Effects of Non-technical Skills Teaching on Provider Performance in Anesthesia Crisis Resource Management

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Dedication and Acknowledgments

First, I want to thank God for giving me the opportunity to be in this program and for giving me the ability to help take care of others in this capacity. Secondly, I want to thank my husband, Harrison, for all his support and patience with me as I have progressed through not only this project, but also anesthesia school. Thank you for being a good listener, for all the times you prayed with me, for helping take care of everything at home when I couldn't, and for being my rock for the last couple of years. I would not have been able to do any of this without you. I also want to thank my parents for their unwavering support, for always propelling me forward, imparting their wisdom, for the countless hours spent talking on the phone and helping me when I did not think I could do this. I am so blessed to have such a great support system. I am also grateful for Dr. Korogoda for helping me so much with this project.

Abstract

Background Medical errors are rife nationwide. Since most errors are preventable, focus has been placed on improving medical education, including non-technical skills. Simulation is a tool used to help train medical professionals in high acuity, low occurrence events without putting patients at risk. **Purpose** The purpose of this DNP project was to assess the effect of an educational intervention on SRNAs' non-technical skills including task management, situational awareness, decision making, and teamwork during an anesthesia crisis simulation. **Methods** This project was a pilot study with an observational design. A convenience sample of ten SRNAs was randomly split into two groups. The first group participated in an anesthesia crisis management simulation (ACRM) without receiving an educational intervention on non-technical skills, while the second group took part in the simulation after learning about non-technical skills and the benefits of ACRM. The Anesthetist Non-technical Skills (ANTS) rating tool was used to evaluate each participant's performance in the simulation. **Results** Mann-Whitney U for independent samples t-test was used to analyze data. There were statistically significant differences between the control group and intervention group in the situational awareness ($p = 0.032$) and decision making ($p = 0.032$) categories. There was no statistically significant difference between groups for the task management ($p = 0.095$) and teamwork ($p = 0.841$) categories. **Recommendations and Conclusions** Simulation should be implemented into the curriculum of nurse anesthesia schools because it improves SRNA confidence and performance. Developing competence and refining skills in a simulated setting could translate to better patient safety and improved outcomes.

Background and Significance

Medical errors have been described as preventable failed processes which may or may not lead to adverse outcomes (Hofer et. al, 2010). Medical errors have recently been reported as the third leading cause of death in the United States, with over 250,000 deaths per year (Makary & Daniel, 2016). In 2016, Risk Management Monthly reported several issues that led to medical errors including misdiagnoses, failure to order appropriate tests or treat results, and poor communication among multiple providers. Studies have also shown that medical errors are most likely to occur in the intensive care units (ICU) and operating rooms (ORs), especially with new procedures or in emergencies (Carver et. al, 2020). The Joint Commission Safety Goals for 2021 emphasized not only improving medication administration, patient identification, and reducing harm, but also caregiver communication and reporting of critical information (The Joint Commission, 2021). With the exponential growth of deaths related to medical errors, hospitals and medical associations nationwide have made efforts to promote patient safety now more than ever.

The use of simulation has grown in the medical field as a safe avenue for medical errors to occur without penalty. Simulation has been a beneficial tool for medical education because it provides a low-stress environment where providers can experience real-life emergencies that may not occur during their clinical training (Park, 2011). It presents a way for students to assess situations and determine interventions about patient care without patient safety being put at risk. In addition, providers who go through simulation have a heightened sense of self-awareness and gaps in knowledge, which fosters personal and professional growth. Simulation is especially beneficial in the field of anesthesiology, where there are many low occurrence, high acuity events. As little as a one-time exposure to simulation has been proven to show improved skills in

anesthesia providers (Yee et. al, 2005).

Student registered nurse anesthetists (SRNAs) are experienced ICU nurses who get a masters or a doctoral degree in nurse anesthesia. Although SRNAs are well prepared and trained to take care of adverse events in the ICU, the OR presents new challenges, not only in patient care, but in their new role as a team member. The operating room consists of the surgeon, certified registered nurse anesthetist, circulating nurse, scrub nurse/technician, and sometimes a resident, physician's assistant, or nurse practitioner. Since operating room teams can change throughout the day, it can be a daunting and frustrating task for the SRNA to communicate clearly and adequately with everyone in addition to learning how to provide safe anesthesia.

Much of nurse anesthesia training is focused on technical skills of how to provide a safe anesthetic for different procedures and patient comorbidities. Although technical skills are vital for patient safety and good outcomes, there is less emphasis on teaching non-technical skills such as how to adequately manage tasks, work as a team, have situational awareness, and how to make decisions, which are just as vital in achieving good patient outcomes.

Purpose

The purpose of this DNP project was to assess the effects of an educational intervention on SRNAs' non-technical skills including task management, situational awareness, decision making, and ability to work as a team member during an anesthesia crisis simulation.

Review of Current Evidence

The goal of this review was to evaluate the association between anesthesia crisis simulation, anesthesia provider non-technical skills, and improving patient safety. The databases searched for this literature review were MEDLINE, CINAHL, and PubMed. The key search terms included non-technical skills, anesthesia, anesthesia crisis resource management (ACRM),

and anesthetist's non-technical skills (ANTS). The studies were limited to peer-reviewed journals published within the last ten years in the English language. After careful consideration, the year range of the search was expanded because many classical works on simulation and ANTS had been published between the 1990s and 2000s, resulting in the review of eleven articles.

The main themes observed in the review were the key role aviation played as a model for anesthesia crisis management simulations, human behavior as a major factor in medical errors, the importance of simulation in medical training and the significance of non-technical skills in anesthesiology.

Medical errors are the third leading cause of death in the United States, with over 250,000 deaths per year (Makary& Daniel, 2016). Main contributors to errors include a lack of non-technical skills (NTS) such as situational awareness, decision making, task management, and communication (Fletcher et. al, 2002; Morgan et. al 2011; Sidi et. al, 2014; Wunder, 2016). In anesthesia, NTS develop with continued exposure to different clinical situations and as medical knowledge is accrued (Murray & Henrichs, 2007; Sidi et.al, 2014; Wunder, 2016; Yee et.al, 2005). Although most novice providers do not possess adequate non-technical skills, clinical training and exposure to different emergency situations help them develop these skills over time.

With technological advancements and the push to decrease medical errors nationwide, the safety level of anesthetic practice has improved, resulting in significantly lower exposure to emergency situations for anesthesia trainees during training. Since high acuity and low occurrence events are less likely to happen, new anesthesia providers have fewer experiences dealing with emergencies and may not evolve the non-technical skills needed to manage these

events. However, simulation has been highlighted as a valuable pathway to grow skills in both novice and experienced providers.

Anesthesia Crisis Resource Management (ACRM) was modeled after aviation's crew resource management (CRM) training to help prevent errors in health care (Fletcher et.al, 2002; Gaba et.al, 2001; Morgan et.al, 2011; Wunder, 2016). CRM was developed after flight data recorders and cockpit voice recorders suggested many accidents during flights were not due to lack of technical expertise of the crew, but were actually caused by the crew's lack of situational awareness and inability to communicate and work as a team to solve the situation (Skybrary, 2021). Wrong decisions made by the team led not only to serious incidents, but sometimes fatal outcomes. The introduction of the dynamic flight simulator allowed for training of the crew under different conditions and for the exploration of areas crew members needed to improve on, in a risk-free environment. Classroom education on cognitive and interpersonal skills was combined with simulation to improve NTS. CRM was adopted worldwide due to excellent results and feedback from those who took part (Skybrary, 2021). In aviation, CRM became a way to integrate leadership, teamwork, and communication in a simulation setting to improve crew performance and, as a result, flight safety.

Similarly, high-fidelity simulation in anesthesia was first introduced in the 1990s to improve patient safety by bridging the gap between technical and non-technical skills in high stress situations (Gaba et.al, 2001). Gaba et al realized that anesthesia and aviation both have a high risk for crises with the potential to cause harm due to the limitations of human behavior. NTS training has been studied extensively in aviation, but there is paucity in the literature of the effects of its teaching in anesthesiology, especially in SRNAs.

The use of high-fidelity simulation has grown exponentially in the last thirty years. While

simulation was pioneered in the academic setting, it has also gained popularity in the workplace. Although it can be conducted virtually, mannequin simulation has shown to be the most effective way of increasing participant knowledge, comfort level, and performance even after just one simulation (Erlinger et.al, 2019; Shields and Gentry, 2020; Staun et.al, 2020; Yee et.al, 2015). High-fidelity simulation allows participants to have hands-on experience in real-life situations. It provides an environment where mistakes can be made, gaps in knowledge evaluated, and NTS assessed, without exposing patients to harm (Holzman et.al, 1995; Staun et.al, 2020; Wunder, 2016). Studies show that second-year SRNAs and second-year anesthesia residents had prolonged response times to correctly identify myocardial infarctions or anaphylactic reactions and to intervene appropriately during simulation, but this was not detrimental to real patients since it did not occur in the clinical setting (Erlinger et.al, 2019 & Johnston et.al, 2019). Not only were SRNAs able to learn how to correctly handle this situation in the future, but there were no poor patient outcomes associated with the training. While simulation can expose gaps in knowledge, the debriefing process is also a vital part of building both technical and non-technical skills through providing feedback and allowing for self-reflection.

In recent years, root-cause analysis for morbidity and mortality and post-crisis debriefs have become more common. Skelton et al (2011) evaluated the differences in ANTS scores between anesthesia residents who received NTS teaching followed by a debriefing session and anesthesia residents who went through the simulation without any intervention or debriefing. Participants in the intervention group with debriefing scored statistically higher on the ANTS rating scale than those who did not receive NTS teaching or debriefing. Debriefing is also an important tool to utilize after any crisis because it provides each individual with an opportunity to self-evaluate. It is vital to analyze mistakes, why they occurred, individual thought processes,

and how to prevent mistakes from happening in the future. Debriefing allows people to learn from their errors and, together with root-cause analysis, may improve outcomes.

The direct impact of simulation-based medical education on patient safety and provider aptitude to perform clinically has been studied extensively (McGaghie et.al, 2011). Although Skelton et.al (2011) found evidence that non-technical skills education during ACRM led to better patient outcomes, there is an overall lack of evidence in literature directly linking non-technical skills education with decreased morbidity and mortality. However, several studies have indicated there is a significant correlation between technical and non-technical skills, which may signify that improving both sets of skills could lead to better patient care (Hull et. al, 2012 & Riem et.al, 2013). Anesthesia providers' inability to effectively perform non-technical skills could lead to poor technical performance, and therefore, increased morbidity and mortality. Ultimately, the goal of ACRM is to refine clinician skills, build confidence, and enhance patient outcomes. Its incorporation is an important aspect of anesthesia training and could contribute to a decrease in medical errors in novice anesthesia providers.

Theoretical Model

Changing one's practice is a challenge all providers face at one point in their careers. Whether it is a change in how to make clinical decisions based on new evidence or a change in how to communicate, most clinicians do not welcome change with open arms. Lewin's Theory of Planned Change explores the driving forces for people's behaviors and what needs to be done to enable change.

The first stage of Lewin's Theory of Planned Change is called *unfreezing*. In this stage, a leader in the organization realizes the need for change, barriers to change, and what needs to be done in order to maximize forces that aid in change and minimizing the forces that inhibit change

(Shirey, 2013).

The second next stage is named *moving and transitioning*. This is where individuals realize that change is not a one-time event, but a process that will take not only time, but a commitment to a new path (Shirey, 2013). This stage necessitates a plan of action for change and clear communication to not lose sight of how to accomplish the proposed plan.

The third and last stage, *refreezing,* is where change is embedded into practice and is considered the new norm (Shirey, 2013). Barriers to change are removed and factors that help the successful transition into new ways of accomplishing tasks are encouraged. If done correctly, the refreezing stage will allow changes to become part of the fiber of an organization and will be sustainable over time (Shirey, 2013).

Lewin's Theory of Planned Change fits well into this project because it mirrors the goals of improvement in non-technical skills in SRNAs. For SRNAs to be able to evolve their non-technical skills, they must be open to changing the way they manage tasks, work in a team environment, have situational awareness, and ultimately, make decisions. They must first realize the need to enhance their non-technical skills, transition into learning how to do it, and lastly be able to incorporate the teachings provided in this project to advance their practice. Simulation provides the perfect environment for self-awareness and cognizance of the need for change. Once participants realize areas in their own lives where they need to improve, there is a seamless opportunity for change. The education portion of this DNP project will provide the tools participants will need to make changes to their own practice, but it is ultimately the responsibility of each person to take what they have learned and make it a part of their everyday lives.

Methods

The purpose of this DNP project was to assess the effects of an educational intervention on SRNAs non-technical skills including task management, situational awareness, decision making, and the ability to work as a team member during an anesthesia crisis simulation.

Design

This pilot study was a simulation with an observational design and post intervention survey. Each participant was the sole anesthesia provider in the high-fidelity crisis simulation. Participants were observed by the PI during anesthesia crisis simulation and rated on the Anesthetists' Non-technical Skills rating tool.

Population

This project used a convenience sample of SRNAs in the class of 2023 at a school of nursing anesthesia in the southeastern region of the United States. Students were recruited by the principal investigator through e-mail and in person after Institutional Review Board (IRB) approval. The selection criteria were enrollment in the class of 2023 in the college of nursing in the nurse anesthesia subspecialty. The participants were men and women over the age of 18 years. The participant pool was ten students. This population was similar to the population described in the literature because participants were anesthesia providers, although most studies have been done on anesthesia residents.

Setting

The project took place in the simulation lab at a school of nursing at a southeastern U.S. public research university in the Fall of 2021.

Project Implementation

IRB Approval

This project was submitted to and approved by the IRB as low risk to participants. Potential risks to participants included minimal psychological risks such as embarrassment, temporary decrease in confidence, and possible feelings of stress. Data privacy was maintained through participant de-identification. Data was collected on the PI's password-protected computer and video recordings were safely locked and stored in SimCapture and only accessible if given access on campus with a secured network. Informed consent was obtained from volunteers to participate in the project.

Intervention

Students were randomly assigned into two groups. Both groups had the opportunity to attend the educational session, but the control group participated in the simulation before receiving the educational intervention. The intervention group took part in the simulation after receiving education on non-technical skills and ACRM.

The PI provided a report to each participant before the transfer of care of the simulated patient. The report included the patient's medical history and the surgery the patient was having. A preoperative assessment was also provided to participants with the patient's history and surgical procedure. The patient had a history of obesity, type 2 diabetes mellitus, obstructive sleep apnea and no known allergies. The procedure was an emergent open appendectomy. In the report, participants were told succinylcholine was used for rapid sequence induction and the surgeon had asked for muscle relaxant for this procedure. Fifty milligrams of rocuronium were administered as the PI gave report and subsequently left the simulation room.

The crisis scenario was anaphylaxis due to rocuronium administration. To keep every experience as similar as possible, the PI set up the room the same way after each person finished their simulation. Participants were encouraged to verbalize their thoughts, describe their actions during simulation, ask for something specific if needed, and to communicate with the surgical team which included a surgeon and a circulator (university staff). Volunteers were also made aware of the shortcomings of the simulation mannequin and ventilator, and to focus on the monitor, which was where vital sign changes would take place. Students were asked to not share information about the crisis scenario with other participants.

The educational intervention (Appendix A) was reviewed by the nurse anesthesia faculty and focused on non-technical skills such as teamwork, situation awareness, decision making, and task management. Each non-technical skill was defined in detail and real-life examples were provided of appropriate and inappropriate behavior pertaining to each skill. The presentation also discussed the history and benefits of ACRM.

Instruments

Simulations were videotaped and rated on the (ANTS) rating tool. The ANTS tool has been vigorously evaluated for interrater reliability, validity, accuracy, and usability by Fletcher et. al in 2003. It is divided into four main categories: task management, decision making, teamwork, and situational awareness. Each of those categories is further divided into subcategories such that the lowest total score one can achieve is four, if the participant scored one in each category, and the highest is sixteen if the participant scored four in each category. A score of one was given in each class for poor performance, two for marginal, three for acceptable, and four for good performance. The simulation was determined to be over once the participant correctly identified and treated anaphylaxis, if ten minutes had passed without correct

diagnosis, or if the participant said they did not want to continue. Following the simulation, the participants were given a survey to assess their confidence in patient care and crisis management.

ANTS scores were collected by the PI as individual students performed the simulation. Data was collected on the PI's password-protected computer. The Excel sheet had each category for ANTS, with distinct separation between the intervention and the control groups. Individual scores were added at the end and the mean score for each category was calculated. Barriers to data collection included not capturing students' actions if there was not enough time to capture all the data onto the Excel sheet in real time. However, since each participant was also video recorded, recordings were re-watched to ensure the accuracy of the data collected. Each recording was maintained confidential and safe in the SimCapture cloud, which is only accessible if given authority to access the videos and could only be accessed on campus with a secured network by authorized individuals.

Post-surveys were divided into the pre-intervention group and the post-intervention group. The survey analyzed the helpfulness of the intervention, assessed areas of improvement in their practice in both clinical and non-technical skills, increased confidence, if they would apply the skills learned in their practice, if they would like to conduct similar simulations with different scenarios, and what improvements could be made to simulations in the future.

Data Analysis

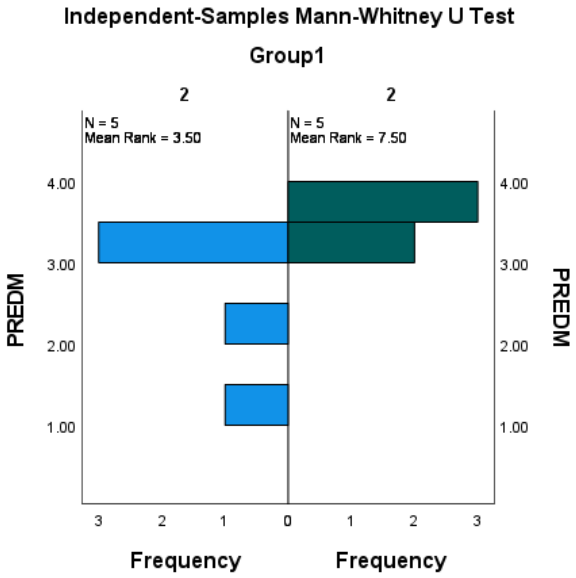
IBM SPSS software was used to calculate the skewness score on a Q-Q plot and to run a Kurtosis analysis. It was determined normality was not met for either category because the skewness score was <0.8 and Kurtosis was < 2. Therefore, a nonparametric Mann-Whitney U test was performed to compare the independent sample's t-test ANTS scores in the control group and the intervention group. The post-survey was analyzed by calculating percentages of the

overall scores participants gave to each answer.

Results

Evaluate Outcomes

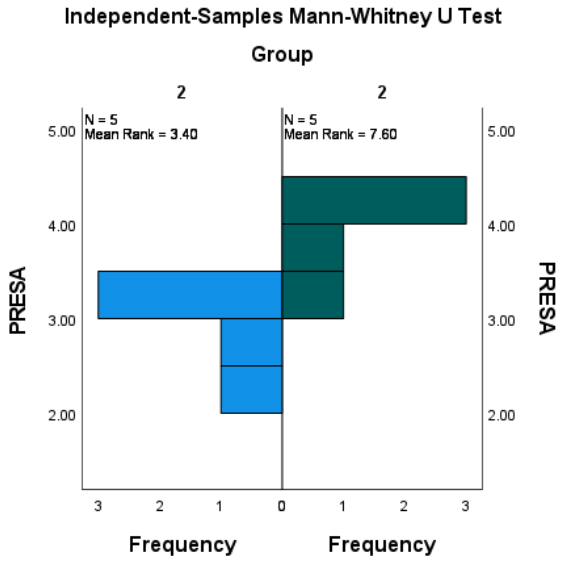
The potential participant pool was 28 students, but the final sample was comprised of 5 females in the control group and 3 females and 2 males in the intervention group. The p-value for the decision-making category was 0.032, revealing there was a statistically significant difference between the control and intervention groups ($p<0.05$). There was also statistically significant difference in the situational awareness category (p 0.032). However, in the task management (p 0.095) and teamwork (p 0.841) categories, the $p>0.05$, showing there were no statistically significant differences between groups. Tables portraying these results are shown below.



Independent-Samples Mann-Whitney U Test Summary

Total N	10
Mann-Whitney U	22.500
Wilcoxon W	37.500
Test Statistic	22.500
Standard Error	4.655
Standardized Test Statistic	2.148
Asymptotic Sig.(2-sided test)	.032
Exact Sig.(2-sided test)	.032

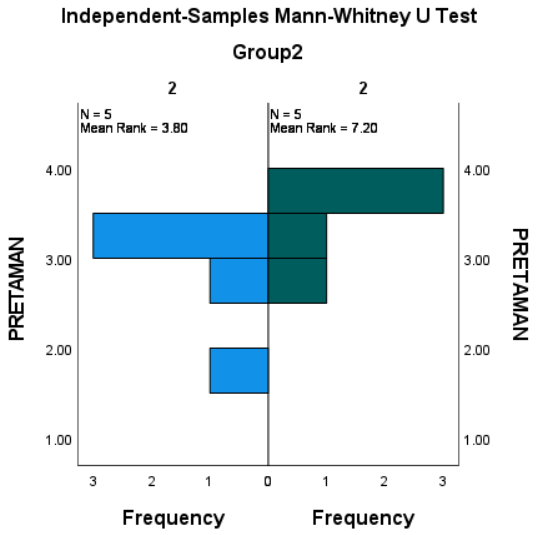
Figure 1.1 and Table 1 Independent Samples Mann-Whitney U Test for decision making



Independent-Samples Mann-Whitney U Test Summary

Total N	10
Mann-Whitney U	23.000
Wilcoxon W	38.000
Test Statistic	23.000
Standard Error	4.670
Standardized Test Statistic	2.249
Asymptotic Sig.(2-sided test)	.025
Exact Sig.(2-sided test)	.032

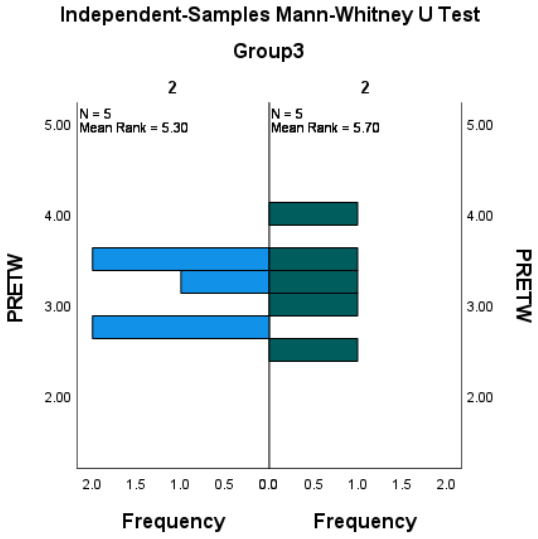
Figure 1.2 and Table 2 Independent Samples Mann Whitney-U Test for situational awareness



Independent-Samples Mann-Whitney U Test Summary

Total N	10
Mann-Whitney U	21.000
Wilcoxon W	36.000
Test Statistic	21.000
Standard Error	4.714
Standardized Test Statistic	1.803
Asymptotic Sig.(2-sided test)	.071
Exact Sig.(2-sided test)	.095

Figure 1.3 and Table 3 Independent Samples Mann Whitney-U Test for task management



Independent-Samples Mann-Whitney U Test Summary

Total N	10
Mann-Whitney U	13.500
Wilcoxon W	28.500
Test Statistic	13.500
Standard Error	4.699
Standardized Test Statistic	.213
Asymptotic Sig.(2-sided test)	.831
Exact Sig.(2-sided test)	.841

Figure 1.3 and Table 4 Independent Samples Mann Whitney-U Test for teamwork

In the postsurvey, 100% of the participants in the post-intervention group agreed or strongly agreed this simulation exercise uncovered areas for improvement in their non-technical and clinical skills, compared to 80% of participants in the pre-intervention group. In addition,

60% of participants in both groups strongly agreed they would apply skills learned in this simulation to their practice. Conversely, 40% of participants in the control group strongly agreed they had increased confidence in their ability to manage this crisis in the clinical setting, 20% agreed, 20% were neutral, and 20% strongly disagreed. In the intervention group, only 20% strongly agreed they had increased confidence in handling this crisis in the future, while 40% agreed, 20% were neutral, and 20% disagreed.

All participants agreed or strongly agreed they would like to do more simulations with different scenarios in the future and this educational intervention and simulation should be a part of the nurse anesthesia curriculum. Additionally, 90% of participants strongly agreed or agreed they would apply the skills learned in the simulation to their clinical practice. One participant in the control group stated, “good simulation of real-life experience jumping into a new case for a break not knowing much ahead of time”. When asked what improvements could be made to this intervention in the future, a volunteer in the intervention group stated, “more simulations! This was a great experience and so helpful”.

Discussion

Simulation-based education is an indispensable tool for medical education. It allows for self-reflection and acknowledgment of personal shortcomings and areas for improvement. The current literature shows non-technical skills develop with experience and exposure to high acuity and low occurrence events, but this simulation provided participants with a chance to analyze gaps in their knowledge at an early stage of their training. Previous studies had shown that education on non-technical skills improved ANTS scores, but this was not true for every category in this study. It had been anticipated the intervention group would have higher ANTS scores for all non-technical skills, however this was not the case. The intervention group had

significantly improved scores in decision-making and situational awareness, but there was no statistically significant difference between groups in the teamwork and task management categories. It can be inferred that the educational intervention on non-technical skills had its expected effect and improved participant decision making and situational awareness but did not make a statistically significant difference in teamwork and task management. This may have been due to individual personality traits or previous ICU experience. As former ICU nurses, SRNAs have many opportunities to work as a part of a team and to learn how to manage tasks appropriately. Although they are in a different role in the operating room, previously developed skills are still relevant and vital to patient care, especially in emergencies. However, the same may not be true for situational awareness and decision making because in the ICU nurses worked in collaboration with other providers; whereas in simulation, SRNAs were expected to assess and treat patients independently.

Positive behaviors noted in the control group were self-awareness, assessing team capabilities, and being assertive. Participants asked for help early on and clearly discussed pertinent information. They also appropriately and respectfully asked team members to accomplish different tasks and took charge of the situation, which all contributed to higher task management and teamwork scores. However, many participants scored lower in the situational awareness category because they were unable to piece together all the symptoms the simulated patient was experiencing and failed to come up with differential diagnoses. It was noted they continued to treat specific vital signs individually, instead of looking at the bigger picture and treating the patient as a whole. In addition, many of the participants in the control group persistently used the same treatment measures, even though there was not much improvement in the patient status. Although the patient was exhibiting oxygenation issues, only a few listened to

breath sounds and correctly administered albuterol. This group also scored lower in the decision-making category because many of the participants did not come up with different possibilities of what could be happening and did not reevaluate patient status appropriately to change the route of care. None of the participants correctly diagnosed and treated anaphylaxis in the control group.

On the other hand, over half the participants in the intervention group came up with the correct diagnosis, due to their improved situational awareness and decision-making skills. However, some participants came up with the wrong diagnosis and could not look beyond that specific diagnosis to assess what else could be causing the patient's vital sign changes. Among those who came up with the correct diagnosis, two students spoke of two differentials before arriving at the conclusion that it was in fact anaphylaxis from rocuronium administration. Furthermore, most of the participants listened to breath sounds and asked for albuterol once they were told the patient had wheezes. This was an important assessment in tying together all the vital sign changes to diagnose the patient with anaphylaxis. All the students who stated they thought the patient was experiencing anaphylaxis administered epinephrine. Participants in the intervention group also asked for help early on, were assertive and included the rest of the operating room team in their decision-making, and appropriately assigned tasks to the rest of the personnel in the room.

All the participants felt this simulation unearthed areas for improvement in their non-technical and technical skills and only 20% strongly agreed (compared to 40% in the control group) that they felt confident in taking care of a similar crisis scenario in the future, while 40% agreed (compared to 20% in the control group) and 20% were neutral (in both groups). Most SRNAs in both groups concurred they would apply the skills learned from this experience to

their practice and all SRNAs agreed simulations should be a part of the curriculum for nurse anesthesia training. These results highlight the benefits participants gain from simulation and the desire to do more of them to gain more confidence and familiarity with the equipment. Not only do simulations improve confidence, but they also shed light on gaps in knowledge that were previously unknown.

The results tie into Lewin's Theory of Planned Change because students had the opportunity to go through the first stage of change, *unfreezing,* as they realized their need for improvement as anesthesia providers. This was evidenced in the post-survey where over half of the participants agreed or strongly agreed this simulation provided areas for improvement in both clinical and nontechnical skills. Additionally, students moved forward into the *moving and transitioning stage,* when they agreed they would apply the skills learned in this project in their future endeavors as SRNAs and future CRNAs. The only stage left for the full change to take effect is *refreezing*, which will hopefully occur as these students employ the techniques learned in this project in their practice.

Strengths and Limitations

Strengths

Some strengths of this project include avid participation from the volunteers, high-fidelity simulation equipment working flawlessly, and the support the PI received from faculty. Each participant was fully committed to the simulation and willing to do their best with the scenario. Even when some participants lost confidence, they persevered until they could no longer think of any other options. The simulation mannequin and the monitors also worked seamlessly, which made the simulation run smoothly without any distractions. The faculty were present, available, and encouraging throughout the whole process.

Identify barriers to success

One of the limitations of this project was the small sample size. The students were notified two weeks in advance of when the project would be taking place, which created many scheduling conflicts. Another identified barrier was that implementation occurred on a Friday before a long holiday weekend, which may have made it challenging to set aside time to participate. In addition, it was explained to students that if the whole class participated, the simulations could potentially take up to six hours to complete, and due to conflicting schedules, students were not able to make the time commitment. If the PI had planned better for when the project implementation would take place, it could have increased sample size and provided stronger data and results.

Several improvements could be made to this project. The first would be better planning by the PI when choosing a date to have the intervention take place so it does not fall on a Friday before a holiday weekend. This could have increased the sample size, which could have provided stronger data and results. The other improvement would be to have an adequate orientation for all the participants so they could have asked questions and had a better understanding of the equipment and simulation environment. Additionally, more simulations could have been performed with both groups to assess for improvement in individual ANTS scores with more simulations, since many previous studies published in the literature were done with more than one simulation. This could have provided stronger, more generalizable data.

Recommendations

Based on the results of this project and the existing literature on non-technical skills and simulation, it would be of great value to incorporate nontechnical skills teaching and ACRM into

the curriculum of the school of nursing at this facility. Initiating this type of training early in the nurse anesthetist's career could provide numerous opportunities for personal and professional growth. Doing simulation while in school could lead to significantly better performance in the clinical setting. ACRM simulation would also increase provider confidence and clinical skills upon transitioning to practicing as a CRNA. Additional studies should also be done to assess when ACRM training is best administered in the curriculum and what frequency would be most beneficial to students. Further research linking ACRM simulation and improved patient outcomes is also needed to increase the utilization of simulation.

Conclusion

This project aimed to assess the effects of an educational intervention on SRNA non-technical skills including task management, situational awareness, decision making, and the ability to work as a team member during an anesthesia crisis simulation. The results showed the education had the expected effect in the situational awareness and decision-making categories, but not in the teamwork and task management categories. It is crucial for SRNAs and nurse anesthetists to effectively communicate, prioritize, make appropriate decisions, have situational awareness, and work well as a team member. Improving non-technical skills is beneficial for healthcare providers because it could help develop provider confidence in emergency situations and provide a risk-free environment to make mistakes and learn from them. Integration of simulation and education on non-technical skills could translate to better technical skills and improved patient outcomes.

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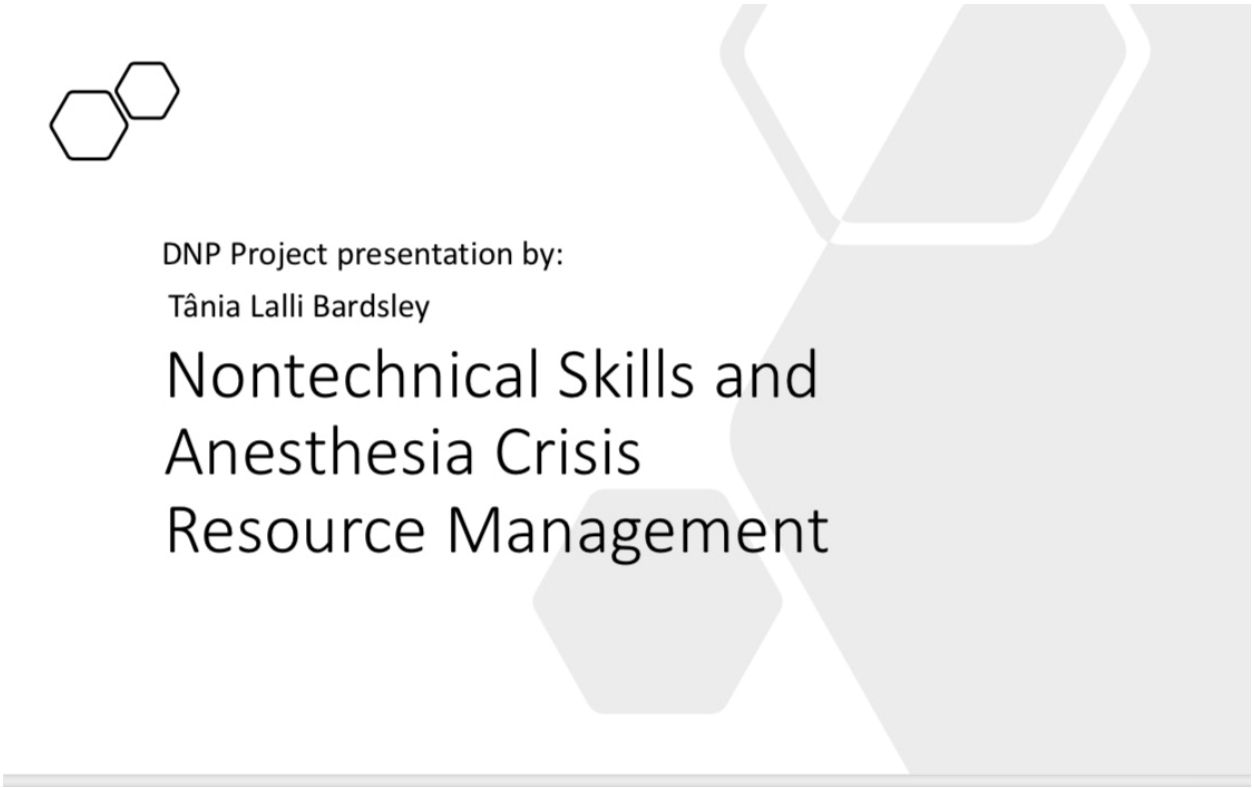
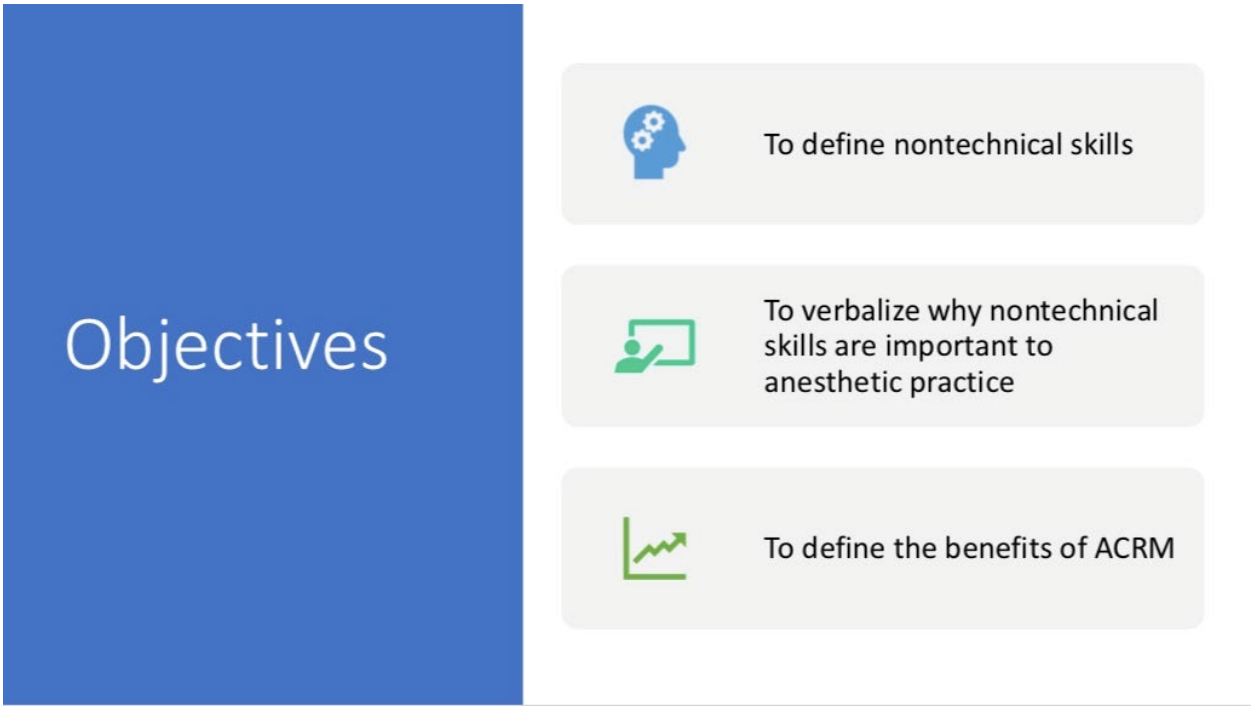
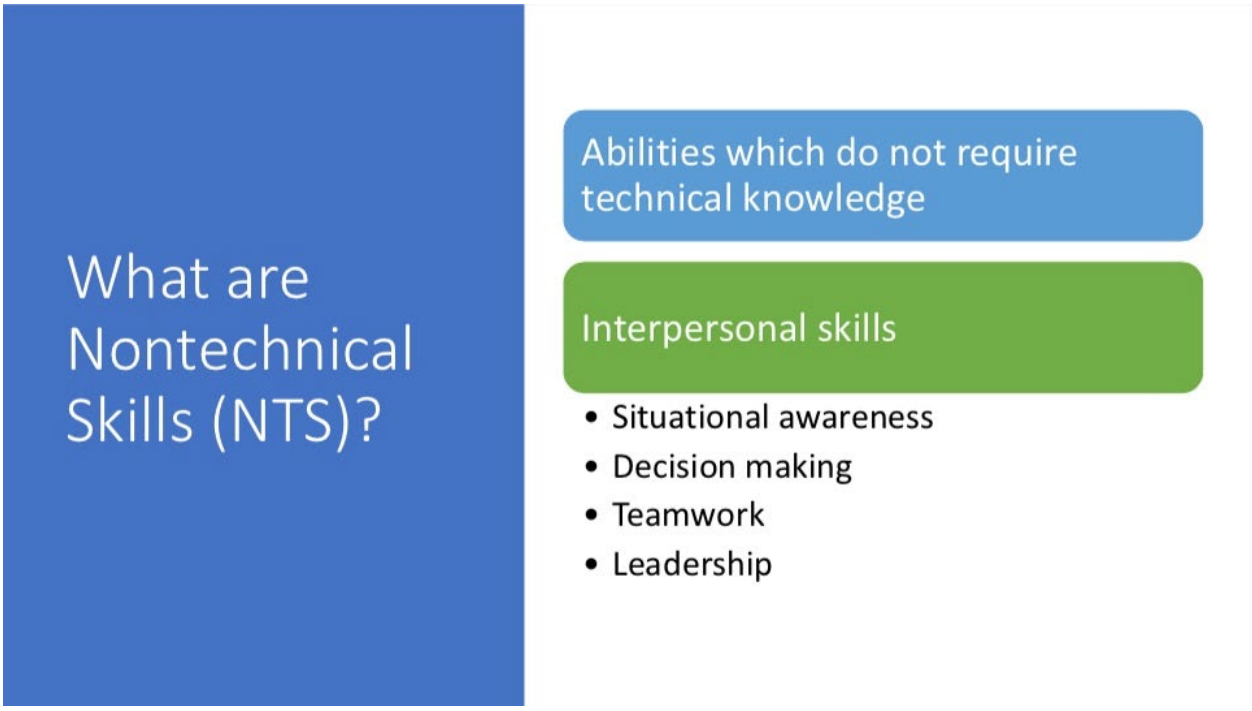
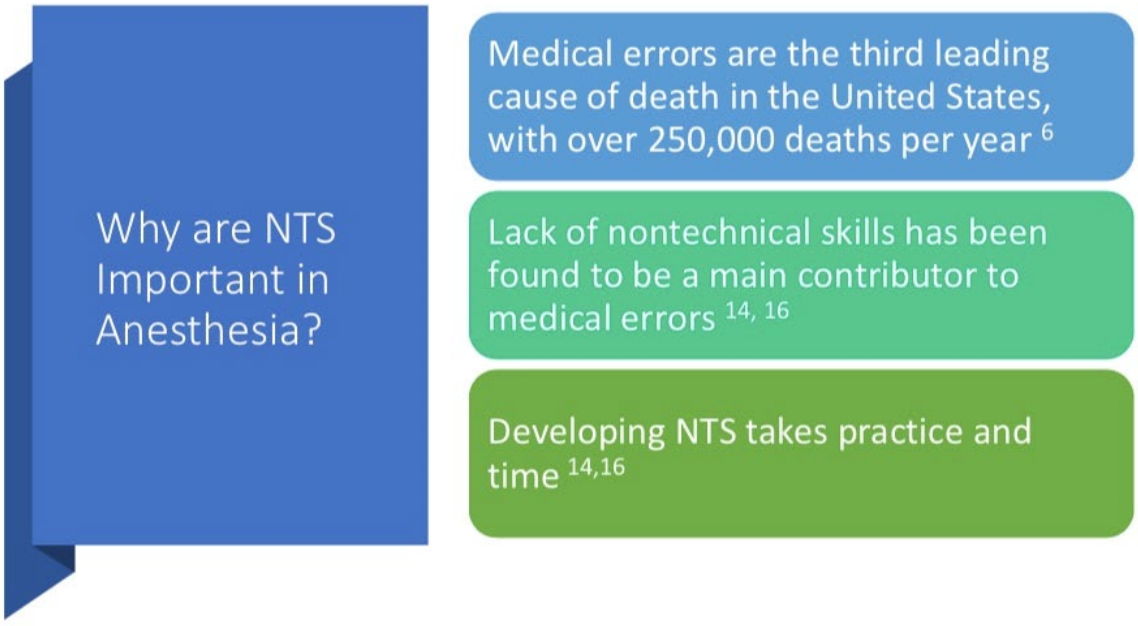
Appendix A: Nontechnical Skills and Anesthesia Crisis Resource Management Powerpoint






What are Nontechnical Skills (NTS)?
Abilities which do not require technical knowledge
Interpersonal skills
• Situational awareness
• Decision making
• Teamwork
• Leadership


Why are NTS Important in Anesthesia?
Medical errors are the third leading cause of death in the United States, with over 250,000 deaths per year [6]
Lack of nontechnical skills has been found to be a main contributor to medical errors [14, 16]
Developing NTS takes practice and time [14,16]

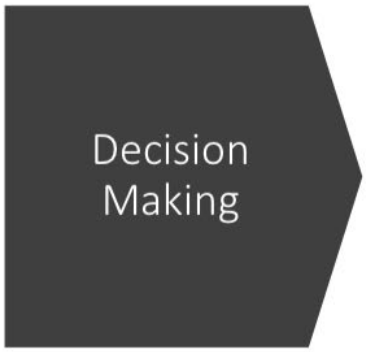
Why are NTS Important in Anesthesia?

- One of the main predictors of adequate NTS is experience[9]
- Studies have shown that third-year residents and senior SRNAs score better on the Anesthetist's Nontechnical Skills rating tool compared to first and second-year residents and SRNAs [4,9,10,11]
- Normally, NTS develop over time with practice and more exposure to crisis and different clinical scenarios[10,11]
- Anesthesia Crisis Resource Management (ACRM) has been used to help novice and experienced providers to evolve technical and nontechnical skills in a shorter period of time [3,10,11,13]
- Simulation has shown to be one of the most effective ways to improve NTS in many different medical fields [15]

Situational Awareness

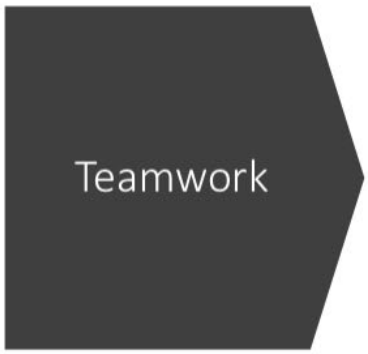
	Description	Example of Good Behavior
Self-Awareness	Knowing your own skills and shortcomings pertaining specific situations	Recognizing your own limitations, competence, and abilities Knowing when to ask for help Accept your own need for personal growth
Gathering Information	Assessing the patient condition and pertinent information	Constantly collecting information and methodically putting the pieces together
Recognizing and understanding	Analyzing facts to recognize patterns and evaluate the current situation	Construing gathered information and coming up with differential diagnoses Based on differentials, having plans for action Communicating with the team about severity of patient status Asking yourself, is there a need for additional action?
Anticipating	Thinking of hypothetical scenarios and having a plan on how to act	Preparing for potential outcomes for each plan Setting thresholds for vital parameters and interventions

Adapted from table found on: http://emss17.sats-kbh.dk/non-technical-skills-workshop/



	Description	Examples of Good Behavior
Identifying options	Distinguishing possibilities for what is going on before taking action	Postulating an overview of the situation Examining different options with the rest of the team Discussing advantages and disadvantages
Making, communicating, and implementing decisions	Making decision based on identification of different options and confirming its execution	Including standards of care, practice guidelines, and algorithms in decision making Communicating decisions with the team Following through until the end
Re-evaluating	Re-assessing and implementing new actions as needed	Re-evaluating the patient and need for changes of current plan

Adapted from table found on: http://emss17.sats-kbh.dk/non-technical-skills-workshop/



	Description	Examples of Good Behavior
Exchanging information	Discussing pertinent information to manage tasks	Giving updates about the patient Sharing concerns Clear, close-looped communication Using name and eye contact when directly speaking to someone
Assessing capabilities	Knowing your team members capabilities and competences to delegate tasks appropriately and avoid fatigue and anxiety	Introducing yourself and your role Reading the room and assessing when other people are unable to complete a task Offer help and know when to ask others for help
Coordinating activities	Working as a team to achieve good patient outcomes	Validating each person's roles and responsibilities
Supporting the team members	Leading by example in having a positive attitude and contributing to a good work environment	Giving constructive feedback and encouragement Being an approachable team member and helping others when needed
Being assertive	Being respectful, yet being a leader and making yourself heard when you have a concern	Speaking calmly and with conviction in a manner others can hear you

Adapted from table found on: http://emss17.sats-kbh.dk/non-technical-skills-workshop/

	Description	Examples of Good Behavior
Planning	Organizing tasks	Being prepared and communicating your plan to the team
Utilizing resources	Knowing what resources are accessible and how to use them appropriately	Ensure adequate equipment is available for emergencies Avoid work overload
Prioritizing	What tasks need to be done first	Delegating tasks to specific team members Notifying team of priorities Being adaptable if situation changes
Maintaining standards	Being focused on safety and optimal outcomes for the patient	Follow protocols, checklists, and guidelines Double check with others to ensure appropriate actions
Using authority	Taking charge of the situation and leading the team	Clear, close loop communication Know when to take the lead and when to step back

Adapted from table found on: http://emss17.sats-kbh.dk/non-technical-skills-workshop/

Anesthesia Crisis Resource Management (ACRM)

- Was originally modeled after aviation's crew resource management[3]
- Both aviation and the medical field have high risk, low occurrence events that can cause great harm to clients[3]
- Aviation and anesthesia both have dynamic work environments[3]
- Human error has shown to be the cause of poor outcomes in both fields[3]
- High fidelity simulation was introduced in the 1990s by David Gaba, MD[3]

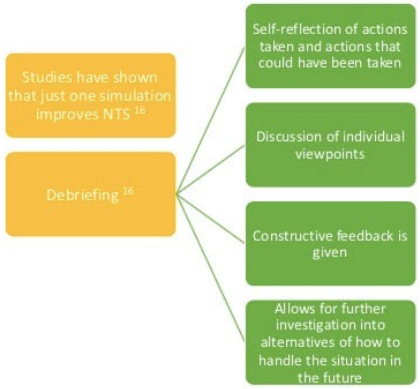
Crew Resource Management (CRM)

- Crew Resource Management was developed after flight data recorders and cockpit voice recorders suggested that many accidents during flights were not due to lack of technical expertise of the crew, but were actually caused by the crew's lack of situational awareness and inability to communicate and work as a team to solve the situation[1]
- Wrong decisions made by the team led not only to serious incidents, but sometimes fatal outcomes [1]
- The introduction of the dynamic flight simulator allowed for training of the crew under different conditions and the allowed for the exploration of areas crew members needed to improve on, in a risk-free environment [1]
- Classroom education on cognitive and interpersonal skills was combined with simulation in order to improve NTS[1]
- CRM was adopted worldwide due to excellent results and feedback from those who took part in it [1]

Anesthesia Crisis Resource Management (ACRM)

- David Gaba, MD pioneered ACRM in the 1990s after seeing its success in aviation[3]
- He wanted to bridge the gap between technical and nontechnical skills through high fidelity simulation[3]
- Training of "single discipline" crew – in our case, SRNAs[3]
- Can also be done with multi-disciplinary team and include all the people that would normally work in the OR[3]
- This allows you to be able to utilize resources appropriately and speak to team members about decisions[3]
- David Gaba's goal of ACRM was to "integrate cognitive, technical, and behavioral skills in managing crisis"[3]

ACRM Continued



Goals of ACRM

- To allow participants to see how they act under stress[14]
- To give an opportunity for participants to analyze their own thought processes
- To recognize erroneous attitudes, beliefs, and knowledge[14]
- To gain the ability to handle high acuity, low occurrence situations[14]
- All of these put together could translate to improved patient outcomes

Benefits of ACRM Simulation

- Allows mistakes to be made without endangering patients[11]
- Novice providers have the chance to be leaders in emergencies
- Improved self confidence[14]
- Enhanced technical and nontechnical skills[14]
- Heightened efficacy
- Potential for improved patient outcomes

Does simulation lead to positive patient outcomes?

- Not a lot of research has been done linking ACRM simulation and patient outcomes
- However, anesthesia providers' inability to effectively perform in nontechnical skills could lead to poor technical performance, and therefore, increased morbidity and mortality[7,12,13]
- More research needs to be done on correlation between NTS training and improved patient safety

Summary

Incorporate the skills you have learned from today not only in ACRM, but in everyday practice!

Work on improving your nontechnical skills daily so that when an emergency arises, you will already have established good habits you can pull from

Having strong NTS can make a huge difference in your practice and may lead to better patient outcomes

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Appendix B: Postsurvey

1. This education is helpful.
   1.Strongly agree 2.Agree 3. Neutral 4. Disagree 5. Strongly disagree

2. This simulation provided areas for improvement in my non-technical skills
   1.Strongly agree 2.Agree 3. Neutral 4. Disagree 5. Strongly disagree

3. This simulation provided areas for improvement in my clinical skills
   1.Strongly agree 2.Agree 3. Neutral 4. Disagree 5. Strongly disagree

4. I have increased confidence in my ability to manage this crisis in the clinical setting
   1.Strongly agree 2.Agree 3. Neutral 4. Disagree 5. Strongly disagree

5. I will apply skills learned in this simulation to my practice
   1.Strongly agree 2.Agree 3. Neutral 4. Disagree 5. Strongly disagree

6. I will apply skills learned in the educational intervention to my practice
   1.Strongly agree 2. Agree 3. Neutral. 4. Disagree 5. Strongly disagree

7. I would like to do more simulations like this for different crises
   1.Strongly agree 2.Agree 3. Neutral. 4. Disagree 5. Strongly disagree

8. I think this educational intervention and simulation should be part of nurse anesthesia curriculum
   1.Strongly agree 2.Agree 3. Neutral. 4. Disagree 5. Strongly disagree

9. What improvements do you suggest to this educational intervention and simulation for the future?

Appendix C: ANTS Rating Tool

Task Management	1 Poor	2 Marginal	3 Acceptable	4 Good	Not observed	Comments
Planning and preparing						
Prioritizing						
Providing and maintaining standards						
Identifying and utilizing resources						

Team Working	1 Poor	2 Marginal	3 Acceptable	4 Good	Not observed	Comments
Coordinating activities with team members						
Exchanging information						
Using authorities and assertiveness						
Assessing capabilities						
Supporting Others						

Situational Awareness	1 Poor	2 Marginal	3 Acceptable	4 Good	Not observed	Comments
Gathering information						
Recognizing and understanding						
Anticipating						

Decision Making	1 Poor	2 Marginal	3 Acceptable	4 Good	Not observed	Comments
Identifying options						
Balancing risks and selecting options						
Re-evaluating						