global	27	3	0	0	0
Cochrane Library	176	2	0	0	0

Note. Number of duplicate articles removed = 10

Table 2
Review of Literature Matrix

Database # Article First Author, Year (Full citation in References)	Purpose of Study Major Variables (IV, DV) or Phenomenon	Theory or Conceptual Framework	Design	Measurement Major Variables (Instrument)	Data Analysis (Name of Statistics, descriptive, Inferential and Results)	Findings	Evidence Level of Research & Quality Johns Hopkins Nursing Evidence-Based Practice
CINAHL # 1 Nigatu, M. (2022).	To analyze nurse emergency airway and breathing management knowledge, practices, and associated factors in the ED of 3 selected public hospitals. DV: knowledge and practice of nurses in emergency airway and breathing management IV: sociodemographic characteristics:	None	Cross-sectional survey	Standardized self-administered questionnaire. 16 multiple choice questions in the knowledge section with 1 correct answer (mean value for knowledge was determined). 10 multiple choice questions in practice questions regarding emergency airway and breathing management.	Descriptive Statistics used to summarize data on nurse practice in emergency airway and breathing management. Information entered to epi data 3.1 then transferred to SPSS version25. Bivariable and multivariable logistic regression models were used to link DV and IV. All IV with p value <0.25 in bivariable logistic regression analysis were fitted into multivariable logistic regression analysis. Strength of connection was measured using crude odds ratio and adjusted	Survey n=102, 96.2% response rate. Mean value knowledge questions=9.44 (59%), respondents scoring ≥ mean value were considered knowledgeable. Participant knowledge of airway/breathing management was 46 (45.1%). Bivariable logistic regression showed that related training and job experience were significantly correlated with knowledge of airway/breathing management ($p=0.029$ and $p=0.075$ respectively). Nurses that received training were 2.72	III-B

	age, sex, education level, work experience, emergency training				odds ratio with 95% confidence intervals. Statistical significance p<0.05.	times more likely to be knowledgeable, p=0.047 (COR 2.72, 95%, CI 1.11-6.67) compared to those that did not receive training. Nurses with 1-5 years experience were 2.54 times more likely to provide knowledgeable answers compared to those with <1 year experience.	
PubMed #1 Gupta, B. (2022).	The purpose of this study was to assess the efficacy of a standardized online airway course to increase the ability of nurses in airway management of critically sick patients and to develop Emergency Airway Response Team knowledge, dynamics, and individual confidence. DV: nurse knowledge regarding protection required during	None	Prospective observational study over 4 months	Google form links of "pre test" and "post test" questionnaire consisting of 20 multiple choice questions with 1 point each, including theoretical questions relating to airway management. 10 objective structured clinical examinations-OSCE (1 point each). Skill performance stations were evaluated by 2 experienced instructors based on OSCE response. Successful completion was achieved with a 70% on post test and 80% on skills. 8 question Likert scale feedback	SPSS version 23.0 was used to evaluate statistical analysis. pre and post test questionnaire was analyzed for primary outcome. Secondary outcome was assessed as OSCE based assessment. Descriptive statistics were used to represent the results and were presented as the mean and standard deviation. Student's t-test was used to analyze data regarding intra- and inter group comparison. A mean Likert score was used to assess the survey. P<0.05 was considered statistically significant.	n=946 nurses completed the pre test, training, and post test. Pre-test analysis found a mean score of 8.47±4.2 out of 20 while the post-test found a mean of 17.4±1.8, statistical significance p<0.001. 68% of nurse participants were life support trained. 71% of participants displayed a knowledge deficit in plans for airway management, drugs required for RSI, and advanced equipment like video-laryngoscope. Overall knowledge of airway management of COVID 19 patients improved significantly after the education session (p<0.001). ~92% of nurses correctly responded to questions specific to airway	III-B

	airway assessment, difficult airway predictors, management guidelines and sequence of plan, airway equipment, drugs, RSI, mask ventilation, video laryngoscopy, SGA placement, and front of neck access (FONA). IV: live audio-visual lectures, case scenarios, presentations, and skills stations.			form provided information regarding participant efficacy in airway management.		management on post-test. All participants score ≤80% on OSCE based assessment. Participants identified video demonstration of airway procedure, preparation of airway cart and medications as the most helpful portion and 79% reported they were familiar with airway management, 63.3% and 74.3% reported self-confidence in the role of airway assistant and medication assistant on the post program survey.	
PubMed #2 Han, M. (2018).	The aim of this study was to inspect the effects of a simulated emergency airway management education program on the self-efficacy and clinical performance of	None	Quasi-experimental; one group pre-post design	Pre-post Nurses' self-efficacy in emergency airway management was measured using a validated 10 question Likert scale survey; the Cronbach's = 0.9 Pre-post clinical performance in airway management	Sample size was determined using G*power 3.1.8 program and it was determined by power analysis that the minimum sample size was 34 for medium effect of 0.5, significance level of 0.05, and power of 0.8. 70 participants volunteered for the	n=35 completed the pretraining evaluation, training, and post-training evaluation. 91.4% of participants held bachelor degrees and 65.7% had worked in ICU for <5 years while 34.3% reported >5 years in ICU setting. 42.9% had never previously had simulation education experience. The self-	II-B

	nurses in the ICU. DV: self-efficacy and clinical performance of nurses in the ICU regarding RSI, medication, assessment and interventions of patients with airway distress, and airway devices IV: educational program encompassing lecture and simulation			was measured using 27 validated questions on a Likert Scale involving assessment, intubation, confirmation, rescue devices, and surgical airway. Cronbach's =0.97.	training, so in order to minimize selection bias 36 participants were randomly selected from the 70; 1 participant did not complete the questionnaire so was excluded. Post test evaluations were collected 1 week after training sessions. Data were analyzed using SPSS version 21. Results were written as N (%) or mean ± standard deviation. The study utilized paired t-tests to assess if the simulation education enhanced self-efficacy and clinical performance in airway management. $P<0.05$ was considered statistically significant	efficacy score pre-training was 3.40 ± 0.33 and 3.98 ± 0.38 after education, indicating statistical significance $p<0.001$. Clinical performance scores were 3.90 ± 0.47 before training and 4.23 ± 0.45 after, again meeting statistical significance of $p<0.003$. Assessment, intubation, rescue device: indication, bag mask ventilation single handed and two handed, and surgical airway indications all had statistically significant improvements in post training scores. The only category not meeting statistical significance of $p<0.05$ was confirmation of ETT placement. The category of greatest improvement of scores was indications for supraglottic devices/rescue devices. 87% of nurses in this study reported a desire for training in rescue	

						devices and surgical airway, recognizing this would help them confidently take leading roles in airway emergencies.	
Summons #1 Ben-Haddour, M. (2022).	Determine if a cognitive aid in the emergency department would improve adherence to guidelines during emergency intubations; secondary objective to measure procedure times. DV: adherence to guidelines	None	2-center Single-blinded randomized control trial	Manikin-based in situ simulation in ED resuscitation rooms. Participants were being tested on adherence to RSI guidelines. Primary outcome was the performance of physician-nurse pairs according to their adherence to guidelines score of 30 on a grid; the scoring grid comprised 30 items. Each item was scored binary as done or not done. Secondary outcomes were procedures times, defined as time between intubation	Required number of participants to meet a 90% power with alpha value <5% was 30 pairs, 34 pairs of physician-nurse teams total utilized. Mean score estimated to be 70%, a 20% gain would indicate clinical significance of the CA. Adherence to guideline scoring and duration were conveyed in median with interquartile range and compared using Wilcoxon test. The CA and control group were compared by Fischer exact test and statistically significant results	RCT N=34, adherence to guideline scores found to be statistically significant in CA group versus control group; median = 28 of 30, IQR = 25-28, vs. median = 24 of 30, IQR = 21-26, respectively, p<0.01. Individual items presented in univariate analysis with completion rate of more than half of criteria being high >90%, and identical between groups. Items with low completion rates but no significant difference were face mask size checked, sedation maintenance prepared, Jackson-position modified/ intubation head pad modified, hemodynamics	I-A

				and start of anesthetic induction; and time between start of induction and inflation of endotracheal tube cuff. Post simulation evaluation completed by all participants. Additionally, a Likert scale survey asked participants to rank the CA based on usefulness, ease of use, and realism of scenario.	needed to yield P < 0.05. Standard deviation was computed using standard deviations observed in the control groups and interventional groups of 2 similar studies.	maintenance considered, and endotracheal tube placement checked. Four items were significantly more performed by the CA group versus the control group and accounted for overall difference: oropharyngeal airway requested and ready to use, mechanical ventilator prepared, and checked, quantitative capnography ready to use, and difficult intubation kit prepared in the event of difficult intubation. Preparation time and intubation time were not statistically significant. CA preparation time: IQR = 9.9-18.1 minutes; control group preparation time: IQR = 8.8-13.9 minutes (p = 0.29). Intubation time for CA, IQR = 2.0-3.9 minutes; control group, IQR = 1.9-3.0 minutes (p=0.49). Total time was not statistically	

						significant with IQR of CA group median 28.6 minutes and control group median time of 23.0 minutes; p=0.45.	

Note. *Full Citation cited in References

Table 3

Likert-scale Scoring

Code	Label
1	Not important
2	Somewhat important
3	Important
4	Very important

Table 4

Degree of Relevance	
1 =	Item is not important to measured domain
2 =	Item is somewhat important to measured domain
3 =	Item is quite important to measured domain
4 =	Item is highly important to measured domain

Table 5

Relevance Rating	
Degree of relevance = 1 or 2	Relevance rating = 0
Degree of relevance = 3 or 4	Relevance rating = 1

Table 6

Item Content Validity Index Analysis																		**Experts in agreement**	**I-CVI**
	Ex-1	Ex-2	Ex-3	Ex-4	Ex-5	Ex-6	Ex-7	Ex-8	Ex-9	Ex-10	Ex-11	Ex-12	Ex-13	Ex-14	Ex-15	Ex-16			
Item																			
Q4	0	1	1	1	0	0	1	1	0	1	1	0	1	0	1	1		10	0.63
Q5	0	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1		13	0.81
Q6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		16	1
Q7	0	0	1	0	0	0	0	1	1	0	1	0	1	0	0	0		5	0.31
Q8	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1		14	0.88
Q9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		16	1
																		S-CVI/Ave	0.77

Appendix A

Letter of Support

Einstein
MEDICAL CENTER MONTGOMERY

More than Medicine

Frank J. Tornetta School of Anesthesia
LaSalle University School of Nursing

Michael Kost, DNP, CRNA
Director

Cynthia Betron, DNP, CRNA
Associate Director

October 5, 2022

DNP Committee Members
(Bernard & Callaro)

Letter of Support for DNP Project

Dear LaSalle University Nurse Anesthesia Track DNP Project Committee Members:

This letter is in strong support of the DNP project currently proposed by Ryan Bernard and Danielle Callaro. The Frank J. Tornetta School of Anesthesia at Einstein Medical Center Montgomery will provide clinical experts for Mr. Bernard's and Ms. Callaro's project, while adjusting their anesthesia clinical and class schedules to allow for adequate time to complete their DNP project. Once the team successfully defends their proposal, they will submit the project to Einstein's Institutional Review Board (IRB) for review. Since the nature of the project is quality improvement and is without risk to human subjects, it is expected to be given IRB approval with exempt status. Any future work that involves use of this project's materials will be submitted for its own separate IRB review.

Please let me know if you have any questions or need any additional information. We remain in full support of Mr. Bernard's and Ms. Callaro's DNP project and will make every effort to accommodate them so that their DNP project remains a scholarly priority while enrolled in this program.

Respectfully Submitted,

Robert Simon, DNP, MS, CRNA, CHSE, CNE
Assistant Director

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Einstein Medical Center Philadelphia Einstein Medical Center Elkins Park Einstein Medical Center Montgomery
MossRehab Willowcrest Einstein Physicians Einstein Outpatient Care

Appendix B

La Salle University IRB

Date: December 7th, 2023

Type of Review: Initial

Project Title: Evidence-Based Cognitive Aid on Rapid Sequence Induction for Non-Anesthesia Care Providers Outside of the Operating Room

Investigator: Ryan Bernard and Danielle Callaro

To the investigator:

The abstract of the planned activity noted above was reviewed by a member of the La Salle University IRB and determined not to be human subjects research. This decision applies only to the planned activity described in the abstract as provided to the IRB. As the person accountable for the conduct of the activity, you are responsible for ensuring that it is conducted as described in the materials provided.

Please note that any data collected for this activity cannot be analyzed and presented for another purpose unless an updated project description and analysis plan is approved by the IRB. Although much can be learned from these types of activities and sharing your findings is strongly encouraged, this project as currently described cannot be referred to as "human subject research" when discussed in publications and presentations. Innovation Programs (IP) and Quality Improvement (QI) projects should not be described as a "study" or "research" in publications or presentations, but should be clearly identified as a "program", "program evaluation", or "QI project." An acceptable statement that could be included in the manuscript would be "The project was reviewed and determined not to meet the definition of human subjects research by the La Salle University IRB."

Please contact me at borkowsk@lasalle.edu if you have any questions.

Susan C. Borkowski, Ph.D.

Chair, Institutional Review Board

Appendix C

Expert Analysis

Block 1

EVIDENCE-BASED COGNITIVE AID ON RAPID SEQUENCE INDUCTION FOR NON-ANESTHESIA CARE PROVIDERS OUTSIDE OF THE OPERATING ROOM

Dear Anesthesia Colleagues,

As part of the fulfillment of the requirements for the Doctorate of Nursing Practice (DNP) degree through Frank J. Tornetta School of Anesthesia at Jefferson Einstein Medical Center Montgomery, in conjunction with La Salle University, we, Ryan Bernard and Danielle Callaro, have chosen Evidence Based Cognitive Aid on Rapid Sequence Induction for Non-anesthesia Care Providers Outside of the Operating Room as our doctorate topic.

The goal of this project is to identify critical communication points to be included in a future cognitive aid on rapid sequence induction (RSI) outside of the operating room for use by non-anesthesia care providers; including pertinent communication points prior to anesthetic induction. This cognitive aid will be a mixed-method quality improvement initiative focused on RSI outside of the controlled environment of the operating room and will serve to improve healthcare delivery and patient outcomes.

Your contribution to this project as a content expert in the field of anesthesia is valued. We are asking that you please complete this brief survey to aid in validating essential areas of communication that should be implemented in a cognitive aid utilized outside of the operating room during Rapid Sequence Induction. This will serve to reduce cognitive overload of non-anesthesia care providers while offering anesthesia providers information necessary to tailor emergent induction plans.

Please note that your participation is completely voluntary, you may stop at any time and/or choose not to respond to any question. All collected survey information is dis-identified and stored in the Qualtrics Survey Software Program. Access to the Qualtrics Survey Software Program is limited to the individual DNP Project team members. We ask that you complete this survey before 3/15/24.

Thank you for participating in our DNP scholarly project survey,
Danielle Callaro and Ryan Bernard

Default Question Block

Are you an Anesthesiologist or CRNA?

- ○ Anesthesiologist
- ○ CRNA

How many years of anesthesia experience do you have?

- 0-5 years
- 6-10 years
- 11-15 years
- >15 years

How many times per month do you intubate patients outside of the OR?

- 0-5
- 6-10
- 11-15
- >15

When intubating outside of the OR, how important is it to know the patient age and weight?

	Not Important (comment required)	Somewhat Important	Important	Very Important
Comments. An answer choice of Not important requires a comment.	○	○	○	○

When intubating outside of the OR, how important is it to know patient allergies?

	Not Important (comment required)	Somewhat Important	Important	Very Important
Comments. An answer choice of Not Important requires a comment.	○	○	○	○

When intubating outside of the OR, how important is a brief history and presenting illness?

	Not Important(comment required)	Somewhat Important	Important	Very Important
Comments. An answer choice of Not Important requires a comment.	○	○	○	○

When intubating outside of the OR, how important is it to know the length of current hospitalization?

	Not Important(comment required)	Somewhat Important	Important	Very Important
Comments: An answer choice of Not Important requires a comment. No comment write n/a	○	○	○	○

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