EMERGENCY MANUALS IN ANESTHESIA

IMPLEMENTATION OF AN EMERGENCY MANUAL AT A LEVEL 1 TRAUMA CENTER AS A PILOT PROJECT

by

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Abstract

Background: Managing rare anesthesia emergencies (eg, amniotic fluid embolism, anaphylaxis, malignant hyperthermia, or an unanticipated difficult airway) are challenging. Having immediate access to evidence-based solutions may improve patient safety. Despite significant training of anesthesia providers, studies have shown that recall of best treatment practices are less than optimal during stressful situations. This can be partially remedied by use of a collection of evidence-based checklists - an emergency manual.

Method: A pilot project implementing an adult-specific emergency manual at five anesthetizing locations at a level 1 trauma hospital to assess the awareness, interest, and knowledge among the peri-operative team towards utilization of a collection of evidence-based checklists.

Results: Convenience sampled surveys using a pretest-posttest design tested if the awareness, interest, and knowledge towards the use of an emergency manual increased after implementation. Results showed a widespread pre-implementation awareness, interest, and knowledge, yet indicated this level increased 15% after implementation and that a substantial majority of previous users recommended the utilization of an emergency manual during crises situations.

Conclusions: Literature shows the use of an emergency manual improves management of rare anesthesia emergencies and, thereby, increases patient safety. Awareness, interest, and knowledge towards the use of an emergency manual can increase after implementation.

Keywords: emergency manual, cognitive aid, checklist, anesthesia.

SECTION 1

Section One includes a short description of the premise of this capstone project. This chapter is divided into the following sections: (a) Introduction, (b) PICO Statement, and (c) Plan for This Capstone Project.

1.1 Introduction

Patients having unexpected physiologic reactions are seen during everyday life in the operating room, but most of these are insubstantial and have no consequences for patient outcomes. Recognizing the situation early will most often allow the health care provider opportunities to change course and remedy a potential bad outcome. The use of potent drugs and volatile gasses by anesthesia providers affect the patient's physiological systems and at any time these systems may react with an unpredicted response. There is a constant possibility for this unpredicted response to cause an adverse event, although, such an event is not necessarily initiated by an error. Use of an emergency manual with a collection of diagnosis specific and evidence-based checklists can be an invaluable tool in such crisis situation.

For an adverse event to occur several errors or unexpected reactions need to line up without being recognized; this is termed the Swiss cheese model.[1(p769)] Our daily work has several layers of protection,[1(p769)] which each has the potential to block an error in a previous layer. Only when all the layers of protection line up 'perfectly', like the holes in slices of Swiss cheese, is it possible for this string of errors to cause an adverse event. The potential for a bad patient outcome is introduced. When an adverse event initiated by a string of errors or unpredicted physiological reactions happens, quick and accurate recovery becomes essential. A well-known adage states 'speed comes from doing it right the first time'. Recovering from a difficult situation should not expose the patient to greater probability for a poor outcome. These adverse types of situations happen infrequently and, therefore, the correct recovery sequence

may be difficult to remember, despite the anesthesia providers extensive training. Relying on memory and experience from previous similar circumstances during the stress of a critical situation become unreliable.[2,3] Writing in relation to emergency situations Goldhaber-Fiebert and Howard[3(p1149)] note "the vast majority of clinicians do not implement all known best practices optimally. Sometimes, vital steps are never performed."

How is it possible to change the odds stacking up against the human memory function during stress? Several authors have suggested the use of cognitive aids also called checklists or emergency manuals.[1–11] Goldhaber-Fiebert and Howard write "with appropriate use, emergency manuals can be a helpful resource for important management priorities during many critical events,"[3(p1149)] although, they do emphasize that "emergency manual *implementation and use* [emphasis added] are 2 important elements."[3(p1149)] Both of these elements must be shared to improve the odds of our memory function during stress. Having a successful implementation of the Emergency Manual will be useless if it is not utilized during a crisis. The question arises - is this the right time for emergency manuals? Shekelle, Pronovost, Wachter et al[10] did an extensive literature search for the top patient safety strategies that could be encouraged for adoption at this time. The number one recommended initiative with strong recommendations from this study was "preoperative checklists and anesthesia checklists to prevent operative and postoperative events."[10(p336)]

Checklists are not a new concept and have been used extensively in other industries (eg, airlines and nuclear power plants). Checklists are part of a larger concept used in aviation - the Crew Resource Managements (CRM) concept. Pizzi et al write "CRM emphasizes the role of human factors in high-stress high-risk environments"[12(p501)] and further elaborate that CRM involves team training, simulation, and group debriefings, as well as measurements and

improvement of performance. Moreover, Pizzi et al mention that "65-70% of safety problems (accidents or incidents) have been attributed at least in part to human error"[12(p504)] and CRM training, known in anesthesia as Anesthesia Crisis Resource Management (ACRM), has been developed and can be a valuable tool in anesthesia.

In 2001 Pronovost[13] introduced a trial of a simple checklist at a hospital and Pronovost et al[14] published the results of this concept used on a much larger scale in 2003. Gawande[15] in *The Checklist Manifesto* exposes the extreme complexity and the massive amounts of new knowledge we rely on in our professional life using examples of intensive care units at hospitals, flying large airplanes, and building enormous skyscrapers. Such complexity, Gawande explains, makes it highly unlikely a single practitioner can "deliver its benefits correctly, safely, or reliably. Knowledge has both saved us and burdened us."[15(p13)] His solution is a checklist. Wachter on the topic on patient safety writes that "Gawande would doubtless agree that checklists can't solve all our problems, but they … can help us deliver healthcare that is safer and more reliable."[16(p270)]

The goal of this capstone project is to increase the awareness, the interest, and the knowledge about cognitive aids by implementing and encouraging the use of an emergency manual for adults at five pilot anesthesia locations at a level 1 trauma hospital. There is overwhelming support found in the literature for the concept of emergency manuals. Interestingly, no studies identified during the literature search had measured changes in awareness, interest, and knowledge after implementing an emergency manual. Having a readily available emergency manual at an anesthetizing location will make recovery from unavoidable emergency situations safer for the patients. The institution, where this capstone project's emergency manual will be implemented, had no anesthesia specific cognitive aid for adults available at the time of implementation. Research of available cognitive aids or emergency

manuals, already extensively tested in clinical or simulation settings at other institutions, was completed. The best and most useful of these options was selected for implementation at the project institution.

1.2 PICO Statement

1.2.1 Population

The chosen population for this project was the peri-operative team available during a crisis situation at an anesthetizing site at a level 1 trauma center.

1.2.2 Intervention

The project called for placing a sturdily bound adult-specific emergency manual that would be readily available at the pilot locations at the project institution. The Emergency Manual included available, already made and tested, as well as customized to the project institution, evidence-based and diagnosis-specific emergency situation checklists.

1.2.3 Comparison

Comparisons for this project were the pre- and post-implementation surveys on awareness, interest, and knowledge among stakeholders towards use of emergency checklists in a crisis situation.

1.2.4 Outcome

The outcome of this project was to improve the awareness, interest, and knowledge for the use of emergency checklists among the peri-operative team.

1.3 Plan for Capstone Project

A thorough review of the literature was conducted to explore the available knowledge in the use of cognitive aids in anesthesia. After sampling several available premade emergency manuals, the best option for the project institution was chosen. The choice was based on the superior quality, as well as the thorough testing which this manual had endured at several

hospitals and the reputations of the anesthesia cognitive aid group associated with this manual. Furthermore, the ability to customize the selected emergency manual to better adapt to the project institution's needs was considered. The management group at the project institution was approached to solicit general and financial support for the project of implementing emergency manuals at five pilot locations. Prior to implementation of the customized emergency manual, several volunteer champions among the CRNAs, SRNAs, and MDAs were selected. Awareness, interest, and knowledge toward the use of an emergency manual among staff members at the project institution were evaluated; this was done prior to as well as after implementation of the Emergency Manual. After implementation, review of the results, and completion of this capstone project, the stakeholders at the project institution were briefed on the findings and conclusions.

1.3.1 Pilot Project Step-by-Step

Below is a short step-by-step outline of the process for this capstone project. A more detailed description can be found under 7.2 Audit Trail. The audit trail, sometimes called a decision trail, "provides a summary of important activities that have been completed in the process of developing the capstone project."[17(p104)] Bonnel and Smith suggest thinking about the audit trail "as a listing by dates of specific activities you have completed."[17(p104)]

- Read announcement of Anesthesia Patient Safety Foundation (APSF) workshop regarding emergency manuals;
- Applied and was approved as APSF workshop participant;
- Searched the available literature regarding cognitive aids;
- Capstone synopsis, proposal, literature review, timeline, and PICO statement sent to advisors and approval received;

- Participated in APSF workshop in Phoenix, AZ;
- Researched possible emergency manuals and selected emergency manual to implement, made customization, and bought copies for project;
- Received general and financial support from department corporate director and department management;
- Created surveys;
- Pitched project for department staff, operating room (OR) staff, and anesthesia physician group;
- Did pre-implementation survey;
- Distributed emergency manuals to all pilot locations;
- Continual in-services to staff and anesthesia physicians regarding project;
- Did post-implementation survey;
- Analyzed results from pre- and post-implementation surveys;
- Wrote capstone project paper;
- Created webpage at http://em.stormanesthesia.com specific for capstone project;
- Disseminated the capstone project to anesthesia staff and students, OR staff and anesthesia physician group, as well as Missouri State University.

SECTION 2

Section Two includes a description of the conceptual framework and a thorough review of the literature on cognitive aids in anesthesia. This chapter is divided into the following sections: (a) Definitions, (b) Theoretical Framework for Capstone Project, (c) Search Strategy, (d) Review of the Literature, and (e) Purpose Statement.

2.1 Definitions

Emergency manuals, cognitive aids, or checklists are interchangeable terms used in the literature to describe lists of evidence based steps necessary for specific emergency situations.

This project will use the term emergency manual to describe the collection of several evidence-based and diagnosis-specific emergency situation checklists to be used in an emergency situation where anesthesia is involved. This emergency manual will be tailored towards adults, although, it may be useful for selected pediatric emergencies as well. The Emergency Manual (capitalized) in this project is such a customized manual.

A reader is a person whose responsibility during the emergency situation is to read from the Emergency Manual. This person will not have other duties during this crisis situation. For this project the reader is an available CRNA, although, not the primary CRNA for the emergency situation.

Job credentials used in the surveys for this project include: CRNA is a Certified Registered Nurse Anesthetist, SRNA is a Student Registered Nurse Anesthetist, MD is a Medical Doctor, RN is a Registered Nurse, Scrub technician is a surgical technologist, Other technician covers all other technician credentials (eg, cardiovascular technician or x-ray technician).

MDA is a medical doctor specializing in anesthesiology.

Peri-operative team includes CRNAs, SRNAs, MDs, RNs, Scrub technicians, Other technicians, and any other staff member available in the operating area.

ACLS, PALS, and CPR are acronyms for Advanced Cardiac Life Support, Pediatric Advanced Life Support, and Cardiopulmonary Resuscitation respectively.

2.2 Theoretical Framework for Capstone Project

Implementation of a new tool in the operating area can be a challenge. Many stakeholders are involved and the probability of a successful implementation increases when all stakeholders believe in the project. "Nurses [and physicians] can no longer rely solely on their clinical experience to provide quality care."[18(p4)] Critical situations for the anesthesia providers are rare despite increased patient acuity, in part because the safety of anesthesia has improved significantly over the last couple of decades.[19,20] Regardless of these improvements, Cooper and Gaba write, "safety is a never-ending process" and "we should not be complacent, believing that we have won the war."[19(p1337)] White and Dudley-Brown acknowledge there is a "tremendous growth of new knowledge available to today's health care clinician"[18(p4)] which makes it exceedingly difficult to rely on the clinicians personal practice experiences. Use of an evidence-based-practice (EBP) model will allow for a better guidance of the implementation of a new tool. Most models have several steps in common (ie, identify the clinical issue, search for the best evidence, critically appraise the evidence, decide on recommended actions, implement the actions, and finally evaluate the implementation in relationship to chosen outcomes).[18(p7)]

This capstone project was based on a mixed method design. First, a EBP model as the conceptual framework and, second, a testing model to allow for documentation of any changes noted after the implementation of this new tool.

The Advancing Research and Clinical Practice Through Close Collaboration (ARCC)[18(p18)] model was chosen due to: (a) its focus on an advanced practice nurse's EBP mentoring of clinical staff (the peri-operative team); (b) the model's intention to help bridge the gap between academic and clinical nursing (CRNAs, SRNAs and RNs); and (c) the model's

emphasis on organizational strength and support for successful implementation of the chosen project. A pretest was given prior to implementation of the Emergency Manual to assess the awareness, interest, and knowledge toward a cognitive aid. Five weeks after the Emergency Manual was implemented the same test was given to see if the level of knowledge about emergency manuals, as well as the awareness and interest towards its use had changed. Terry explains: "Pretest-posttest designs look at the outcome of interest before the application of an intervention and then after an intervention."[21(p85)] Despite the weakness of this design, as pointed out by Terry, "difficult to attribute causation to the intervention when there is neither randomization nor a control group,"[21(p86)] the design was chosen to help determine the level of interest for such an emergency manual implementation across the campus of the project institution.

The Advancing Research and Clinical Practice Through Close Collaboration model was originally conceptualized by Bernadette Melnyk in 1999 to "more fully integrate research and clinical practice as well as to advance EBP within an academic medical center."[22(p337)] Fineout-Overholt et al further describe how one of the goals of this model is "disseminating and facilitating use of the best evidence from well-designed studies to advance an evidence-based approach to clinical care."[22(p337)] This project implemented an emergency manual – evidence-based and specific to emergency situations arising in the anesthesia environment. The ARCC model "relies on mentors with in-depth knowledge of EBP and expert clinical and group facilitation skills"[18(p18)], all of which define the CRNA undertaking the Doctor of Nurse Anesthesia Practice education. The ARCC model is described as a model focusing on EBP implementation[23(p1200)] and recommends five steps[18(pp18-19),23(p1200)] for this EBP implementation process: (1) decide on the clinical question; (2) search and find the best available evidence and

assess the EBP process within the institution; (3) decide on an EBP mentor; (4) implement the EBP into practice, if the evidence is found adequate; and (5) evaluate the outcomes from the implementation project. Fineout-Overholt et al describe how implementation of EBP can be made more successful. Success entails having EBP mentors, partnership between academic and clinical settings, use of champions, time and resources, and administrative support.[22(p342)]

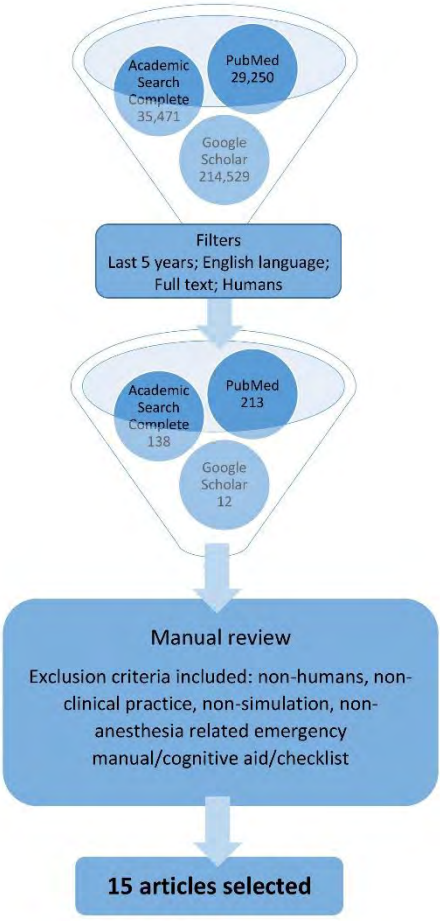
The collection of quantitative data using a pretest-posttest design allows the researcher to assess the awareness, interest, and knowledge among the stakeholders at the project institution and determines the need for further education and training. Identifying baseline awareness, interest, and knowledge is essential to guide continuous education and training to ensure a successful across campus implementation of an emergency manual at the project institution.

2.3 Search Strategy

A thorough search of the literature utilizing PubMed, Google Scholar, and Academic Search Complete from Missouri State University Library was done in July 2015 and again in February 2016. The raw search results were then manually examined, reference lists from selected articles were reviewed, and relevant articles not found in the initial search were included.

Filters used for search were full text, last five years, humans, and English text. Search terminology used were ‘emergency manuals’, ‘cognitive aids’, ‘checklists’, and ‘anesthesia’. A total of 363 articles were identified following filtering. After manual review, which excluded articles not pertaining to humans, clinical practice,

Figure 1 – Search Strategy



simulation, or anesthesia related emergency manual/cognitive aids/checklist, the final count of relevant articles were 15 as shown in Figure 1. A detailed review of these 15 articles can be seen in the 7.3 Literature Review Table.

2.4 Review of the Literature

This review of the literature found extensive support for the use of cognitive aids. Despite a few individual comments in the anesthesia literature that expressed concerns of the value of checklists, all studies reviewed recommended the use of checklists and cognitive aids during the management of crises situations.

Although the concept of 'choking' is well documented[24] in relation to athletes, the same concept is also present during crises management in the operating room, where "failure to implement knowledge under stress"[3(p1152)] is common. This, according to Goldhaber-Fiebert and Howard, can be seen as avoidable performance gaps[3(p1151)] and, they further elaborate, "stressful situations have been shown to negatively impact multiple aspects of human memory, including retrieval of inert knowledge, working memory for calculations, and prospective memory for future tasks."[3(p1152)] Goldhaber-Fiebert and Howard note that those "that consult an emergency manual for simulated critical events perform vital actions more often, more efficiently, and more accurately than those who do not."[3(p1152)] Jenkins writes: "Cognitive aids are documents, visual prompts or decision guides that, unlike guidelines or protocols, are used when tasks are being performed."[2(p660)] This distinction between guidelines/protocols and cognitive aids is important and as Marshall explains, the main difference is that the cognitive aids "are to be used while the task is being performed."[25(p1162)] Guidelines and protocols are lengthy written documents[25(p1163)] the anesthesia provider adhere to in their daily practice, but these guidelines or protocols are written too intricately to be of value in an emergency situation. Jenkins further writes: "Checklists contain actions or tasks that cannot be readily recalled due to their sheer number, or

where the correct sequence of tasks is important."[2(pp660-661)] As mentioned, human brains deceptively do not perform optimally under stress, which becomes a major hurdle when handling rare emergency situations in the operating room.[3(p1152)] Immediate availability of a well-written evidence-based emergency manual as a reference source during a crisis would be one solution to this lack of optimal human brain performance.[2(p660),3(pp1149,1151)]

Cognitive aids, as part of Crew Resource Management (CRM), have proven effective combating the problem of suboptimal human brain performance. The concept of CRM was developed by the aviation industry under the name 'cockpit resource management' - later renamed crew resource management[11(p25)] - and "improvements in the safety record of commercial aviation may be due, in part, to this training."[12(p501)] Team work is the cornerstone of CRM. Health care has been working on the application of the CRM concept for the last 25 years[12(p501)] and experience "has demonstrated that effective resource management is an important component of managing challenging situations."[11(p25)] Anesthesia has embraced the concept of CRM and the slightly altered terminology 'Anesthesia Crisis Resource Management' (ACRM) has been adopted.[11(p25)] Goldhaber-Fiebert and Howard mention that "emergency manual implementation and use are 2 important elements within the larger context of team training, such as crisis resource management (CRM)."[3(p1149)] One potential difficulty when introducing CRM in surgery is the historical steep hierarchy (in which junior staff do not question senior staff) in the operating room and Sexton et al note that "consultant surgeons were least likely to advocate flat hierarchies (55%). By contrast, 94% of cockpit and intensive care staff advocated flat hierarchies."[26(p747)] As pointed out by Pizzi et al: "Cultural shifts in medicine are also necessary if the CRM approach is truly to take root."[12(p506)]

Search of available literature on the topic of emergency manuals/cognitive aids/checklists for anesthesia reveals that there are many potentials for the anesthesia response to falter when crisis strikes. Crises will happen; it is only a matter of when. Preparing for a crisis is difficult, since most emergencies will be different from normal practice situations. Jenkins[2(p661)] comments that management of emergency situations has a tendency to rely heavily on previously gained experience, and most of this experience has been acquired through routine practice. Jenkins[2(p661)] and Borshoff[27] note that in emergencies there is a risk for fixation errors, which Gaba et al define as "persistent failure to revise a diagnosis or plan in the face of readily available evidence that suggests a revision is necessary."[11(p44)] Mishaps have been documented in the anesthesia literature where experienced anesthesia providers became victims of fixation errors. One such prominent experience was the Elaine Bromiley case in Great Britain.[28,29] An independent investigation for that tragic incidence concluded: "Too much time was taken in trying to intubate the trachea rather than concentrating on ensuring adequate oxygenation by other means such as direct access to the trachea."[28(p15)] Undoubtedly an example of fixation error by the anesthesia providers. A solution to fixation errors could be use of an emergency manual. Jenkins writes[2(p662)] "cognitive aids have been shown to improve adherence to standard treatment" and that "they [cognitive aids] may also help by reducing dependency on factual recall during stress, and reduce errors by constraining actions to a pre-determined sequence of evidence-based interventions."

Arriaga et al found "in a high-fidelity simulation study, checklist use was associated with significant improvement in the management of operating room crises."[6(p246)] Furthermore, 97% of the participants reported "that they would use the checklists if presented with these operative emergencies in real life"[6(p250)] and that "if I [the participants] were having an operation and

experienced this intraoperative emergency, I would want the checklist to be used."[6(p250)] Gaba concluded that "absence of evidence is not evidence of absence, and the growing number of groups that have decided to vote with their feet by creating or adopting what they see as the best available set of cognitive aids attests to the desire of clinicians to avoid paralysis by analysis and to do something sensible to close the gap from nothing to something."[5(p1035)] Augoustides et al suggest "that it is time to move the implementation of checklists beyond the simulation laboratory into anesthetic practice both for elective and emergency care. The cheese has moved, and it is time to enjoy the taste of the new offerings."[7(p1038)]

During cardiac arrest situations, deployment of Advanced Cardiac Life Support (ACLS) is standard practice. American Heart Association (AHA) has developed structured, sequence-logic algorithms to provide help during the stressful emergency of a cardiac arrest. Jenkins recognizes that "these aids may be viewed as 'cognitive crutches' to provide visual and textual prompts during lapses of memory or, on another level, as tools that help individuals and teams cope with a rapidly changing, complex and stressful environment."[2(p662)] Use of ACLS algorithms during the resuscitation of a cardiac arrest have long been recognized as the standard, and proper adherence to these standards have shown increased survival rates.[30(p86)] It is easy to imagine that implementation and usage of emergency manuals in the operating room could have an equally positive influence on anesthesia related crises. At the recent Anesthesia Patient Safety Foundation (APSF) expert workshop titled *Implementing and Using Emergency Manuals and Checklists to Improve Patient Safety,* 82% of the participants supported broad implementation and felt that "every site of perioperative care should have one or more emergency manuals readily accessible."[31(p68)] The APSF workshop went as far as to recommend that "the pre-surgical

timeout should consist of the verification of the presence of an emergency manual, to remind the team that anyone can suggest its use, and that a reader be designated."[31(p71)]

As early as 1924 Babcock asked the question: "Have you a plan of action so developed that the right thing is always done in the emergency and time is not frittered away with useless or non-essential details?"[32(p208)] Furthermore, Babcock asked: "Do you ever hold emergency drills in your operating room?"[32(p208)] These questions could be asked today with equal validity. Goldhaber-Fiebert and Howard write: "In other high-stakes industries, such as aviation and nuclear power, emergency manuals have proved to be helpful tools, are integrated into training, and are expected to be used."[3(p1149)] On the same topic, Mulroy writes: "We are now adapting to the checklist concept that has been used in aviation for 80 years, and for anesthesia machine checks for 50."[9] Clearly, the high-risk industry of anesthesia is late in the adoption of the cognitive aids concept. In an analysis of patient safety strategies that can be encouraged for adoption at this time, Shekelle et al[10(p366)] found 22 such strategies, and their number one suggested strategy with a strong recommendation was "anesthesia checklists to prevent operative and postoperative events." Is the time right for the adoption of emergency manuals in the anesthesia setting? It seems prudent to conclude that the anesthesia community should employ the adage "better late than never" and fully embrace the concept of emergency manuals. Gawande[15(p13)] writes that "the volume and complexity of what we know has exceeded our individual ability to deliver its benefits correctly, safely, or reliable" and his solution: "It is a checklist."

What are some of the downsides to emergency manuals/cognitive aids? It is obvious that choosing the wrong checklist may lead the management of the crisis down the wrong path.[31(p69),33(p6)] Emergency manuals may list positive identifiers in the individual checklists and

as August writes: “Confirmation bias may also play a role, as clinicians look to verify that, indeed, the suggested items on the checklist are present, rather than seeking any disconfirming evidence to support an alternate diagnosis.”[34] Confirming wrong markers as correct and present is known as confirmation bias and will lead the anesthesia provider down the wrong path. Stiegler and Tung[35(p214)] suggest checklists, written algorithms, or clinical decision aids as tools to limit these biases that can lead a provider to prematurely settle on a diagnosis. They specifically mention that “checklists and similar algorithmic cognitive aids, particularly when managed by a caregiver (‘reader’) whose explicit task is limited to ensuring the algorithm is followed, are increasingly popular as decision support tools for critical events in the operating room.”[35(p214)]

August mentions that “phenomena such as framing effects, premature closure, and confirmation bias are among a larger group of decision factors that might contribute to error.”[34] The framing effect is the “preference to behave differently depending on whether the decision is viewed as a gain or a loss.”[35(p211)] When confronted with a difficult airway crisis will the anesthesia provider consider a surgical airway (eg, a cricothyrotomy) a liability for the anesthesia provider, a loss, or a possibility of patient survival, a gain? This distinction will affect what decision the anesthesia provider will make since, as Stiegler and Tung write, there “is a stronger preference to avoid a loss compared with the desire for a similarly sized gain.”[35(p211)] The use of an emergency manual/cognitive aid, listing the recommended steps for the chosen diagnosis, may help alleviate the fear of failure, the loss, that may cloud the anesthesia provider’s decision making.

This researcher participated in the APSF expert workshop titled *Implementing and Using Emergency Manuals and Checklists to Improve Patient Safety* in September 2015. At this

workshop Raemer spoke on" the pitfalls and risks associated with the use of emergency manuals."[31(p69)] Raemer acknowledged not having data but raised anecdotal stories about the difficulties with the use of emergency manuals that had led him to question their usefulness. He gave examples[31(p69)]: (a) a wrong diagnosis lead the practitioners down the wrong path, and correct treatment is not applied; (b) a mixed diagnoses caused team confusion by going back and forth between pages; and finally (c) team-distraction, when no page in the emergency manual covered the crisis at hand the team became distracted looking for the missing page and did not provide appropriate treatment. The conference participants consisted of more than one hundred anesthesia safety stakeholders from around the US and the audience response "revealed that 99% of participants believed that the introduction of EMs [emergency manuals], like any new technique or technology in medicine, presents unanticipated risks and potential complications."[31(p69)] Borshoff[27(p1387)] raises the concern that "an incorrect diagnosis can lead to the wrong checklist being used, and a disproportionate sense of urgency can result in fixation error" and he continues "specific checklists will not be a perfect fit for every clinical context and may actually distract from task prioritizing." Despite these potential pitfalls "the audience response [at the APSF workshop] indicated that only 19% of participants believed that limitations of checklists must be overcome before their use should be widely adopted."[31(p70)]

Goldhaber-Fiebert and Howard expressed that individual practitioner's unfamiliarity with the terminology "may feel it insults their capabilities, implying that they have a cognitive impairment."[3(p1150)] Another view mentioned by Gaba: "Historically, there are many pejorative terms for such aids, such as 'cheat sheets', 'crib sheets', 'crutches', and 'cookbooks'."[5(p1033)] Use of aids has historically been perceived by anesthesia providers "as a sign of weakness or lack of intelligence."[5(p1033)] This perception may be a challenge to change among some, but as advocated

by Hannenberg at the APSF conference "we create a 'we use checklists' mentality, the idea being that good clinicians use cognitive aids."[31(p70)] Gaba points out that "to force a definitive taxonomy could be counterproductive"[5(p1033)] and he suggests the more neutral terminology 'emergency manual', which was adopted by this capstone project. As outlined in this literature review, the information strongly supports the usefulness of cognitive aids. Two questions come to mind: (1) who should develop such checklists with focus on anesthesia emergency situations, and (2) should use of an emergency manual be standard of care? Among the APSF conference audience "79% agreed that anesthesia professionals should lead the development of the content for cognitive aids"[31(p70)] but only 67% supported that the time was right "whether EMs should ever become a standard of care."[31(p71)]

Patient safety and use of emergency manuals or other cognitive aids are still in its infancy and more research is necessary before we can state with certainty if patient outcomes will improve. Though skeptics and practitioners who believe they 'know it all' will always exist, the preponderance of the evidence is unequivocal in its support for the implementation and usage of emergency manuals.

2.5 Purpose Statement

The purpose of this capstone project was to increase the awareness, interest, and knowledge towards the utilization of an adult-specific emergency manual in crises situations. This was accomplished through implementation of the Emergency Manual at five pilot anesthesia locations at a level 1 trauma hospital. If support for the use of an emergency manual can be established in this capstone project, the future goal is to implement the Emergency Manual across campus at the project institution, which will make handling of rare emergency situations safer for the patients and easier for the anesthesia providers.

SECTION 3

Section Three includes the methodology of the project. This chapter is divided into the following sections: (a) Pilot Project, (b) Institutional Review Board, (c) Data Collection, (d) Timeline, (e) Budget, and (f) How Did the Implementation Take Place.

3.1 Methodology

3.1.1 Pilot Project

Pilot testing is a well-recognized approach to validate a new instrument on a small scale before a full implementation. Instead of an immediate implementation across campus of a major institution a phased approach, a pilot study, allows the opportunity to receive feedback and work out any barriers before going live facility-wide.[36(p82)] Weaknesses in the process can be addressed and the slight delay of the full implementation, due to the pilot testing, may actually ensure success when going live across campus. According to Mason and Zuercher (as cited by van Teijlingen and Hundley[37]) pilot studies can show "unanticipated problems, but it is better to … deal with them before investing a great deal of time, money."

The project Institution is a level 1 trauma center in a metropolitan area in the Southeast US. It was decided to do a five-location pilot project choosing four operating rooms: the trauma room, two neurosurgical rooms, the orthopedic trauma room, and one remote location: an X-ray vascular procedure room. Each anesthetizing location was equipped with two copies of the Emergency Manual. One copy was located at the anesthesia cart close to the CRNA and the other copy was with the circulating nurse at the computer on wheels. Both copies were tethered with an 8-foot steel cable to make loss of the manual less likely. The cables were secured using a quick link system for possible removal if necessary.

As mentioned earlier, several champions were identified. Each of these champions were chosen based on their interest in patient safety and emergency manuals and the champions

included CRNAs, MDAs, and SRNAs. While this researcher was the primary initiator of the implementation of this project, the champions were important to spread the awareness and interest in the project among other stakeholders.

Prior to the implementation of the pilot project a pre-implementation survey (Appendix A) was completed to establish the baseline of awareness, interest, and knowledge towards emergency manuals/cognitive aids/checklists among stakeholders at the project institution. Correspondingly, five weeks after the implementation a post-implementation survey (Appendix B) was completed to see if the awareness, interest, and knowledge towards this new tool had changed.

3.2 Institutional Review Board

According to the project institution's Institutional Review Board (IRB) policies this project does not need IRB approval, as it is a survey not dealing with patient specifics. This was confirmed with the IRB manager at the project institution, as well as the IRB specialist at the Missouri State University Anesthesia program. The surveys were anonymous and, thereby, maintaining the privacy of the survey participants. No identifiable data such as age, gender, or ethnicity were collected. No survey participants were paid, coerced, or received any incentive to participate in the surveys.

3.3 Data Collection

Human subjects were the source of data for this project design. The participant population included a convenience sample among staff and physicians in the surgery and x-ray departments working on a single day prior to implementation and two consecutive days five weeks after implementation of the Emergency Manual.

The project included a pre-implementation survey (Appendix A) given to all available certified registered nurse anesthetists, registered nurses, physicians, scrub technicians, and other

technicians working the day of implementation, although, prior to the implementation being commenced. A post-implementation survey (Appendix B) was done five weeks later to assess if any changes in awareness, interest, and knowledge were noted. The goal of these surveys was to document the level of awareness about and knowledge of emergency manuals before and after implementation of the project, as well as the interest towards the use of an emergency manual.

Both surveys were given as a paper copy and were anonymous. All results were manually tallied by primary researcher and verified by an independent party. The data was then entered into Microsoft Excel spreadsheet (pre-implantation survey: Appendix C and post-implementation survey: Appendix D).

A pretest-posttest design was utilized for the surveys, which included identical questions in both surveys. The goal was to establish a baseline of knowledge regarding emergency manuals, as well as interest and awareness towards the use of such a tool. The follow up survey was distributed five weeks after implementation to see if this baseline level of awareness, interest, and knowledge towards emergency manuals had changed.

Results were tallied according to credential: CRNA, RN, MD, Scrub Technician, and Other Technician, as well as an aggregate of all participants.

3.4 Timeline

Timeline for Capstone Project		
ANE 897 – Summer 2015 through ANE 898 – Spring 2016		
Dates	**Milestone**	**Met**
June 2015	Identify potential areas of interest for capstone project	✓
June 2015	Do preliminary literature search for potential project	✓
June 2015	Develop a problem statement for proposed project	✓
June 2015	Determine the type of project I want to do	✓
June 2015	Identify secondary advisor	✓
July 2015	Identify primary advisor	✓
July 2015	Complete and send Capstone Committee approval form for project to program director	✓
July 2015	Comprehensive literature searches and write literature review	✓
July 2015	Write a proposal, with references, and submit to primary advisor	✓
July 2015	Obtain approval from both advisors to proceed with project	✓
August 2015	Determine if IRB approval is needed. Check process with Kevin LeBlanc PhD, CRNA if necessary at the project institution for this type of project	✓
End of ANE 897 – Summer 2015		
September 2015	Select possible options of the Emergency Manual	✓
September 8-9, 2015	Attend the APSF conference in Phoenix, AZ on the topic "Implementing and Using Emergency Manuals and Checklists to Improve Patient Safety"	✓
October 2015	Present the Emergency Manual to the management team at the project institution	✓
October 2015	Create, pre-implementation and post-implementation surveys	✓
November 2015	Make revisions to the Emergency Manual with input from management team	✓
February 2016	Order the selected Emergency Manual	✓
March 2016	Deliver in-services for staff (CRNAs, MDs, OR staff) on the use of The Emergency Manual	✓
March 2016	Distribute the Emergency Manual to all anesthetizing sites at the project institution	✓
March 2016	Distribute, and collect pre-implementation survey to all stakeholders	✓
April 2016	Distribute, and collect post-implementation survey to all stakeholders	✓
April 2016	Evaluate the implementation of the Emergency Manual and assess to what extent this new tool is being used	✓
May 2016	Create a presentation of the project for ANE 898	✓
May 2016	Final product - webpage at http://em.stormanesthesia.com	✓
May 2016	Complete the Capstone Project Completion Form and submit to program director	✓
End of ANE 898		

3.5 Budget

The cost of this project included buying sample emergency manuals and multiples of the chosen emergency manual, the tether cables and quick-links for distribution, copying of surveys, travel and accommodation for the Anesthesia Patient Safety Foundation (APSF) workshop, and the time involved by the primary researcher and volunteer champions (CRNAs, SRNAs, and MDAs). The direct costs were absorbed by the hospital anesthesia department and the champions volunteered their time at no cost.

SECTION 4

Section Four includes the results of the project. This chapter is divided into the following sections: (a) Results, (b) Pre-implementation Survey, and (b) Post-implementation Survey.

4.1 Results

The surveys were conducted at the project institution, which is a single, although representative, institution in the Southeast United States. The participants were staff and physicians in the surgery and X-ray vascular procedure departments. This cohort consisted of CRNAs, RNs, scrub techs, other techs, as well as physicians. Students nurse anesthetists were counted as RNs and physicians were both anesthesiologists and other physicians. The pre-implementation survey was done during a single day and the post-implementation survey over two days.

4.2 Pre-implementation Survey

The pre-implementation survey was conducted on March 07, 2016. A total of 144 surveys were distributed and 111 responses were collected, which gave a response rate of 77.1%. One of the surveys was incomplete and removed from analysis, leaving a final sample size of

Figure 2 – Pre - Credentials Distribution

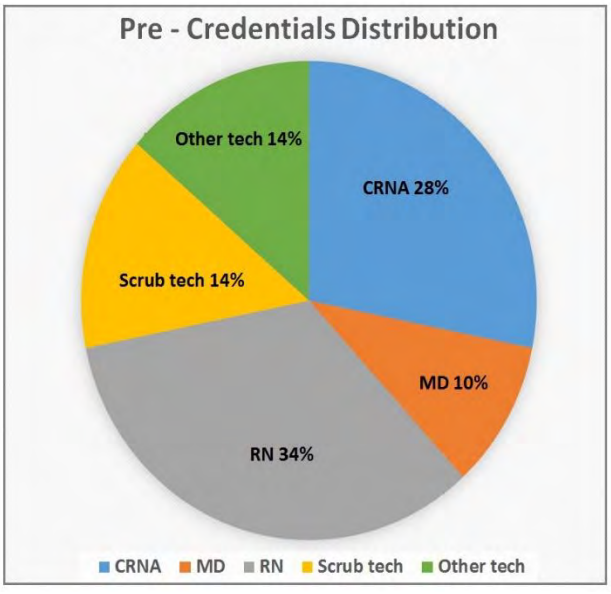
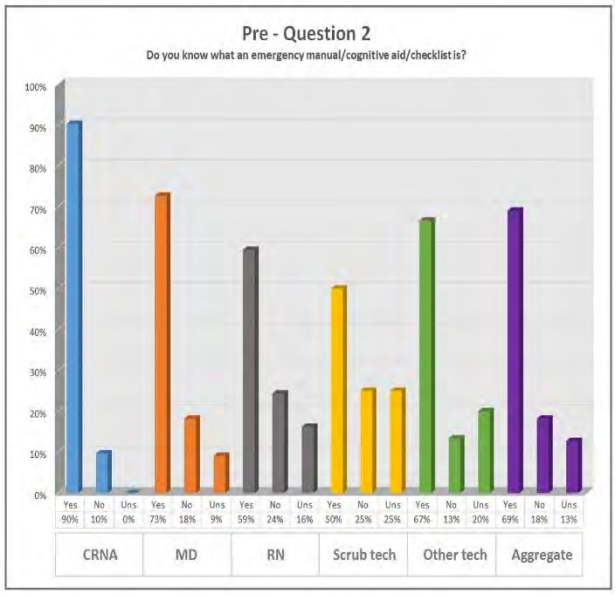


Figure 3 – Pre - Question 2



n=110. The full chart of pre-implementation responses can be seen in Appendix C. The majority of the responses were from RNs (34%; n=37) closely followed by CRNAs (28%; n=31). The credential characteristics of the participants can be seen in Figure 2.

The aggregate result of Question 2 (Figure 3) showed that the majority of participants (69%; n=76) knew what an emergency/cognitive aid/checklist was and within these responses CRNAs (90%; n=28) and MDs (73%; n=8) showed a greater knowledge than Other techs (67%; n=10), RNs (59%; n=22), and Scrub techs (50%; n=8). There were 31% (n=34) in the aggregate that did not know or were not sure if they knew what an emergency/cognitive aid/checklist was. Scrub techs (50%; n=8), RNs (40%; n=15), and Other techs (33%; n=5) had the lowest levels of knowledge as to what an emergency manual/cognitive aid/checklist was.

In response to Question 3 (Figure 4) regarding use of an emergency manual/cognitive aid/checklist in their work area the aggregate result showed that a small majority (53%; n=48) used such aid. CRNAs (64%; n=18) had the highest usage, but Scrub techs (58%; n=7), MDs (56%; n=5), and RNs (50%; n=14) were close behind. Other techs (31%; n=4) had the lowest

Figure 4 – Pre - Question 3

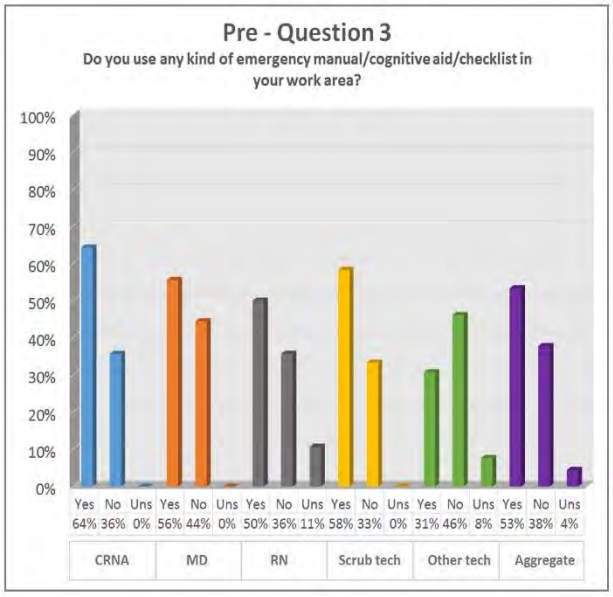
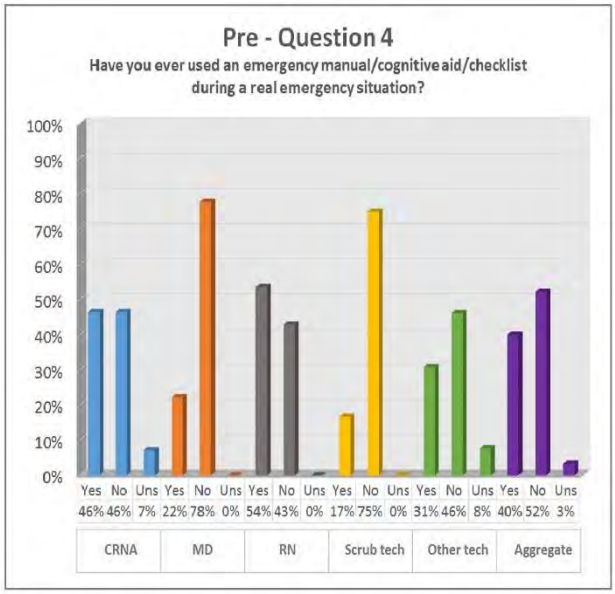


Figure 5 – Pre - Question 4



usage. The aggregate showed that 38% (n=34) did not use an emergency manual/cognitive aid/checklist. The credentials that used an emergency manual/cognitive aid/checklist the least were Other techs (46%; n=6) and MDs (44%; n=4). CRNAs (36%; n=10), RNs (36%; n=10), and Scrub techs (33%; n=4) were all in the vicinity of one third.

Question 4 (Figure 5) asked if the participant had ever used an emergency manual/cognitive aid/checklist during a real emergency situation and the aggregate result showed that only a minority (40%; n=36) had done so. More RNs (54%; n=15) and CRNAs (46%; n=13) had used it than Other techs (31%; n=4), MDs (22%; n=2), and Scrub techs (17%; n=2). Only among the RNs had a majority used an emergency manual/cognitive aid/checklist during a real emergency situation. Among the MDs (78%; n=7) the majority had never used an emergency manual/cognitive aid/checklist during a real emergency.

Question 5 (Figure 6) asked if, among the participants who answered yes to Question 4 (had used an emergency manual/cognitive aid/checklist during a real emergency situation), the use of such an aid had helped. Overwhelmingly, the aggregate result (97%; n=35) showed that

Figure 6 – Pre - Question 5

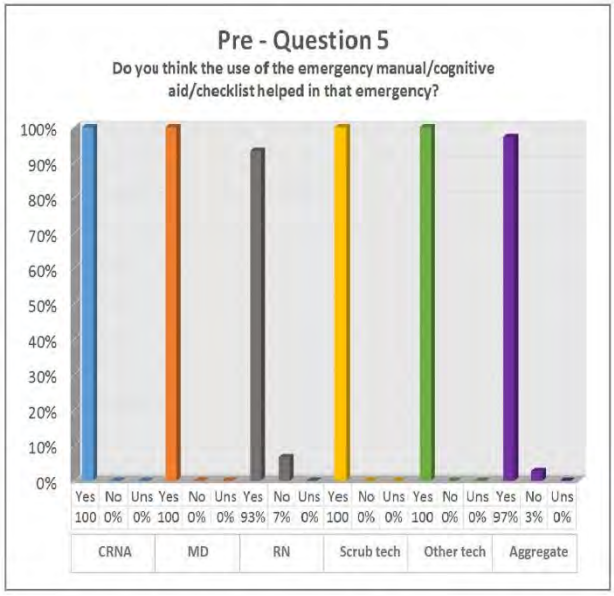
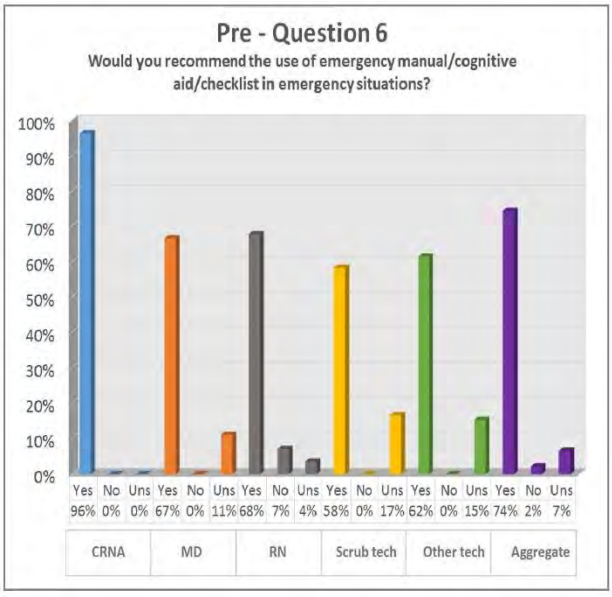


Figure 7 – Pre - Question 6



participants found it helpful. CRNAs (100%; n=13), MDs (100%; n=2), Scrub techs (100%; n=2), and Other techs (100%; n=4) all had total confidence that the use of an aid had helped. Among the RNs (93%; n=14) a single participant did not think the aid had been helpful.

Question 6 (Figure 7) asked if the participant would recommend the use of such an emergency manual/cognitive aid/checklist in emergency situations. The aggregate result showed the majority (74%; n=67) would recommend the use. CRNAs (96%; n=27) had the highest amount of agreement, but among RNs (68%; n=19), MDs (67%; n=6), Other techs (62%; n=8), and Scrub techs (58%; n=7) the majority agreed as well. A few RNs (7%; n=2) did not recommend the use of an emergency manual/cognitive aid/checklist.

4.3 Post-implementation Survey

The post-implementation survey was conducted over two days, April 7-8, 2016. A total of 169 surveys were distributed and 135 responses collected. This corresponds to a response rate of 79.9%. None of the responses were discarded. The full chart of collected responses can be seen in Appendix D. The majority of the post-implementation survey responses came from

Figure 8 – Post - Credentials Distribution

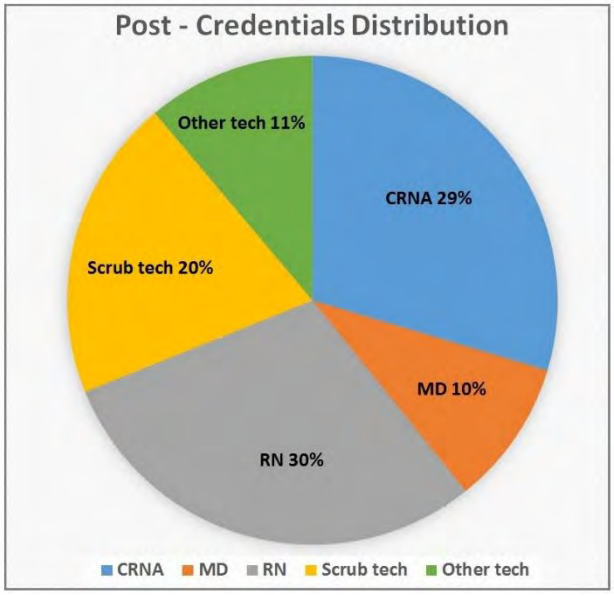
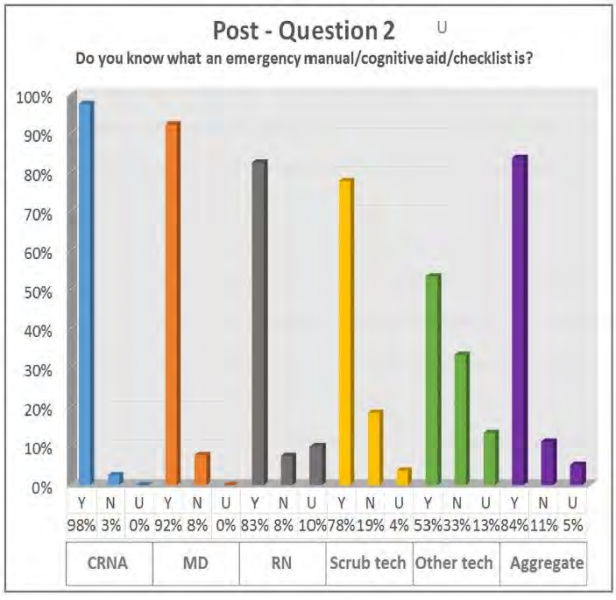


Figure 9 – Post - Question 2



CRNAs (30%; n=40) and RNs (30%; n=40). Credentials distribution of participants is shown in Figure 8.

Aggregate result of Question 2 (Figure 9) shows that the majority of participants knew what an emergency manual/cognitive aid/checklist was (84%; n=113). CRNAs (98%; n=39) and MDs (92%; n=12) showed the highest level of knowledge for this tool, although, among RNs (83%; n=33), Scrub techs (78%; n=21), and Other techs (53%; n=8) the majority also knew about this tool. There were 16% (n=22) in the aggregate that did not know or were not sure what an emergency manual/cognitive aid/checklist was and these participants were mostly among Other techs (46%; n=7) and Scrub techs (23%; n=6), although, there were people among all credentials that did not know or was not sure what it was: RNs (18%; n=7), MDs (8%; n=1), and CRNAs (3%; n=1).

In response to Question 3 (Figure 10) regarding the use of an emergency manual/cognitive aid/checklist in their work area the aggregate result showed that the majority did so (74%; n=84), although, the individual credentials were closely bundled: RNs (82%;

Figure 10 – Post - Question 3

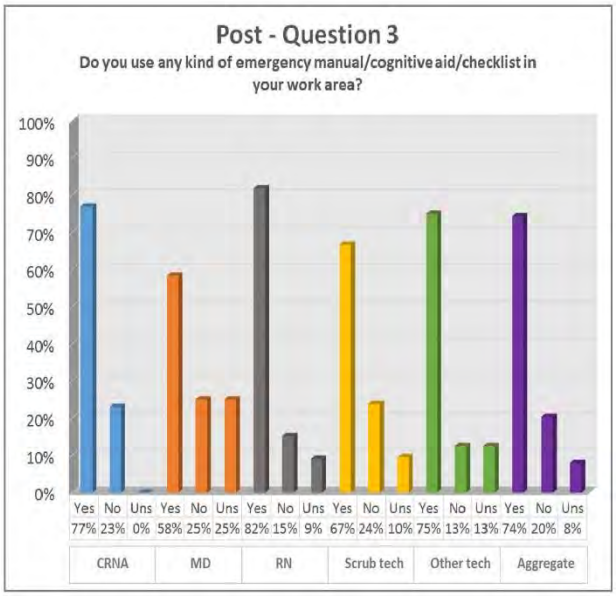
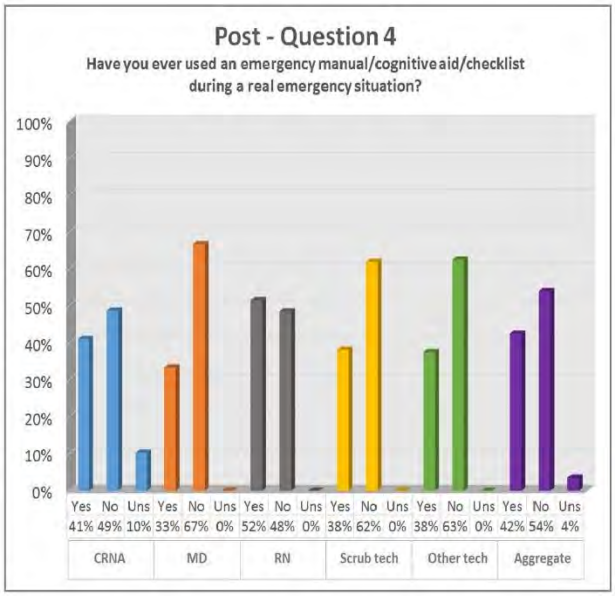


Figure 11 – Post - Question 4



n=27), CRNAs (77%; n=30), Other techs (75%; n=6), Scrub techs (67%; n=14) slightly lower, and MDs (58%; n=7). The aggregate showed that 20% (n=23) did not use an emergency manual/cognitive aid/checklist. The credentials with the highest amount of non-users were MDs (25%; n=3), Scrub techs (24%; n=5), and CRNAs (23%; n=9) and the least non-user groups were Other techs (13%; n=1) and RNs (15%; n=5).

Question 4 (Figure 11) asked if the participant had ever used an emergency manual/cognitive aid/checklist during a real emergency situation and the aggregate result showed that only slightly more than a third (42%; n=48) of participants had done so. The most frequent users were the RNs (52%; n=17), closely followed by CNRAs (41%; n=16). Scrub techs (38%; n=8), Other techs (38%; n=3), and MDs (33%; n=4) had the lowest usage during real emergency situations.

Question 5 (Figure 12) asked if, among the participants who answered yes to Question 4 (had used an emergency manual/cognitive aid/checklist during a real emergency situation), the use of such an aid had helped. Overwhelmingly, the aggregate result (98%; n=47) showed that

Figure 12 – Post - Question 5

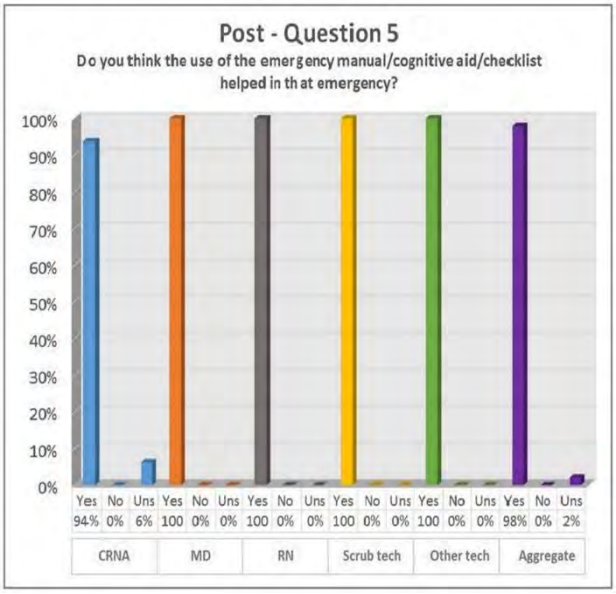
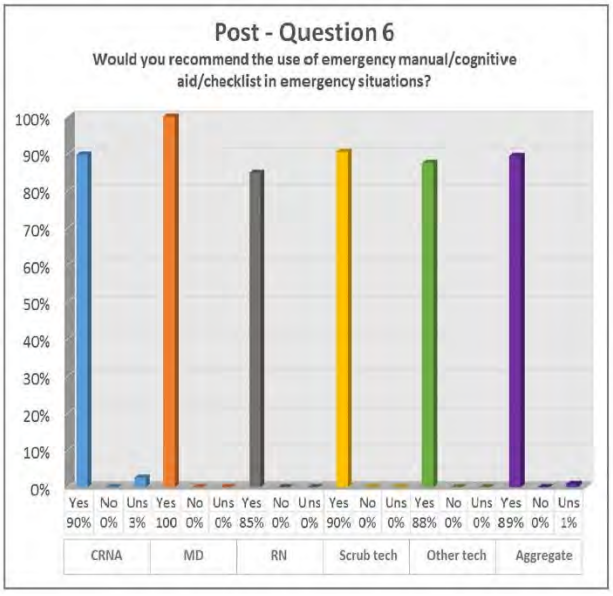


Figure 13 – Post - Question 6



actual users found it helpful. MDs (100%; n=4), RNs (100%; n=17), Scrub techs (100%; n=8), and Other techs (100%; n=3) all had full confidence this tool had helped. CRNAs (94%; n=15) had a single CRNA who was not sure.

Question 6 (Figure 13) asked if the participant would recommend the use of an emergency manual/cognitive aid/checklist in emergency situations. The aggregate result (89%; n=101) showed that the majority felt the use of this tool would be recommendable. Among MDs (100%; n=12) there were unanimous recommendation, although, within all credentials a majority felt they could recommend the use: CRNAs (90%; n=35), Scrub techs (90%; n=19), Other techs (88%; n=7), and RNs (85%; n=28). Of all participants only a single CRNA felt ‘not sure’ if the use could be recommended.

SECTION 5

Section Five includes the discussion of the results found in the project. This chapter is divided into the following sections: (a) Discussion, (b) Limitations, and (c) Implications.

5.1 Discussion

5.1.1 Discussion

Crises situations in anesthesia are rare, but can have devastating consequences for both patients and anesthesia providers. Despite significant improvements in anesthesia safety over the last several decades, crises situations are bound to happen due to the unpredictability of patient's physiologic reactions to drugs, volatile agents, fluid shifts, blood loss, surgical procedures, etc. The anesthesia providers handling of such crises situations are what makes the patient safer.

The purpose of this capstone project was to increase the awareness, interest, and knowledge towards the utilization of an adult-specific and evidence-based emergency manual in crises situations at a level 1 trauma center in the Southeast region of the US. Anesthesia emergency situations are rare for the individual anesthesia provider and handling such a crisis will be stressful and could potentially also be challenging. Multiple articles in the anesthesia literature have documented the use of cognitive aids or emergency manuals in anesthesia, as well as other fields (eg, airline pilots and nuclear power plants). All the articles and studies reviewed for this project have shown strong support for the use of an emergency manual in anesthesia and some have also commented that the time is right to do so. The project institution did not have an anesthesia specific emergency manual for adults available at the time of this capstone project.

The data for this study was based on a convenience sampling of the staff and physicians available in the surgery and x-ray vascular procedure departments on specific dates.

The posttest results showed an increase in awareness, interest, and knowledge towards an emergency manual. Although, there were widespread awareness, interest, and knowledge about

cognitive aids prior to the implementation of the Emergency Manual, the results indicated an increase. Prior to implementation 69% of the project institution's stakeholders had knowledge about an emergency manual/cognitive aid/checklist (Figure 3). Five weeks after implementation there was a 15% increase in the aggregate of this knowledge and now 84% of the stakeholders felt they knew about this concept (Figure 9). One group, Other techs demonstrated slightly less knowledge.

There was a 53% usage of an emergency manual/cognitive aid/checklist among the aggregate prior to implementation of the Emergency Manual at the five pilot locations (Figure 4). The aggregate use of such a tool increased significantly to 74% after the implementation (Figure 10). This could reflect an educational utilization or increased awareness and interest among the stakeholders for a newly introduced emergency manual. There was a significant amount of participants (aggregate 38%) that did not use an emergency manual/cognitive aid/checklist prior to the implementation (Figure 4). The amount of self-confessed non-users decreased significantly (aggregate 18%) after the implementation of the Emergency Manual (Figure 10). The low usage pre-implementation could be due to lack of availability, lack of knowledge, or lack of awareness or interest for such tool. Post-implementation the awareness about an emergency manual/cognitive aid/checklist did increase, which could explain the lower number of self-confessed non-users. The Emergency Manual has utility in crises situations, but also is an educational tool during downtime, where the diagnosis-specific checklists may serve as training and review of crises situations. The largest increase in utilization was seen among the RNs (32%) and the CRNAs (13%) (Figure 10). Increased interest may be attributed to these stakeholders being more directly involved in the handling of a crisis situation and, additionally, these two groups having direct access to the Emergency Manual in the room.

Within the sample there were considerable variations among credentials that previously had used an emergency manual/cognitive aid/checklist during a real emergency situation. Among the aggregate 40% (Figure 5) and 42% (Figure 11), pre- and post-implementation respectively, had used such a tool during a real emergency situation. The RN group had consistently higher usage of 54% and 52% and the CRNA group of 46% and 41%, pre- and post-implementation respectively. The other three groups, MDs 22% and 33%, Scrub techs 17% and 38%, and Other techs 31% and 38%, had an overall lower experience during a real emergency situation. This could reflect the wide-spread exposure to cognitive aids in the ACLS/PALS/CPR training that is required for many RNs and CRNAs, but not for MDs, Scrub techs, and Other techs.

A key finding was the almost universal recognition of the benefit of an emergency manual during crises situations among all stakeholders that had used such a tool previously. The aggregate findings were very high in both the pre- and post-implementation surveys (97% (Figure 6) and 98% (Figure 12) respectively). This is similar to the study by Arriaga et al that showed previous users of a checklist concluded "if I were having an operation and experienced this intraoperative emergency, I would want the checklist to be used."[6(p250)] The strong support from previous users of an emergency manual/cognitive aid/checklist substantiates the validity of this projects future goal - a full implementation of the Emergency Manual across campus at the project institution.

A second key finding further supports the full implementation of the Emergency Manual across campus at the project institution. When the surveys asked if the participants would recommend the use of an emergency manual/cognitive aid/checklist in emergency situations the aggregate result indicated increasing support for this with the pre-implementation's 74% (Figure 7) as well as post-implementation's 89% (Figure 13) support. This is consistent with the

statement by Gaba that "the growing number of groups that have decided to vote with their feet by creating or adopting what they see as the best available set of cognitive aids attests to the desire of clinicians to avoid paralysis by analysis and to do something sensible to close the gap from nothing to something."[5(p1035)] A deeper examination of the data for Question 6 showed that fewer participants felt negatively or unsure about their recommendations. The pre-implementation data had these two groups at 8% and this value had decreased in the post-implementation data to 1%. This significant decrease could signify an increased awareness, interest, and knowledge among stakeholders about the emergency manual/cognitive aid/checklist after the implementation.

A strength of the Advancing Research and Clinical Practice Through Close Collaboration (ARCC) framework is the utilization of an advanced practice nurse's evidence-based-practice mentoring of clinical staff. Having the Emergency Manual available at an anesthetizing location allows for easy access to emergency scenarios and evidence-based solutions, which can be explored during simulations of emergency situations in the OR. Introduction to the Emergency Manual should be made compulsory for new anesthesia students and regular OR staff, and the use should be reinforced on a regular basis. This reinforcement could be during annual competency training or, on a more regular basis, during downtime in the OR. The advanced practice nurse is in an optimal position to lead such simulation scenarios. Anecdotally, both during and after the implementation of the capstone project the researcher experienced significantly increased interest among staff for the concept of cognitive aids, substantiated by many questions. These questions ranged from clarification of what a cognitive aid is, how to use the Emergency Manual, where the Emergency Manual would be located, to what is a 'reader' and who will fulfill this role during a crisis. Another strength of the ARCC is its ability to bridge

the gap between the academic and clinical setting often noticed among students. The utilization of SRNAs during the pilot project allows these students to experience how an academic concept - an emergency manual - can be realized and how it can make a difference in the clinical setting.

This capstone project accomplished its primary goal of increasing the awareness, interest, and knowledge toward cognitive aids through implementation of a carefully chosen, customized, adult-specific, and evidence-based emergency manual. The use of the Emergency Manual could make handling of rare emergency situations safer for the patients and easier for the anesthesia providers. The positive results from the post-implementation survey strongly supports the project's future goal of implementing the Emergency Manual across campus at the project institution.

5.1.2 Limitations

The surveys had a couple of limitations in their design. Several participants had never encountered the wording emergency manual/cognitive aid/checklist and needed a brief explanation before they felt comfortable answering the surveys. Including pictures of existing aids (eg, ACLS checklists, pilot checklists, or hurricane emergency checklists) along with a pre-survey introduction at the individual stakeholder's staff meetings, might have increased the understanding of the terminology.

The pre-implementation survey asked the participants to stop if they answered 'No' to Question 2 and all others to proceed. This wording potentially may have created ambiguity, when they were asked to evaluate an instrument they did not fully understand. This uncertainty was corrected in the post-implementation survey where only participants that could answer Question 2 in the affirmative were asked to continue.

Statistical significance calculations are not meaningful when using a convenience sample in the pretest-posttest design. This capstone project was not intended to calculate such significance to meet the goal of the pilot project, nor was such calculations necessary to make a decision regarding the future goal of across campus implementation. All the participants were asked to voluntarily answer the surveys handed out by the researcher, creating a voluntary response sample, which could have introduced the possibility of response bias. Such responses may include an oversampling of people with strong opinions about the topic or the researcher. With the utilization of a convenience sample from a single institution it may not be possible to generalize this project's findings to other institutions.

5.2 Implications

The results from this capstone project do support a global policy change in anesthesia. The time to implement emergency manuals at all anesthetizing locations has never been better than – now. The literature is unequivocal on the concept of emergency manuals; whether it's called an emergency manual, a cognitive aid, or a checklist, there is an almost unchallenged body of studies that supports the use in clinical practice. Equally, the consensus (82%) of the anesthesia experts at the APSF workshop in 2015 felt every perioperative location should have at least one copy of an emergency manual easily accessible. Never mind that the airline industry, the nuclear power plant industry, and other high-risk industries have already implemented such tools. It is never too late to do the right thing.

As an educational tool an emergency manual can prove to be a bridge between the anesthesia provider and the other stakeholders in the operating room. Use of the Emergency Manual during simulations of clinical emergency situations on a regular basis could allow for better team-building among the members of the OR team. This concept was proposed by Babcock as early as in 1924, when he asked: "Do you ever hold emergency drills in your

operating room?" Such simulation should not only be incorporated early in the anesthesia education, but also among seasoned CRNAs, MDs, RNs, and other stakeholders during annual competency training and downtime in the OR.

As a matter of policy, mentioning of the Emergency Manual and assigning a dedicated 'reader' during timeout will increase the awareness, interest, and knowledge about this tool. It should be recognized that if nobody knows about the availability of the Emergency Manual, nobody is going to use it. This capstone project found extensive support among seasoned OR practitioners for the availability of an emergency manual. The preponderance of the literature reviewed for this capstone project support the use of such a tool during an emergency situation. Although the expert stakeholders at the APSF workshop recommends the mentioning of the availability of an emergency manual during timeout, only 67% supported the idea that the use of an emergency manual should be standard of care. To think every anesthesia stakeholder would embrace an emergency manual as a standard of care may be premature. However, the need for anesthesia providers to incorporate the use of cognitive aids in practice is long overdue.

This capstone project has indicated an increased awareness, interest, and knowledge towards emergency manuals after implementation. Utilization of an emergency manual as part of the Anesthesia Crisis Resource Management has the potential to 'flatten' the historically steep hierarchy within the peri-operative team. This would improve teamwork, conceivably leading to increased patient safety and, possibly, better patient outcomes. Increased patient safety as well as better patient outcomes through the use of an emergency manual need to be validated. We also need to examine which method is the most effective for implementation of an emergency manual in the complex peri-operative environment.

SECTION 6

6.1 References

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SECTION 7

7.1 Appendices

7.1.1 Appendix A

Emergency Manual Survey

Pre-implementation

This short survey is meant to assess stakeholder knowledge and attitudes towards the use of Emergency Manuals in anesthesia related emergency situations. The Emergency Manual is developed with the intent of helping the team during an anesthesia related emergency situation.

As part of my Doctor of Nurse Anesthesia Practice (DNAP) studies I am implementing the Emergency Manual as a pilot project in OR 12, 16, 17, and X-Ray Specials. The Emergency Manual will eventually be located at all locations where anesthesia providers may be performing patient care (ie, main operating rooms (ORs), OB ORs, PACU stations, cath lab stations, X-Ray specials, CT, MRI, etc.). The Emergency Manual will not be present at individual patient care stations (eg, ICU or other patient rooms).

For the purpose of this survey an emergency manual/cognitive aid/checklist is any kind of written list that includes the recommended sequence of actions to take in an emergency situation.

Thank you for your participation,

Michael Storm MNA, CRNA

DNAP student

Please go to survey on next page →

Emergency Manual pre-implementation survey

Palmetto Health Richland's anesthesia department has decided to introduce an **Emergency Manual** to the area where you work. We have decided to do this because many other high-quality hospitals and a significant amount of literature support such an **Emergency Manual** as best practice for handling rare emergency situations.

This manual will be present in OR 12, 16, 17, and 20, as well as in X-Ray specials. You are a valued staff-member who often work in one or more of these areas and therefore **must** know about this new **Emergency Manual**.

We will have a formal in-service regarding how you are expected to be involved in an emergency situation where the **Emergency Manual** will be used.

Please take a minute to mark what you know about an emergency manual. Other words for an emergency manual is a checklist or cognitive aid.

1) What is your credential?
   ❒ CRNA ❒ MD ❒ RN ❒ Scrub technician ❒ Other technician
2) Do you know what an emergency manual/cognitive aid/checklist is?
   ❒ YES ❒ NO ❒ NOT SURE

If you answered NO, please STOP here. Thank you.

If you answered YES or NOT SURE, please continue and mark the following questions

3) Do you use any kind of emergency manual/cognitive aid/checklist in your work area?
   ❒ YES ❒ NO ❒ NOT SURE
4) Have you ever used an emergency manual/cognitive aid/checklist during a real emergency situation?
   ❒ YES ❒ NO ❒ NOT SURE
5) If you answered **YES** in question 4):
   Do you think the use of the emergency manual/cognitive aid/checklist helped in that emergency?
   ❒ YES ❒ NO ❒NOT SURE
6) Would you recommend the use of emergency manual/cognitive aid/checklist in emergency situations?
   ❒ YES ❒ NO ❒ NOT SURE

Thank you for participating in this survey, it is greatly appreciated.
Michael Storm MNA, CRNA

7.1.2 Appendix B

Emergency Manual Survey

Post-implementation

This short survey is meant to assess stakeholder knowledge and attitudes towards the use of Emergency Manuals in anesthesia related emergency situations after implementation of the Emergency Manual in several areas of the hospital. The Emergency Manual was developed with the intent of helping the team during an anesthesia related emergency situation.

Currently, the Emergency Manual has been implemented as a pilot study and is only present in OR 12, 16, 17, 20, and X-Ray specials. The Emergency Manual will eventually be located at all locations where anesthesia providers may be performing patient care (ie, all main operating rooms, all OB ORs, all PACU stations, cath lab stations, X-Ray specials, CT, MRI, etc.). The Emergency Manual will not be present at individual patient care stations (eg, ICU or other patient rooms).

For the purpose of this survey a checklist (emergency manual/cognitive aid/checklist) is any kind of written list that includes the recommended sequence of actions to take in an emergency situation.

Thank you for your participation,

Michael Storm MNA, CRNA

DNAP student

Please go to survey on next page →

Emergency Manual post-implementation survey

Palmetto Health Richland's anesthesia department recently introduced an **Emergency Manual** to the area where you work. We decided to do this because many other high-quality hospitals and a significant amount of literature support such an **Emergency Manual** as best practice for handling rare emergency situations.

This manual is now present in OR 12, 16, 17, and 20, as well as in X-Ray specials. You are a valued staff-member who often work in one or more of these areas and therefore may know about this new **Emergency Manual**.

Please take a minute to mark what you know about an emergency manual. Other words for an emergency manual is a checklist or cognitive aid.

1) What is your credential?
❒ CRNA ❒ MD ❒ RN ❒ Scrub technician ❒ Other technician

2) Do you know what an emergency manual/cognitive aid/checklist is?
❒ YES ❒ NO ❒ NOT SURE

If you answered NO or NOT SURE, please STOP here. Thank you.

If you answered YES, please continue and mark the following questions

3) Do you use any kind of emergency manual/cognitive aid/checklist in your work area?
❒ YES ❒ NO ❒ NOT SURE

4) Have you ever used an emergency manual/cognitive aid/checklist during a real emergency situation?
❒ YES ❒ NO ❒ NOT SURE

5) If you answered YES in question 4):
Do you think the use of the emergency manual/cognitive aid/checklist helped in that emergency?
❒ YES ❒ NO ❒NOT SURE

6) Would you recommend the use of emergency manual/cognitive aid/checklist in emergency situations?
❒ YES ❒ NO ❒ NOT SURE

Thank you for participating in this survey, it is greatly appreciated.
Michael Storm CRNA

Pre-implementation Survey

Q #	Question text	CRNA			MD			RN			Scrub tech			Other tech			Aggregate		
Q1	Total number of people identifying with the group	31			11			37			16			15			110		
	Formula to create %: Q1/Total#	28%			10%			34%			15%			14%			100%		
		Yes	No	Uns	Yes	No	Uns	Yes	No	Uns	Yes	No	Uns	Yes	No	Uns	Yes	No	Uns
Q2	Do you know what an emergency manual/cognitive aid/checklist is?	28	3	0	8	2	1	22	9	6	8	4	4	10	2	3	76	20	14
	Not answered question		0			0			0			0			0			0	
	Formula to create %: Q2/Q1	90%	10%	0%	73%	18%	9%	59%	24%	16%	50%	25%	25%	67%	13%	20%	69%	18%	13%
Q3	Do you use any kind of emergency manual/cognitive aid/checklist in your work area?	18	10	0	5	4	0	14	10	3	7	4	0	4	6	1	48	34	4
	Not answered question		0			0			1			1			2			4	
	Formula to create %: Q3/Q2(y+uns)	64%	36%	0%	56%	44%	0%	50%	36%	11%	58%	33%	0%	31%	46%	8%	53%	38%	4%
Q4	Have you ever used an emergency manual/cognitive aid/checklist during a real emergency situation?	13	13	2	2	7	0	15	12	0	2	9	0	4	6	1	36	47	3
	Not answered question		0			0			1			1			2			4	
	Formula to create %: Q4/Q2(y+uns)	46%	46%	7%	22%	78%	0%	54%	43%	0%	17%	75%	0%	31%	46%	8%	40%	52%	3%
Q5	If you answered YES in question Q4 Do you think the use of the emergency manual/cognitive aid/checklist helped in that emergency?	13	0	0	2	0	0	14	1	0	2	0	0	4	0	0	35	1	0
	Not answered question		0			0			0			0			0			0	
Q6	Would you recommend the use of emergency manual/cognitive aid/checklist in emergency situations?	27	0	0	6	0	1	19	2	1	7	0	2	8	0	2	67	2	6
	Not answered question		1			2			6			3			3			15	
	Formula to create %: Q6/Q2(y+uns)	96%	0%	0%	67%	0%	11%	68%	7%	4%	58%	0%	17%	62%	0%	15%	74%	2%	7%

Legend: CRNA: Certified Registered Nurse Anesthetist; MD: Medical Doctor; RN: Registered Nurse; Scrub tech: Surgical technician; Other tech: All other technicians; %: Percentage; Q: Question; Uns: Unsure.

7.1.4 Appendix D

Post-implementation Survey

Q #	Question text	CRNA			MD			RN			Scrub tech			Other tech			Aggregate		
Q1	Total number of people identifying with the group	40			13			40			27			15			135		
	Formula to create %: Q1/Total#	30%			10%			30%			20%			11%			100%		
		Yes	No	Uns	Yes	No	Uns	Yes	No	Uns	Yes	No	Uns	Yes	No	Uns	Yes	No	Uns
Q2	Do you know what an emergency manual/cognitive aid/checklist is?	39	1	0	12	1	0	33	3	4	21	5	1	8	5	2	113	15	7
	Not answered question		0			0			0			0			0			0	
	Formula to create %: Q2/Q1	98%	3%	0%	92%	8%	0%	83%	8%	10%	78%	19%	4%	53%	33%	13%	84%	11%	5%
Q3	Do you use any kind of emergency manual/cognitive aid/checklist in your work area?	30	9	0	7	3	2	27	4	2	14	5	2	6	1	1	84	22	7
	Not answered question		0			0			0			0			0			0	
	Formula to create %: Q3/Q2(y)	77%	23%	0%	58%	25%	17%	82%	12%	6%	67%	24%	10%	75%	13%	13%	74%	19%	6%
Q4	Have you ever used an emergency manual/cognitive aid/checklist during a real emergency situation?	16	19	4	4	8	0	17	16	0	8	13	0	3	5	0	48	61	4
	Not answered question		0			0			0			0			0			0	
	Formula to create %: Q4/Q2(y)	41%	49%	10%	33%	67%	0%	52%	48%	0%	38%	62%	0%	38%	63%	0%	42%	54%	4%
Q5	If you answered YES in question Q4 Do you think the use of the emergency manual/cognitive aid/checklist helped in that emergency?	15	0	1	4	0	0	17	0	0	8	0	0	3	0	0	47	0	1
	Not answered question		0			0			0			0			0			0	
	Formula to create %: Q5/Q4(y)	94%	0%	6%	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%	98%	0%	2%
Q6	Would you recommend the use of emergency manual/cognitive aid/checklist in emergency situations?	35	0	1	12	0	0	28	0	0	19	0	0	7	0	0	101	0	1
	Not answered question		3			0			5			2			1			11	
	Formula to create %: Q6/Q2(y)	90%	0%	3%	100%	0%	0%	85%	0%	0%	90%	0%	0%	88%	0%	0%	89%	0%	1%

Legend: CRNA: Certified Registered Nurse Anesthetist; MD: Medical Doctor; RN: Registered Nurse; Scrub tech: Surgical technician; Other tech: All other technicians; %: Percentage; Q: Question; Uns: Unsure.

7.2 Audit Trail

Date work completed	Objectives How to meet	Activities Events	Rationale for activities/events	Key points from activity/event Contribution to meeting objectives	Notes	Refs Full below
4/7/2015	APSF conference	APSF conference in Emergency Checklists in Phoenix, AZ	Would be interesting and could work for potential capstone project			
4/13//2015	Approved for APSF conference	September 8-9, 2015			Hotel at the conference is booked and confirmed 4/10/2015	
6/01/2016	Capstone project	Decided on capstone project	Must have capstone project!	Topic for capstone project: Emergency Manuals Will implement an emergency manual in the OR at the project institution	Need to contact Monika Feeney DNAP, MS, BS, CRNA for preliminary approval	
6/11/2015	Capstone project advisor	Ask Catherine Gutshall DNAP, CRNA to be local advisor	Must have two advisors for capstone project	Gutshall accept to be local advisor Emailed Feeney with this information		
6/13/2015	Checked into the possibility of writing about emergency checklists APSF summer 2013 article	Googling in general Found copy of APSF article	To find support for the topic "emergency aids"	Plenty of support The APSF article shows that there is significant interest in the anesthesia community for emergency checklists		1
6/26/2015	APSF conference	APSF conference program received				2
6/28/2015	Preliminary literature search-terms: ▪ Emergency checklists	Database search: ▪ PubMed ▪ Google Scholar ▪ Google ▪ MSU Complete	To gain insight into whether there is any literature regarding my chosen idea for capstone project	Found numerous articles in journals and books to support the idea of use of emergency checklists		3–8,1,9–13

Date work completed	Objectives How to meet	Activities Events	Rationale for activities/events	Key points from activity/event Contribution to meeting objectives	Notes	Refs Full below
	▪ Emergency manuals ▪ Crisis checklists ▪ Cognitive aids ▪ Simulation ▪ Anesthesia					
6/29/2015	Adjunct faculty request	Deliver forms to Gutshall	Gutshall needs to fill out form and supply supporting material for approval to adjunct faculty at MSU			
6/30/2015	Project Synopsis	Synopsis regarding my ideas for the project Email synopsis to advisor and MSU	To solidify my thinking and to start the application process To get feedback if this project is acceptable		Able to place my ideas on paper Mailed off to Monika Feeney and Catherine Gutshall	
7/1/2015	Project Synopsis	Feeney responds Gutshall responds		Feeney: Looks very good! Great idea. I'd be happy to be on your capstone committee Gutshall: Can meet with me this week	I gladly accepted Feeney as primary advisor Will meet with Gutshall Thursday or Friday this week	
7/2/2105	Met with Gutshall	Synopsis	Feedback on synopsis	Gutshall thought the synopsis looked good. Had a few pointers to make sure the objectives or goals for the project will be covered by the interventions stated. She felt I was on the right track		

Date work completed	Objectives How to meet	Activities Events	Rationale for activities/events	Key points from activity/event Contribution to meeting objectives	Notes	Refs Full below
	Adjunct faculty request	Received form including supporting material from Gutshall		Received filled out forms from Gutshall including all supporting material Mailed all this to MSU		
7/4/2015	Timeline for project	Develop timeline	Add to approval form	Finished timeline Mailed timeline to Gutshall for feedback		
7/6/2015	DNAP Capstone project advisor form	Submit form to Monika Feeney	Approval of project	Submitted DNAP Capstone project approval form including the Timeline for project to Monika Feeney		
7/12/2015	Formal search of literature Final search terminology: ▪ Emergency manuals ▪ Cognitive aids ▪ Checklists ▪ Anesthesia	Did formal literature search and reviewed potential articles Created literature review table	Reviewed articles and created a review table to gain an overview of the evidence I have collected through my literature search	Completed literature review table for 4 articles Found some additional websites related to cognitive aids Found website that sells premade emergency manuals that are used by Stanford Hospital. Price if buying >50 is $49.00 each	Very time consuming, but I think this will be a valuable tool when I start to write	
7/19/2015	Literature review Proposal (10-15 pages) Email to Feeney (#1)	Worked on the literature review table Started to write the final proposal (10-15 pages) Emailed Feeney question regarding the literature review in relation to proposal writing	Unsure if I need to finish the full literature review prior to start writing the 10-15-page proposal	Added a couple of interesting articles to the mix Finished initial 2 pages of proposal		
7/20/2015	Email to Feeney (#1)	Feeney reply		No <u>you do not need to complete your literature search</u> for this section	Awesome!	

Date work completed	Objectives How to meet	Activities Events	Rationale for activities/events	Key points from activity/event Contribution to meeting objectives	Notes	Refs Full below
	Feeney clarification of what is missing to finish the semester		Feeney's clarification on what I need to finish up prior to end of this semester	Now that you know you have your project, and it is approved, all I need for this section is your ▪ Advisor Request form and Project Approval form signed by Gutshall ▪ I have attached it for your convenience ▪ Please fill out and return to me – I will send you a copy with all signatures ▪ You also need to complete your PICO format – I have attached a sample ▪ Your time line is wonderful. ▪ (Scan and email, or snail mail, I would rather not have FAX – it is not very clear) ▪ Keep up the good work! Let me know if you have any questions. As soon as I have the above you will have an A for ANE 897 – and you can proceed with your timeline. I look forward to this journey! All the best!	I have already sent these forms, although not signed, to Feeney once. I will review them, have them signed by Gutshall 7/21/2015 and send them to Feeney again	
7/25/2015	Proposal 10-15 pages	Wrote proposal		Wrote proposal and feel it is finished and ready for submission. Will review tomorrow prior to mailing to Feeney and Gutshall		
7/28/2015	Proposal	Mailed proposal to Feeney and Gutshall	Finalized ANE897			
7/29/2015	Emergency Manual	Ordered a copy of Stanford Emergency Manual	Wanted to evaluate the quality of the manual made by Alpha Graphics			

Date work completed	Objectives How to meet	Activities Events	Rationale for activities/events	Key points from activity/event Contribution to meeting objectives	Notes	Refs Full below
8/7/2015	IRB approval	Spoke to Kevin LeBlanc PhD, CRNA	LeBlanc is my go-to person for anything university or PHR policy	LeBlanc confirmed, after he contacted the project institution's IRB, that no IRB approval is necessary for this capstone project		
8/10/2015	Proposal	Gutshall approve proposal as is				
8/11/2015	Emergency Manual	Received copy of Stanford Emergency Manual				
8/20/2015	Emergency Manual	Evaluation of Stanford Emergency Manual	Want feedback by others on quality of Stanford EM	▪ Feedback was very positive on the quality and usefulness of the Stanford EM ▪ My own evaluation also gives this product very high marks for usability and quality ▪ Ability to somewhat customize this product to reflect local practices and phone numbers ▪ I have decided to use this product for my capstone implementation	This product is made of high quality paper and front and back is laminated. Book is coil bound. Book can be cleaned without destroying the pages	
9/1/2015	Proposal	Noted a grade was entered for ANE897 by registrar		Since no counter argument, having a grade must equal a 'go-ahead' with the project and approval of proposal by primary advisor and MSU		
9/9/2015	APSF Emergency Implementation Conference Phoenix, AZ	1-day consensus conference covering implementation of Emergency Manuals	Capstone project topic	▪ David L. Hepner, MD: The time is right. Crisis management is a key term and is now found in anesthesiology books. Reader is highly recommended; without only 20-25% used the available checklist. Must have training and be familiar with checklists ▪ Steven K. Howard, MD: Many checklists available. Stanford has long history; next version out after ACLS update, probably summer/fall	▪ Panel discussions #1: ▪ Not a cookbook; sweet-spot in usage; sometimes need to deviate from EM ▪ Some customization of emergency manual is good, but too much	

Date work completed	Objectives How to meet	Activities Events	Rationale for activities/events	Key points from activity/event Contribution to meeting objectives	Notes	Refs Full below
				2017. Paper copy more familiar for clinicians; everybody can open a paper copy. Secure manuals in OR since they tend to 'walk away', can opt to tether ▪ Laura E. Schleelein, MD: Electronic copy easier to update, can have patient information to specify drug dosages, have running clock, can easily save and archive an event log, can interface with other equipment in OR. Disadvantages include technical failure, power failure, user failure, expense, limited size, cumbersome to interact with electronic device, reader may not be familiar with electronic device ▪ Matti E. Lehtonen, GE Healthcare and Life Care Solutions: GE is working on module for their anesthesia machines. Seamless interface with electronic charting, patient specific and automatic data capturing. ▪ Daniel B. Raemer, PhD: possible pitfalls with use of EMs are wrong diagnoses creates fixation, difficult to redirect, mixed diagnoses can waste time flipping around in EM, may consider cross referencing, knowing when not to use EM, false sense of security with EMs ▪ Amanda R. Burden, MD: Emergencies affect cognition, which is why we need EMs. Exponential growth in medical knowledge.	detract from the standardization of the tool overall ▪ Transparency of evidence behind the checklists is key ▪ Must consider legal ramifications when an event log stores all activity during a crisis. This should not stop development. Probably better to have hard evidence of what happened than have no evidence (Steve, JD) ▪ Panel discussions #2: ▪ Change is difficult. May be expensive to exchange all EMs when revisions are made. Use of EM may hinge on available staff. Don't forget to treat the patient. An EM is just another tool. Stressed the	

Date work completed	Objectives How to meet	Activities Events	Rationale for activities/events	Key points from activity/event Contribution to meeting objectives	Notes	Refs Full below
				Assign reader to limit distraction from reading. Team training is essential. Continual improvement of EMs. Checklists must be short and concise ▪ William R. Berry, MD, MPH, FACS: Single standard EM may not be the right thing, too many barriers, good with variety at this time. Format of EM is important, training. Ability for customization of EM is important to add local 'flair' ▪ Paul G. Preston, MD: Standardization is good. Positive history with checklists, ACLS. Potential for electronic version, easy to update. We are building aviation's black box equivalent. We need to continually improve the EMs we are using. Will never reach perfect. Checklists without training are probably harmful ▪ Sara N. Goldhaber-Fiebert, MD: Adapt EM locally is important. Just hanging the EM is not implementation. Important to fully involve all stakeholders. Seek buy-in from all stakeholders, incl. leadership at institution. Broadcast success stories for all to see ▪ Alexander A. Hannenberg, MD: team training is important. Can use sim-training, which can happen in the OR. Role playing is good. Checklist adoption and training bring value before the first use of	transparency of the evidence behind the EMs. Common sense always trumps the checklist. Still a need to have 'ready' knowledge ▪ Response system facts: ▪ 84% found hardcopy EMS to be superior over electronic versions ▪ 92% believe no more studies are needed before utilization of EMs ▪ 72% don't think EMs will distract the team ▪ 83% thinks that an electronic visible checklist would enhance teamwork ▪ 86% thinks that incorporating patient specific data will improve the checklist ▪ 76% believe there should be a designated reader. Best to do this	

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				the checklist. The entire team must be 'on the same page' when it comes to EMs. All team members have their role ▪ Matthew B. Weinger, MD: MOCA have shown an improved score when using EMs. 'You can build a house without a hammer, but it is much easier to use one and you can handle a crisis without EM, but it is safer to use one' ▪ John H. Eichhorn, MD: Is use of EMs cheating? APSF must help change people's mindset. EMs are supplements and the use is not cheating	designation during time-out ▪ 99% agree there will be unanticipated risks and complications with introduction of EMs ▪ 86% think the limitations with EMs are still unknown ▪ 77% thinks those limitations should not stop the adoption of EMs ▪ 87% think we are not ready for a single EM ▪ 86% would like to have a single EM ▪ 62% (34% no) think there exists enough data to validate a consensus Emergency Manual for the more commonly encountered crisis events ▪ 79% think an EM should be developed by anesthesia personnel	

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					▪ 96% believe anybody on the team can call for the use of an EM ▪ 67% (24% no) think an EM should be standard of care	
11/15/2015	Pre-implementation survey	Worked on the surveys		▪ Decided to use surveys for some quantitative data regarding knowledge and attitudes towards emergency manuals ▪ Decided to make the pre- and post-implementation surveys the same		
11/27/2015	Pre-implementation survey Pilot or full implementation	Had survey tested by LeBlanc, and Annette Storm, MNA, CRNA Researched the different aspects	Tested survey to see if changes should be made before use The best implementation may need a pilot approach	A couple of improvements to survey design was made after input from both testers Found some articles and general web-browsing to confirm a pilot approach first		14,15
11/29/2015	Emergency Manual	Requested status update on next version of the Stanford EM, which will include updated ACLS guidelines	Would like the most current version for my implementation	Send request to Stanford Cognitive Aids Group's Steven K. Howard		
11/30/2015	Emergency Manual	Response from Stanford Cognitive Aids Group by Steven K. Howard		Response from Steven K Howard: ▪ There will be an update to version 3 that will include the changes to ACLS guidelines along with some other changes (e.g., ryanodex preparation for MH). This is contingent on other work being		

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				published that we have not yet seen. I would anticipate a revision no earlier than this summer. Please check the emergencymanual.stanford.edu website periodically for updates		
12/01/2015	Meeting with Anesthesia corporate director William Landess JD, CRNA	Wanted to pitch the EM for possible financial support during implementation	Without financial support it would be difficult to make a full implementation	▪ Landess gave full and unrestricted support for the capstone project ▪ Landess felt our department is years behind the curve when it comes to use of emergency manuals ▪ Landess gave support for pilot implementation and full implementation next year ▪ Landess promised full financial support for the implementation of the pilot project as well as the full implementation		
12/11/2015	Pre- and post-implementation surveys	Both pre- and post-implementation surveys are ready	Needed to be done prior to going on vacation			
1/20/2016	Formal meeting with anesthesia department management team	To pitch my capstone project and receive formal support from management team	Had informal support from chief CRNA and corporate director, but formalizing the support will strengthen the project when times come to pitch for other stakeholders	▪ Received full and unrestricted support from the full management team to proceed with the pilot project ▪ Will reevaluate how to manage the full implementation later this year when the next version of the Stanford EM is available ▪ Management team suggested a possibility for printing in-house, which they felt could save money	▪ I'm not sure I was able to bring the value of the pre-made manual across to the whole team ▪ Some on the management team found the pre-made EM expensive	
1/31/2016	Literature search repeat Search terminology:	Repeated the formal literature search using the same	Wanted to check if anything new and relevant would show up that could	▪ Found a couple of extra articles not already well covered in my first search, although, not much new value	Took extensive notes from the APSF workshop myself, but it will	[16–19]

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	▪ Emergency manuals ▪ Cognitive aids ▪ Checklists ▪ Anesthesia	parameters as in July 2015	be useful for the project	▪ Awaiting the APSF workshop being mentioned in the APSF Newsletter. Will have to look out for the write-up by APSF	be interesting to read the "official" APSF write-up of the workshop	
2/4/2016	Literature search	APSF Newsletter arrived		Had article covering the workshop I attended in September 2015		[20]
2/5/2016	Emergency Manual	Contacted Alpha Graphics (printer) regarding the customization of the Stanford EM	Need to know what can be done and how it needs to be done	Received information on what can be customized and how to do this		
2/5/2016	Emergency Manual	Gathered information for customization	Want to have most up-to-date information in the EM	Spoke to OR staff, X-ray staff, management, hospital supervisor staff, and rapid response team staff to gather most up-to-date information		
2/7/2016	Emergency Manual	Worked on customization	Want to make phone list specific for Palmetto Health Richland as well as customizing the Massive Transfusion protocol (part of Hemorrhage in EM)	Finished phone list and designed graphics to insert in EM		
2/8/2016	Emergency Manual	Emailed customizations to Alpha Graphics	Needs approval for my changes	Awaiting feedback on my proposed customizations		
2/9/2016	Emergency Manual	Response from Alpha Graphics		▪ Received cost estimate and proof of EM for my evaluation ▪ Found a couple of errors in what they had placed in the EM ▪ Made updated versions and emailed these back to Alpha Graphics		
2/10/2016	Emergency Manual	Response from Alpha Graphics		Received an updated proof of EM		

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2/10/2016	Emergency Manual	Proofing and ordering		▪ I approved the most recent proof ▪ Ordered 12 books ▪ Decided to place 2 books at each pilot location; one for the CRNA and one for the circulating RN ▪ I think having a separate copy for the circulating RN could create increased buy-in since this would signal their importance in the use of the EM		
2/19/2016	Emergency Manual	Response from Alpha Graphics		My order went into production		
2/22/2016	Emergency Manual	Shipping note from Alpha Graphics		My order was shipped		
3/1/2016	Emergency Manual	Received order from Alpha Graphics		Received 12 books for implementation		
3/6/2016	Emergency Manuals	Prepared EMs for distribution	Need to apply tether to all EMs	▪ Made and applied steel cable tethers to all EMs ▪ Each tether is permanently attached to the EM and the tether is attached to carts with quick link for possible removal if necessary		
3/7/2016	Pitching the EM for the anesthesia department staff, the anesthesiologists, and the OR staff	Met with each group at their monthly staff meetings	Created buy-in and understanding for the pilot project	▪ No negative feedback received at any of the meetings ▪ CRNA staff was very positive and interested in the introduction of an EM ▪ The MDAs were supportive and interested in the EM ▪ The OR staff was receptive; the OR director, OR manager, and RNs as well as Scrub techs were present		
3/7/2016	Pre-implementation survey	Conducted the pre-implementation survey among CRNAs, MDs, and	Part of the quantitative data gathering	Received 111 responses out of 144 distributed surveys	Was able to answer many questions from all	

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		OR staff available on this day			stakeholders during this data collection. Many became much more enthusiastic after a brief explanation on how the use of an EM is expected	
3/8/2016	Emergency Manuals	Distribution of EMs		Distributed EMs to all pilot locations		
3/10/2016	Advisor update	Emailed my writing and outline to Catherine Gutshall for advisement	Need a bit of feedback on where I am at this time		I feel the crunch at the moment!	
3/11/2016	Emergency Manual feedback	Contacted by OR director	OR director contacted me to relay a feedback he received from a safety guru that was at our facility this week	▪ During a formal meeting with safety expert James Reinertsen, MD from the Reinertsen Group the PHR OR director was able to pitch the newly introduced EMs and the feedback was impressive, he told me ▪ Safety expert James Reinertson, MD was very impressed about the quality of our chosen EM	Good timing is everything!	
3/12/2016	Writing	Writing on capstone project		▪ Collected all the areas where I had already done writing for the paper ▪ Literature search for individual sections where I might need more information		21–26
3/13/2016	Writing	Made outline		▪ Used the 'Writing Your Dissertation or Capstone' to help with the outline ▪ Used 'Translation of Evidence into Nursing and Health Care Practice' for help with the conceptual framework		27,28

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3/19/2016	Data work	Manually tallied all the data by primary researcher		Made raw data sheet	Entered tallied data into Excel spreadsheet	
3/20/2016	Data work	Data verified by independent party		A Storm verified all the data tallied by me		
3/22/2016	Data work	Made preliminary data interpretation		▪ Came up with a couple of preliminary ideas on how to interpret the data ▪ Will meet with LeBlanc for more ideas on how to do this	Added formulas to spreadsheet for easy computation of data	
3/25/2016	Data work	Meeting with LeBlanc	▪ To go over my capstone project so far ▪ To receive input on how to process and interpret my data	▪ Worked out a data sheet with percentages on how the data can be interpreted ▪ Received feedback on my project writing up to this point ▪ LeBlanc had several ideas on how I could improve and strengthen the paper ▪ LeBlanc found the outline as well as the writing overall good	Felt much better after this meeting Crunch time is tough	
3/27/2016	IRB approval	Emailed question regarding possible IRB approval from MSU to Tracey L. Poston, PhD and Feeney	Realized I may need IRB approval from both PHR and MSU	▪ Poston is an Assistant Clinical Professor at MSU and also the IRB specialist for MSU ▪ Feeney was kept in the loop by cc	Response from Piston: ▪ If the hospital does not require IRB approval for the project, then I'm ok with it. However, for future reference you probably should of [sic] taken care of this on the front end. The answer could of [sic] been different and your	

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					research would halt till approval. I am surprised they do not want at least an exemption but in the interest of time lets [sic] not argue with them. Please make sure you have some letter or email stating they do not require approval for the file	
3/28/2016	Writing	Writing on capstone project		Wrote up the conceptual framework and pretest-posttest section. Found some good articles to support this framework and other areas in the paper		27,29,28,30
3/29/2016	Meeting with Gutshall	General advisement	Wanted to receive some feedback to make sure I'm on track with what I have done so far	Gutshall liked most of what see read. She felt I was on a good track. She had several suggestions to my writing, but none to my general outline. We discussed my overall structure of the paper and she felt this was solid and correct	Will incorporate some of Gutshall's suggestions and then email Feeney this week for advisement as well	
3/29/2016	Writing	Writing on capstone project		▪ Worked on the suggestions from Gutshall ▪ Made result graphs	Think my graphs look very good and informative	
3/31/2016	Email all writing to Feeney for review	Compiled all the writing as of now in one document	Wanted to give primary advisor the opportunity for input at this time	Received feedback from Feeney same day in which she writes: ▪ Yes, I like it you are on the right track!	Sounds like I'm on the right track at the moment.	

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				▪ Keep up the good work!	Will resend in 7-10 days when a bit further along	
4/01/2016	Writing	Writing on capstone project		Worked on the suggestions from Gutshall		
4/2/2016	Writing	Writing on capstone project		▪ Worked on expanding the literature review ▪ Less 'bullet type' writing, since the original was meant as a preliminary review		31–33
4/3/2016	Writing	Writing on capstone project		Worked on results graphs. Had to redo all of them, since I forgot the aggregate column	Augh!	
4/4/2016	Writing	Writing on capstone project		▪ Started on the result chapter ▪ Expanded on the literature review section		34–38
4/5/2016	Writing	Writing on capstone project Had A Storm make first reading on my writing	I'm far enough along where the writing makes sense	▪ Continued to write on result chapter. Finished the pre-implementation part ▪ Need the post-implementation to move forward ▪ Received good feedback and some correction on the grammar!	Wonder if I need to combine the pre- and post- survey into one writing or should separate them out? Have to ask LeBlanc and Gutshall. Not as many grammatical errors as sometimes! ☺	
4/7/2016	Post-implementation survey	Conducted the post-implementation survey among CRNAs, MDs, and OR staff available on this day.	▪ Part of the quantitative data gathering ▪ Need to finish post-implementation survey tomorrow	Collected 80 responses	Was again able to answer many questions from all stakeholders during this data collection	

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4/8/2016	Post-implementation survey Data work Writing	▪ Conducted the post-implementation survey among CRNAs, MDs, and OR staff available on this day ▪ Manually tallied all the data by primary researcher Writing on capstone project	▪ Part of the quantitative data gathering ▪ Conducted the post-implementation survey over two days ▪ Worked on results section to incorporate the post-implementation survey results	▪ Was able to get more responses with collection over two days, since some people do not work every day of the week ▪ Collected 55 additional surveys. Gave out a total of 169 surveys ▪ Reused the same data sheet made for pre-implementation survey, since the questions are the same, although, I made a slight change to how the responders should fill out the survey after Q2. ▪ Changed the formula use slightly, based on the single change in the follow up after Q2 (changed from "If you answered NO, please STOP here" to "If you answered NO or NOT SURE, please STOP here." Therefore, I had to change to formula to reflect this change.	▪ Was again able to answer many questions from all stakeholders during this data collection ▪ Change was made for logical reasons, which became clear after the data work for the pre-implementation survey	
4/9/2016	Writing	Writing on capstone project	Worked on results section Re-did one figure to match	Found an error in the cross-checking of results. Fixed errors and rechecked both survey results along with independent party	Only a very minor error, but enough to be annoyed about it!	
4/10/2016	Writing	Writing on capstone project	Started on the discussion section	Did additional literature search	CRM, Gawande, original checklist implementation	[39–43]
4/13/2016	Writing	Writing on capstone project	Wrote on discussion section and added limitations	Did additional literature search		[44,45]
4/15/2016	Informal meeting with LeBlanc	Advisement on final result section, as well as discussion	Quick follow up from last meeting to	LeBlanc's feedback confirms that I'm on the correct path with my thinking		

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	Gutshall	and implication sections Requested feedback on the implication section	consolidate my thinking Wanted to check that my ideas are on right tract	regarding the implications for this project		
4/16/2016	Writing	Writing on capstone project	Worked on discussion, implication, and the lit review table sections	▪ Finished discussion and implication sections ▪ Cleaned up in the lit review table		
4/17/2016	Writing	Writing on capstone project	Found errors in the references, did not match the reference list exactly Worked on the lit review table	▪ Had to redo all the references in the paper, a bit tedious, but doable due to the extensive documentation I had done along the way ▪ Finished cleaning the lit review table ▪ Finished draft 7, which includes a paper ready for advisor review	▪ Augh, how can this happen! ▪ Mendeley may make errors when copy/paste in Word. When doing any copy/paste redo the reference for that copy/paste part	
4/18/2016	Advisement	Gave draft to Gutshall and LeBlanc for review and emailed same to Feeney	Receive final feedback before I can finish writing			
4/23/2016	Advisement	Meeting with Gutshall and LeBlanc	Advisement on first full draft	Received several constructive suggestions on the writing and construction on the paper. Discussed aspect concerning graphic text size, specific wordings, and data publication	Great meeting, although still much to do!	

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4/24/2016	Writing	Revised the draft based on A Storm's as well as Gutshall's and LeBlanc's input	Correction and strengthening of paper	Extremely tedious work. Found several minor errors in the data transfer to the paper writing's discussion section Redid graphs once again, as well as redid the excel survey print-outs	Will this never end?	
4/25/2016	Advisement	Received draft back from Feeney		Minor wording changes, which I mostly applied; some of the suggestions were already implemented, other areas were rewritten after Saturday's advisement	Very happy with the minor changes suggested by Feeney	
4/27/2016	Writing	Reading of full paper	Corrections and minor adjustments to references and writing	Found a few reference table errors;	Amazing how it is possible to find errors on every reading!	
5/2/2016	Writing	Final adjustments		DONE	Ahh!	

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7.3 Literature Review Table

Author(s) /Year /Publication	Topic /Purpose	Framework /Method /Sample	Key findings	Limitations	Implications for practice
Jenkins, B Anaesthesia 2014 Anaesthesia 2014, 69, 655–668	Cognitive aids: time for a change? To give an overview of the topic cognitive aids or emergency manuals. To ask the question: is it time to change our current practice of relying on our memory?	Editorial comments	• Cognitive aids are visual prompts or decision guides and are used when tasks are being performed • Checklists contain actions or tasks that cannot be readily recalled and they are used to improve individual and team performance • All task performed by humans and health care systems are prone to error • Safe surgery checklist from WHO in 2009 significantly reduced morbidity and mortality associated with surgery • In emergencies there is a potential for disaster due to an unwillingness or inability to revert to more systematic thinking: Fixation Error • These aids may be viewed as 'cognitive crutches' to provide visual and textual prompts during lapses of memory • Checklists may reduce dependency on factual recall during stress • Checklists must be properly designed and should be validated and agreed upon before use • These aids may be viewed as 'cognitive crutches' • Evidence for adoption of checklists are currently weak (2014) and based on simulated emergencies • Conclusion: investment in cognitive aids seem an effective measure to reduce morbidity and mortality form anesthetic emergencies	• Most of the evidence for cognitive aids inevitably comes from a small number of studies that use simulated emergencies as a proxy for actual emergencies • To maximize benefit, cognitive aids need to be developed at a national level	• Checklists may reduce morbidity and mortality in the OR • Checklists will reduce the reliance of brute memorization • Use of evidence based checklists can improve patient outcomes • With use of checklists everybody in the room will be aware of what is coming next in the process, since everybody will have access to the checklists • Use of checklists will improve communication in the OR and will allow non-anesthesia staff to speak up, when they notice a deviation from the checklist. This can reduce

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					tunnel-vision among the person/persons in charge of the emergency
Gaba, DM Editorial 2013 Anesthesia & Analgesia Anesth Analg. 2013 Nov;117(5):1033-6.	Perioperative Cognitive Aids in Anesthesia: What, Who, How, and Why Bother? An editorial summarizing two articles in same issue of A&A on the topic of cognitive aids	Editorial comments	• Author is professed very pro cognitive aids: First, I am a strong believer in the use of cognitive aids • Historically, there are many pejorative terms for such aids, such as "cheat sheets," "crib sheets," "crutches," and "cookbooks o Definitive taxonomy could be counterproductive • While in the past use of aids have been viewed as weakness or lack of intelligence, author emphasizes that their use is actually sign of strength and wisdom and not using them is sign of weakness and perhaps unwarranted hubris (excessive pride) • Mention already in use cognitive aids: o MH poster, pocket card, and hotline o ACLS poster, pocket card • Currently used aids are developed through formal consensus processes • Level 1a evidenced based literature to support cognitive aids are weak or non-existing • Even within nuclear power and aviation there is weak or non-existing level 1a evidence for the creation of cognitive aids • Implementation is not simple. Process of adoption, placement, training of personnel, creating and sustaining a culture that believe in the use of cognitive aids	• Poor aids, or poor use of aids, may distract clinicians and lead to worse performance than without them • Authors comment: I think that this probability is likely to be very low. • In use of "reader" (someone who reads the aid to the team and checks on their progress in managing the event), there could be a danger implied by the observed results that "total communication" was reduced with a reader in place • Author comment: o Since the effectiveness of the teams with a reader (in simulations) were much greater than without a reader,	• Should make sure the cognitive aids are well designed and user-centered • Implementation should be done carefully and with all stakeholders "on board" • Development of cognitive aids should involve a consensus approach

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			• But absence of evidence is not evidence of absence, and the growing number of groups that have decided to vote with their feet by creating or adopting what they see as the best available set of cognitive aids attest to the desire of clinicians to avoid paralysis by analysis and to do something sensible to close the gap from nothing to something • Author opinion is that what we already know about well-crafted emergency manuals and the use of a reader role (when sufficient number of on-scene personnel allows it) is sufficient justification to warrant widespread adoption • "Whoever saves a life, it is as if he has saved the entire world." Hebrew Talmud (Sanhedrin 4:5) and the Muslim Quran (5:32)	this will probably not be the case • Author is professed very much in favor of the use of cognitive aids. Author has worked extensively with the development of cognitive aids	
Goldhaber-Fiebert, S N Howard, S K Anesthesia & Analgesia 2013 Anesth Analg. 2013 Nov;117(5):1149-61. doi: 10.1213/ANE.0b013e318298867a.	Implementing Emergency Manuals: Can Cognitive Aids Help Translate Best Practices for Patient Care During Acute Events?	Special article for the Anesthesia Patient Safety Foundation	• During the stress of a critical event, the vast majority of clinicians do not implement all known best practices optimally. Sometimes, vital steps are never performed • Implementing and using emergency manuals are 2 different but equally important subjects • Emergency manuals are an extension of Crisis Resource Management (CRM) concept • There is a common misconception that emergency manuals are not relevant in the management of time-sensitive acute events • However, manuals can be a helpful resource for important crisis priorities management • Cognitive aids are already in widespread use within aviation and nuclear power plants. • Growing simulation-based evidence for use	• Author emphasizes the importance for practitioners to be familiar and have trained with emergency manuals • Without training they think the use will be limited • There is a common misconception that emergency manuals are not relevant in the management of time-sensitive acute events • Terminology:	• The implementation and use of emergency manuals could be very valuable both in real crises situations, but also during debriefing after a crisis and during training of staff. Both OR staff and anesthesia staff can greatly

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			• Cognitive aids are tools to help people remember to act on important information that they often already know but may either be inert or nondeployable • Experts rapidly recognize a familiar pattern that matches the current situation "well enough," which is often followed by analyzing the fit using mental simulation, then making adjustments as necessary • Emergency manuals may help avert preventable harm as part of a toolbox • Usually, when teams miss crucial steps in the management of simulated or real critical events, it is not because they have never heard of the appropriate intervention • By providing information that is not easily retrievable from memory, emergency manuals can be helpful in allowing us to focus our limited available attention on higher level cognitive tasks • The common culprits in performance gaps, besides knowledge, are a combination of crisis management team challenges communication, leadership, etc. and a failure to implement knowledge under stress • Stressful situations have been shown to negatively impact multiple aspects of human memory: o Inert knowledge o Working memory o Prospective memory • Providers consulting an emergency manual for simulated critical events perform vital actions	o Difficulty with terminology. The term "cognitive aids" for some individual practitioners unfamiliar with the term may feel it insults their capabilities, implying that they have a cognitive impairment o "Checklist", by its components of word, implies a linear flow to check off items, without subsequent reconsideration that may be needed in some medical situations o A checklist also does not automatically include other considerations; such as signs or differential diagnoses that are not explicit actions o Asking for the checklist during a crisis may create confusion with other routine checklists used in the OR	benefit from this kind of training • The use of emergency checklists will be a significant asset to any OR, but especially to the anesthesia team

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			more often, more efficiently, and more accurately than those who do not • In the case of emergency manuals, the goal is to provide easily accessible information, combined with training, to help clinicians effectively prevent, diagnose, and treat critical events • Article writes extensively on how to implement emergency manuals. They recommend a 4-Element implementation strategy: o Create o Familiarize o Use o Integrate • Conclusion: Emergency manuals address an unmet need and resonate almost universally with practicing clinicians		
Marshall, S 2013 Anesthesia & Analgesia Anesth Analg 2013; 117:1162–71)	The Use of Cognitive Aids During Emergencies in Anesthesia: A Review of the Literature The aim of this literature review was to determine 1. whether cognitive aids improve performance	Literature review searching: • MEDLINE • EMBASE • Cochrane • PhycInfo Search terms: • Anesthesia /anaesthesia • Algorithm • Checklist • Cognitive aid • Standard operating procedure	• Cognitive aids are tools created to guide users while they are performing a task, or group of tasks, with the goal of reducing errors and omissions and increasing the speed and fluidity of performance • Difference from guidelines, protocols or standard operating procedures (all lengthy documents) is that cognitive aids are to be used while the task is being performed • During an emergency, time and cognitive resources are limited • A cognitive aid would theoretically guide stressed clinicians through a sequence of complex steps and prevent them from omitting key actions • The cognitive aid must have the following properties:	• Cognitive aids that are deficient in areas of content, design, training, and team alignment may promote the wrong sequence of actions and potentially cause harmful effects. • There is a need for larger prospective trials of the effect of aids on task completion, practitioners' team behaviors, and overall team functioning	• This study showed in great detail that there is not much evidence for the use of cognitive aids • Some of the existing studies may have shown lack of support for cognitive aids because the aids used were poorly designed. Many studies have

Author(s) /Year /Publication	Topic /Purpose	Framework /Method /Sample	Key findings	Limitations	Implications for practice
	of individuals and teams and 2. whether recommendations can be made for future cognitive aid design, testing, and implementation	• Guideline Inclusion criteria: • A cognitive aid was used or tested • The paper was specifically relevant to emergencies encountered in anesthetic practice • The cognitive aid related to anesthetic emergencies • The paper described a cognitive aid that was not only for an educational or assessment purpose • Involved the use of a cognitive aid by a group other than anesthesia • If the aim of the aid was to assist in emergencies that might also	o Its content must be derived from "best practice" guidelines or protocols; o Its design should be appropriate for use in the context of the emergency situation; o It should be familiar, in a format that has been used in practice and training; o It should also assist other team members to perform their tasks in a coordinated manner • Content: o The information should represent best clinical practice • Design: o The possibilities of harm from improper or unintended use should also be considered o There is no reason to assume that poorly designed cognitive aids in health care would not lead to errors • Training: o Training may improve the familiarity with a cognitive aid and enhance the chance of it being used effectively • Individual Versus Team Performance: o A cognitive aid must support both the individual and the team in managing the emergency o A cognitive aid that distracts and interrupts the team from performing their tasks may increase the risk of errors and have the opposite of the intended effect • There is some evidence that cognitive aids improve technical performance during emergencies, but there is much to be learned about when and why they fail	• The maximum benefit is likely only if practitioners are familiar with the structure of each aid, and how it should be used • The current evidence for the efficacy of cognitive aids in emergencies is inconclusive • The lack of evidence is due to both the limited research that has been performed and the deficiencies in design and evaluation of current cognitive aids	shown that design is very important for the correct utilization of aids • This article gave great input in how to implement cognitive aids and what would be important factors when creating those aids • The article was very positive for the use of cognitive aids, but showed that there is not much evidence behind the mandate for the use of aids • One obstacle to overcome in the implementation of cognitive aids is the perceived lack of knowledge and confidence if a provider "must

Author(s) /Year /Publication	Topic /Purpose	Framework /Method /Sample	Key findings	Limitations	Implications for practice
		occur during anesthetic care Based on the inclusion criteria, 23 papers describing 22 cognitive aids were selected Evidence was sought to establish: 1. Whether cognitive aids improve performance of individuals and teams 2. Whether recommendations can be made for future cognitive aid design, testing, and implementation Author compared cognitive aids implementation against medical devices	• The content or knowledge contained in cognitive aids should be developed from national or international guidelines or from broad consensus • Content needs to be reviewed and adapted as knowledge changes • Evidence from the human factors literature suggests that poorly designed cognitive aids may lead to unintended consequences • Despite the perceived benefits to the team, there is minimal evidence to support an improvement in team function with the use of cognitive aids • Data suggest that cognitive aids may change team coordination and improve task completion but their effects on team processes are not clear • One study showed effects of a designated reader demonstrating decreased communication by the team. Conversely, it may be that the remaining communication was more efficient and targeted • It is reasonable to assume that familiarization to a cognitive aid before its use would mean that the participants would be more likely to use it and use it more effectively • Ideally, as with any medical device, for the best results the cognitive aid should be intuitive to use and should also be used only by individuals trained in its use • Part of the problem of the underuse of cognitive aids may be the existence of a professional culture that does not support their use. Some testers stated that using a cognitive aid reflected a lack of confidence or knowledge • Cognitive aids must be positioned where it would be naturally to look for them, e.g. where		use an aid" during an emergency. This obstacle may be easier to overcome among younger generations of providers than older

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		implementation standards	emergency drugs are kept (associating the aid with the task at hand) • Cognitive aids are not commonly used during emergencies in anesthesia and at present appear not to be supported by the culture • The current evidence for the efficacy of cognitive aids in emergencies is inconclusive. Although the evidence to support the use of cognitive aids in emergencies is currently weak, the success in other settings is compelling		
Augoustides, John G T Atkins, Joshua Kofke, W. Andrew 2013 Anesthesia & Analgesia Anesth Analg. 2013 Nov;117(5):1037-8. doi: 10.1213/ANE.0b013e31829e443a.	Much Ado About Checklists: Who Says I Need Them and Who Moved My Cheese? Editorial to prime readers about the main special articles regarding use of cognitive aids	Editorial comments	• 89 years ago Dr. Babcock asked: o "Have you a plan of action so developed so that the right thing is always done in the emergency and time is not frittered away with useless or non-essential details?" o "Do you ever hold emergency drills in your operating room to see if you are constantly prepared for an instant resuscitation?" • Change happens - they keep moving the cheese: • Anticipate change - get ready for the cheese to move • Monitor change – smell the cheese often so you know when it is getting old • Adapt to change quickly - the quicker you let go of old cheese, the sooner you can enjoy new cheese • Change - move with the cheese; enjoy change - savor the adventure and enjoy the taste of new cheese! • Be ready to change quickly and enjoy it again - they keep moving the cheese		This editorial strongly recommends that the time for implementing cognitive aids in anesthesia is now

Author(s) /Year /Publication	Topic /Purpose	Framework /Method /Sample	Key findings	Limitations	Implications for practice
			• The weight of the evidence, as summarized in this important article, suggests, however, that it is time to move the implementation of checklists beyond the simulation laboratory (T1 setting) into anesthetic practice (T2 and T3 settings) both for elective and emergency care • Components author believes are required for successful and pervasive implementation of cognitive aids: 1. Create the cognitive aid with a focus on clear content and effective design 2. Familiarize teams with the cognitive aid in training exercises 3. Use the cognitive aids that should be accessible in every anesthetizing location 4. Integrate the cognitive aids into the perioperative culture of the institution. The checklists can be used in team preparation for emergencies (pre-crisis), for patient management in real emergencies (intra-crisis), and for guiding improvements in delivery of care after resolution of the emergency (post-crisis) • Key questions were raised: o When do checklists become standard of care in delivery of emergency care? o Is the failure to use a cognitive aid in an emergency clinically negligent? o Who is responsible for developing effective cognitive aids to guide management of perioperative emergencies? o Should the checklists be adapted to local conditions?		

Author(s) /Year /Publication	Topic /Purpose	Framework /Method /Sample	Key findings	Limitations	Implications for practice
			o Who "runs" the checklist protocol during a crisis? • Further it was asked when the whole checklist concept becomes toxic: o If this concept is pushed to the extreme, checklist apathy could develop, with deleterious consequences for patient care		
Shekelle, PG Pronovost, PJ Wachter, RM et al. 2013 Annals of Internal Medicine Ann Intern Med. 2013 Mar 5;158(5 Pt 2):365-8. doi: 10.7326/0003-4819-158-5-201303051-00001.	The Top Patient Safety Strategies That Can Be Encouraged for Adoption Now To identify gaps in evidence on patient safety	Literature review, followed by a review of current patient safety strategies, with a final assessment of evidence strength and quality Project team from: • RAND Corporation • Stanford University • University of California, San Francisco • Johns Hopkins University • ECRI Institute • International panel of 21 stakeholders and	• Concluded that 22 Patient Safety Strategies (PSSs) are ready to be encouraged for adoption by health care providers, of which 10 the expert panel believed should be "strongly encouraged" for adoption • Our expert panel believes that providers should not delay adopting these practices particularly the strongly encouraged ones. Enough is known now to permit health care systems to move ahead • The #1 on the strongly recommended list is o Preoperative checklists and anesthesia checklists to prevent operative and postoperative events	Many of the authors have personal potential conflicts of interest listed, although none of the listed conflicts appear to be significant	This extensive study clearly recommends that anesthesia implement an emergency checklist on a global level

Author(s) /Year /Publication	Topic /Purpose	Framework /Method /Sample	Key findings	Limitations	Implications for practice
		evaluation methods experts • Evidence-based assessment of patient safety strategies (PSSs) • 41 topics were selected of which 18 topics were chosen for in-depth review			
Arriaga, AF Bader, AM Wong, JM Lipsitz, SR Berry, WR Ziewacz, JE Hepner, DL Boorman, DJ Pozner, CN Smink, DS Gawande, A 2013 New England Journal of Medicine	Simulation-Based Trial of Surgical-Crisis Checklists	• OR teams from 3 institutions • Series of surgical-crisis scenarios • Simulated OR • Total of 106 simulated scenarios using 16 teams	• In a high-fidelity simulation study, checklist use was associated with significant improvement in the management of operating-room crises • Failure to effectively manage life-threatening complications in surgical patients has been recognized as the largest source of variation in surgical mortality among hospitals • A total of 97% of the participants agreed with the statement “If I were having an operation and experienced this intraoperative emergency, I would want the checklist to be used.”	• Absence of surgeons as participants in most of the scenarios • Small number of teams	The results of this study suggest that hospitals and ambulatory surgical centers should consider implementation of checklists to in-crease the safety of surgical care
Mulroy, M 2013	Emergency Manuals: The Time Has Come	Editorial in APSF Newsletter Spring-Summer 2013	• The reality is that none of us can any longer function as that “lone expert” recalling every		Significant support for the implementation of

Author(s) /Year /Publication	Topic /Purpose	Framework /Method /Sample	Key findings	Limitations	Implications for practice
Journal of the Anesthesia Patient Safety Foundation			procedure and drug dose from memory, especially in crisis situations • We are now adapting to the checklist concept that has been used in aviation for 80 years, and for anesthesia machine checks for 50 • Simulation testing of such cognitive aids in Palo Alto, Boston, and Seattle has shown, not surprisingly, that performance in emergency situations is greatly improved with a checklist		emergency manuals
Marshall, SD Mehra, R 2014 Anaesthesia	The effects of a displayed cognitive aid on non-technical skills in a simulated 'can't intubate, can't oxygenate' crisis	• Prospective randomized controlled trial • One-day course on advanced airway management • Simulated study on a 'can't intubate, can't oxygenate' scenario • 64 participants	• According to established guidelines, when all other measures to provide oxygen fail, the final common step is the insertion of a surgical infraglottic airway • Lack of proficiency has been suggested as the main reason why over 60% of initial attempts at needle cricothyroidotomy failed • This study shows that when a cognitive aid is present for a CICO crisis, critical care specialists perform non- technical skills better, but they do not perform technical skills faster • Repeated attempts at laryngoscopy are a common feature of failed airway incidents leading to hypoxic brain injury or death. The inability to change strategy represents a fixation error and it is not yet clear if or how cognitive aids may prevent this • The ability of team members to challenge other clinicians in airway crises has some promise in preventing them from persisting with ineffective airway management strategies, and to focus on oxygenation rather than device placement	• Simulated study using actors instead of real patients • Not able to blind observers to the interventions • Due to high educational level of participants, results is likely to be better than with a wider population of critical care specialists	This study demonstrates that the use of a cognitive aid is associated with higher scores of the quality of team behavior during an airway emergency

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Morell, RC Cooper, JB 2016 APSF Newsletter	APSF Sponsors Workshop on Implementing Emergency Manuals	APSF Newsletter Workshop for over 100 anesthesia expert stakeholders in September 2015	See also "Audit Trail" entry for this meeting • Following Dr. Gaba's presentation audience response data demonstrated that 82% of participants felt that every site of perioperative care should have one or more emergency manuals (EMs) • Dan Raemer, PhD, from Massachusetts General Hospital (MGH) who spoke about the pitfalls and risks associated with the use of emergency manuals o In one case of septic shock, the team perseverated on a diagnosis of malignant hyperthermia (MH) o Another case of a mixed diagnosis with possible components of anaphylaxis and/or transfusion reaction, the team went back and forth between pages and to other pages without getting to a correct course of treatment o Yet, another case, the correct diagnosis was septic shock, for which there is no page in the manual. This team became distracted and did not provide appropriate treatment • Recommend that a part of the pre-surgical timeout should consist of the verification of the presence of an emergency manual, to remind the team that anyone can suggest its use, and that a reader be designated as appropriate to the situation • A relevant audience response question revealed that 99% of participants believed that the introduction of EMs, like any new technique or		This workshop firmly agreed that the implementation of emergency manuals in some form should be instituted. They felt strongly that it should be done sooner rather than later

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			technology in medicine, presents unanticipated risks and potential complications • The audience response indicated that only 19% of participants believed that limitations of checklists must be overcome before their use should be widely adopted. • Similarly, 92% of respondents disagreed with the position that if teams and individuals practice CRM, checklists are not necessary • Hannenberg advised that if we create a "we use checklists" mentality, the idea being that good clinicians use cognitive aids • Audience response revealed that 79% agreed that anesthesia professionals should lead the development of the content for cognitive aids for OR emergency management; however, 96% disagreed that only anesthesia professionals should call for the use of an EM • A large majority of the audience felt that the APSF should take a leading role in promoting EMs; however, the audience was split on the question of whether EMs should ever become a standard of care with only 67% voicing that opinion		
Borshoff, D 2014 Anesthesia & Analgesia	The Limitations of Crisis Checklists	Letter to the Editor	• An incorrect diagnosis can lead to the wrong checklist being used, and a disproportionate sense of urgency can result in fixation error. • Specific checklists will not be a perfect fit for every clinical context and may actually distract from task prioritizing • Emergency manuals may prove their usefulness in anesthesia over time		Letter casts doubt if the time is right for emergency manuals at this time

Author(s) /Year /Publication	Topic /Purpose	Framework /Method /Sample	Key findings	Limitations	Implications for practice
Burden, AR Carr, ZJ Staman, GW Littman, JJ Torjman, MC 2012 Simulation in Healthcare	Does Every Code Need a "Reader?'' Improvement of Rare Event Management with a Cognitive Aid "Reader'' During a Simulated Emergency	• Simulation laboratory • 28 residents in mixed specialties • 31 simulation sessions • 2 different scenarios	• Prompt treatment is necessary to assure patient survival during crisis • Reader introduction resulted in execution of all critical actions. During the debriefing of the simulated scenarios, subjects acknowledged the benefit of the Reader • Even subjects who used the cognitive aids reported that they were reluctant to use them, stating that they thought it was not appropriate to use memory assistance tools • Those who did attempt to use the cognitive aids during the event expressed great difficulty in reading the aid while gathering clinical information and communicating with the team. They reported that it was difficult for them to change from a cognitive process to a dynamic process • The subjects noted that the introduction of a Reader helped them overcome these problems and resulted in the appropriate execution of all critical actions • In another investigation of resident physician cognitive aid use during emergent events, some subjects made the wrong diagnosis, chose the wrong cognitive aid, and failed to resuscitate the patient. Complicated, difficult to navigate cognitive aids may have been a limiting factor for our subjects as well. Subjects may have also found it difficult to know which cognitive aid to choose • All subjects acknowledged the benefit of the Reader	• Small number of subjects • Simulation and lab setting only and not a real OR	

Author(s) /Year /Publication	Topic /Purpose	Framework /Method /Sample	Key findings	Limitations	Implications for practice
August, DA 2014 ASA News Letter	Cognitive Aids: Trending, Transformative or Just Too Much?	Article in ASA Newsletter	• Are cognitive aids just the latest trend, or will their widespread integration truly transform the level of safe patient care we deliver? • What is the ideal dose of checklists? • Checklist toxicity? • MHAUS, Stanford Cognitive Aids Group checklist • Confirmation bias may also play a role, as clinicians look to verify that, indeed, the suggested items on the checklist are present, rather than seeking any disconfirming evidence to support an alternate diagnosis • Phenomena such as framing effects, premature closure, and confirmation bias are among a larger group of decision factors that might contribute to error and are reviewed in detail elsewhere		
Pollock, JE Berekynei, S Nandagopal, K Howard, SK Goldhaber-Fiebert, SN 2014 ASA abstract		• Surveys were used to assess clinical adoption of EMs in the OR • Pretest-posttest survey	• Emergency manuals, used in anesthesia simulation training at Stanford for many years, have recently been made clinically accessible in all Stanford Hospital operating rooms, along with increased ongoing trainings • The response amongst residents has been positive overall and many residents have successfully used the EMs in direct patient care • Anesthesia training programs that do not currently have emergency manuals should consider implementation, including not only accessibility but also training in why and how to use them effectively		

Author(s) /Year /Publication	Topic /Purpose	Framework /Method /Sample	Key findings	Limitations	Implications for practice
Ranganathan, P Phillips, JH Attaallah, AF Vallejo, MC 2014 Anesthesia & Analgesia	The Use of Cognitive Aid Checklist Leading to Successful Treatment of Malignant Hyperthermia in an Infant Undergoing Cranioplasty	Letter to the Editor of A&A	• Describe a real life example of the benefits resulting from introduction of one such cognitive aid, The Emergency Manual into each anesthesia workstation • This case illustrates the clinical advantage of using cognitive aids in the operating room		
Thomassen, O Brattebø, G Heltne, JK Søfteland, E Espeland, A 2010 BMC Health Services Research	Checklists in the operating room: Help or hurdle? A qualitative study on health workers' experiences	Focus group interviews Nurses and physicians Anesthesia and Intensive care	• A head physician with a positive attitude was considered crucial for successful implementation • The patient must not be forgotten • New tools can interrupt workflow • Critical voices must be identified and addressed • A checklist may be used in situations for which it was not intended • Standardization is important for the usefulness of checklists	Qualitative study	