

DNP Project:

The Benefits of Implementing Grand Rounds in the Rutgers Nurse Anesthesia Specialty Tract

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Abstract

Purpose

A series of grand round (GR) lectures was introduced in the [REDACTED] Nurse Anesthesia Program (RNAP) for the purpose of greater student engagement via audience response systems (ARS). The goal of these grand rounds was to increase the knowledge retention and clinical preparedness of nurse anesthesia residents while also providing an alternative learning opportunity that contrasts the traditional classroom/didactic model. The review of the literature consistently demonstrates that when students are given the opportunity for interactive education via ARS, especially when it is presented by fellow students and “expert” lecturers in low-stress environments, there is improved knowledge retention and clinical practice.

Methodology

In order to test this hypothesis in the RNAP, a quantitative study was completed. Knowledge retention was evaluated using pre post posttest exams developed with content referenced in the GR presentations. Additional quantitative and qualitative data regarding the practicality and potential continuation of GRs in the RNAP was assessed through a corresponding perception survey that attendees were invited to complete.

Results and Implications for Practice

The information gathered from these various means provided the investigators with an in-depth view of the usefulness of GR. The impact of these findings was quite positive for the RNAP—continuation of this easily implemented GRs lecture series has the potential to improve the knowledge and practice of both current and future nurse anesthesia providers.

Keywords: grand rounds, knowledge retention, nursing anesthesia, SRNA, CRNA, ARS

Introduction

The modern grand round has its origins in the 1800s, when bedside rounds began moving to larger auditorium spaces in order to accommodate the growing number of student physicians. Since that time, GRs have been implemented at hospitals and teaching institutes worldwide as a means of educating medical professionals from all different disciplines. While originally intended as a case-specific, interactive learning experience (similar to the bedside rounds it came from), GRs have since taken on many different formats, depending on the institution and specialty (Effendi et al., 2012; Stanyon & Khan, 2015). While some of these formats are viewed as antiquated and ineffectual, the literature shows that properly implemented GRs can greatly benefit the education and clinical preparedness of medical professionals (Hoof, Monson, Majdalany, Giannotti, & Meehan, 2009; Hull, Cullen, & Hekelman, 1989; Wasser & Ross, 2016; Weigelt, 2009).

GRs should be an interactive, group experience with the presenters serving as facilitators of the case-presentation (or topic) at hand – rather than “lecturers”. The presenters should engage the participants with non-punitive “question-and-answer sessions” and group discussions (Weigelt, 2009; Stanyon & Khan, 2015). This teaching method not only helps make the GR more interactive compared to a traditional lecture, but may also serve as a means of improving knowledge retention – especially when considering the different types of memory acquisition (Lloyd & Reyna, 2009; Volpintesta, 2010). Interaction between presenters and participants can further be enhanced by the use of technology which allows for audience input and polling (Richardson, 2014). Lastly, case-presentations for GRs should be selected based upon the interests of participants and facilitators, with the latter providing research-based literature that

adds to the discussion (Laibhen-Parkes, Brasch, & Gioncardi, 2015; Wasser & Ross, 2016). By incorporating these teaching methods, an institution can better implement efficacious GRs.

The nurse anesthesia specialty tract at [REDACTED] does not currently involve routine GRs, however it is a program which continuously seeks to supplement its traditional classroom-based learning with the use of technology and alternative teaching methods (i.e., simulation labs). While these methods have been shown to improve clinical preparedness and knowledge retention (Jeppesen, Christiansen, & Frederiksen, 2017), the trial introduction of interactive, research-based GRs served as an additional means of engaging and educating nurse anesthesia residents in a low-stress teaching environment. It is through the continued implementation of these GRs, facilitated by experienced CRNAs and nurse anesthesia residents, that [REDACTED] nursing anesthesia tract can increase the knowledge retention of its residents, while also better preparing them for clinical practice.

Background and Significance

The education of the student registered nurse anesthetist (SRNA) takes place in two main settings – the classroom and the hospital. The first setting mainly involves a professor, a series of lectures on a particular topic, simulation labs, and examinations. This acquired knowledge is then translated into practice once the SRNA begins their residency. The hospital setting then serves to educate the SRNA on how to apply this anesthesia knowledge safely and skillfully. While some SRNAs can smoothly transition from classroom to residency, others struggle to recall knowledge that has previously been acquired.

Lloyd and Reyna (2009) discuss how certain knowledge is often lost due to time-constraints and stress, conditions that easily describe nurse anesthesia residency. This type of lost knowledge is what is known as *verbatim* memory (Lloyd & Reyna, 2009). It is information that

is memorized outside of the environment that it will need to be recalled in. For instance, learning the dosage range of intravenous anesthetic induction medications in a classroom. A student can spend many hours studying this information, however, when asked in the operating room which induction medications and dosages should be given to an actual patient, the SRNA struggles to recall what has previously been known.

The type of memory which can be recalled in the situations where it needs to be applied, is *gist* memory. This type of knowledge, as its title suggests, has to do with a practitioner interpreting the gist of a clinical situation, and then recalling the information that is currently needed. This memory goes beyond memorization and can be accessed regardless of current stressors or the amount of time that has lapsed (Lloyd & Reyna, 2009). Gist memory typically develops over time, when one has years of experience to reinforce clinical knowledge.

It is the viewpoint of Lloyd and Reyna (2009), that medical education should incorporate teaching methods that seek to build greater gist memory. How can this be done? Students must be provided more opportunities to “connect-the-dots” between their developed verbatim knowledge and the clinical situation at hand. A systematic review by Jeppesen, Christiansen, and Frederiksen (2017) found an overwhelming amount of positive feedback towards simulation-based learning for student nurses, because it helped bridge the “sharp separation” between what students encountered in the classroom and hospital practice. Jeppesen et al. (2017) likewise found that students were best able to bridge this separation through non-punitive, discussion/debriefing-type simulation environments. In the nurse anesthesia curriculum, simulation lab involves a clinical scenario with diagnostic information that may or may not be relevant to the case, and a “patient” that responds to various anesthetic interventions. These labs

are offered after the SRNA has completed a series of lectures related to the scenario at hand. Gist memory thus begins to take root, as the simulated patient responds to the actions of the SRNA.

While GRs do not involve simulation, they are similar in format. Both are offered in a non-classroom environment with a focus on discussion and case studies. GRs can serve as an additional connect-the-dots model of education, increasing gist memory through the integration of verbatim knowledge with the presented clinical situation. And unlike simulation, GRs offer the opportunity for SRNAs to learn in an ungraded, low-stress setting, alongside anesthesia residents—since SRNAs may find the graded, individualistic nature of simulation lab to be stressful. The addition of this GR educational opportunity, offered by senior residents, can benefit underclassmen by providing a new setting for the imparting of clinical knowledge in a lower-stress learning environment (Melvin, Kassam, Burke, Wasi, & Neary, 2014).

Current literature unanimously agrees that GRs have moved away from this non-classroom/discussion-based model, and instead have become another excuse for a lecture (Ali & Saikumar, 2015; Hoof et al., 2009; Stanyon & Khan, 2015; Volpintesta, 2010; Weigelt, 2009). In the past, GRs originally took place in large amphitheaters, where practitioners would educate resident physicians using real live patients as a necessary extension of the bedside round (Effendi et al., 2012; Stanyon & Khan, 2015). Like these bedside rounds, the GR is to involve “audience participation, presentations with a focus on clinical problem solving, multi-professional interaction and trainee participation in its development” (Stanyon & Khan, p. 11, 2015). With these elements in place, GRs have the potential to return to a connect-the-dots model, with an increased focus on solidifying gist memory (Volpintesta, 2010).

GRs have previously been shown to increase knowledge retention over long periods of time. Winton et al. (2016) and Agee et al. (2009) both found that medical residents had retained

around 40% of the “key learning goals and objectives stated by the presenters” from over a year’s worth of GR presentations. Winton et al. (2016) also used a control group of those that had not consistently attended rounds and found that the intervention group scored 50% higher than the control group on post-intervention surveys. It is also worth noting that the topics of discussion at these GRs were from recent, peer-reviewed journal articles. Which ensured the retained information was not only clinically relevant, but current and research-based.

In addition to increasing memory retention, GRs can also increase clinical effectiveness through the enhanced translation of acquired, research-based knowledge into practice. A study by Glauser, Nevins, Williamson, and Tomlinson (2013) found that their interactive educational initiatives, using “influential” and trusted physicians, led to “durable improvements” in the understanding and treatment of cancer. This demonstrates not only the benefit of GRs for improving practice, but the importance of having trusted medical professionals as presenters. Glauser et al. (2013) felt that the combination of engaging seminars and influential practitioners was important for the effective knowledge transfer of updated clinical practices. That isn’t to say that residents or SRNAs shouldn’t be equally involved in facilitating GRs – it is generally recommended that a resident and an “expert” practitioner co-facilitate rounds, based upon topics of interest to the student population (Armola, Brandeburg, Tucker, 2010; Hoof et al., 2009; Laibhen-Parkes et al., 2015; Stanyon & Khan, 2015; Wasser & Ross, 2016).

Student engagement is important in the development of gist memory, and further delineates GRs from classroom learning. This can best be accomplished by using what today’s millennial students know best – technology. Research shows that modern students are visual learners who absorb information through alternative teaching approaches, especially approaches that use digital technology (Karakas, Manisaligil, & Sarigollu, 2015). In a treatise on how GRs

of the future should look, Ali (2015) proposes the use of touchscreens that allow students to answer questions, offer comments throughout the presentation, and complete surveys.

Fortunately, this technology already exists in the form of smartphones, and online services that allow for audience participation. These types of audience response systems have been found to improve participation, knowledge retention, and overall enjoyment of a presentation (Richardson, 2014). It is through implementation of these engaging, research-based GRs, facilitated by SRNAs and expert CRNAs, that [REDACTED] nursing anesthesia tract can better prepare its residents for clinical practice.

Needs Assessment

Using interactive devices like ARS, GR presenters can implement live, anonymous polling to engage participants, assess the transfer of essential information, and provide immediate feedback to enrich discussions (Richardson, 2014). ARS are a cost-effective means to expand the use of technology in teaching environments, as these programs can now be easily accessed using students' personal hand-held devices. This type of technology is not currently utilized in the RNAP. With the implementation of ARS during GR presentations, data can be generated on the usefulness of this technology in this SRNA population and may also prove beneficial for designing or updating future GR frameworks in similar educational environments.

An education research initiative by Rigby, Schofield, Mann and Benstead (2012), utilized a group decision-making method among practicing neuroscience experts, to gain their opinion on best educational practices for implementing effective GRs. The experts expressed support for GRs that are case-scenario focused and evidence-driven. This criterion has a two-fold benefit to the student presenters – first, it exposes novice student researchers to best research practices, and second, it teaches the student how to apply this learned evidence in clinical practice.

Although the [REDACTED] anesthesia program currently makes use of traditional classroom learning, APEX (an online anesthesia review course), simulation lab, and clinical hours in order to pass on verbatim information and work towards knowledge retention, it was worth examining alternate teaching methods to enhance learner participation and augment memory acquisition. The use of GRs with interesting case scenarios, expert CRNAs, up-to-date practice guidelines, and current peer-reviewed research are designed to better prepare these futures anesthetists for clinical practice, and ultimately improve patient outcomes (Winton et al., 2016).

Project Question/Problem Statement

In the [REDACTED] Nurse Anesthesia curriculum, what was the effect of interactive grand rounds on audience engagement and knowledge retention, according to pre and post survey data, ARS data (via <http://www.polleverywhere.com>), and SRNA participants' responses?

1. Did student attendance in research-driven, interactive GR lectures improve knowledge retention?
2. What was the level of audience participation in ARS technology when the opportunity for interactive learning was offered?
3. From the students' perspectives, was the implementation of technology-based GR a useful means of knowledge translation (KT), ultimately improving clinical preparedness?

Aims & Objectives

Aim

The project aim was to enhance student participation and knowledge retention through the implementation of interactive grand rounds in order to improve [REDACTED] SRNA clinical preparedness.

Objectives

- Development of an “essential features” GR framework for resident and expert presenters, with a design based on the findings of current, peer-reviewed literature
- Implementation of GRs that were interactive, enriching, and research-driven during the Fall 2019 semester
- Evaluation of knowledge retention via pre post posttest surveys, with content specific to the GR topics of discussion
- Integration of cellphone-based input and polling-tools (ARS), in order to increase and measure the level of audience participation
- Assessment of participant satisfaction with GRs in the RNAP curriculum, as well as the perceived impact of interactive GRs on clinical preparedness

Review of Literature**Literature Search**

The literature search for this project involved PubMed, Rutgers University Libraries search engine, and Google Scholar. A multidisciplinary approach was needed, as the inclusion of the terms *SRNA*, *CRNA*, *nurse anesthesia*, or *anesthesia* did not improve search results—since there was little to no research on the topic of GRs within the field of nursing anesthesia specifically. Also, because this current project looks to incorporate alternate teaching styles that have only begun to be used in GRs, search terms had to include the use of alternative teaching methods separate from GRs altogether. The search terms involved in this literature search included: *grand rounds*, *knowledge retention*, *gist knowledge*, *verbatim knowledge*, *clinical preparedness*, *simulation lab*, *technology and learning*, *case-study learning*, *alternative learning*, *interactive learning*, *millennials as students*, *low-stress learning*, and *residents as teachers*.

The search for articles related to GRs did not include date limits so as not to exclude landmark studies on this main topic of discussion. This initial search resulted in 1240 articles regarding GRs, which was then decreased to 389 by including the search terms *design, format, improving, technology, interactive, or residents as teachers*. Of these 389 articles, 17 were relevant to the topic at hand—that is, the history and purpose of GRs, and how can they effectively be utilized to improve the knowledge of student practitioners.

The added search terms (*knowledge retention, gist knowledge, etc.*), when limited to the English language and articles completed within the last 10 years, resulted in an additional 19 articles that were applicable to the topic at hand. Most articles focused on the education of medical residents or nursing students, as well as practicing doctors and nurses, while others focused on the utilization of alternative teaching styles for the current generation of millennial learners. See *Appendix A* for a graphic description of the search strategy utilized, and *Appendix B* for a Table of Evidence that summarizes the relevant literature to this study.

Improving Grand Rounds

When GRs follow research-based designs they have proven to be very beneficial to the education of medical professionals. Weigelt (2009) felt that modern GRs should “seriously challenge” the status quo of didactic learning—since they were not created as an extension of the classroom, but rather as a means for healthcare professionals to collaborate, discuss, and teach via the use of clinical scenarios (or through actual, live patients, as previously discussed). Thus, at a minimum GRs should “emphasize” engaging the audience via interactivity and “question-and-answer sessions”. Weigelt also recommends preparing specific guidelines for presenters, whether they be resident or expert presenters, so that time is consistently provided for audience participation.

Hoof et al. (2009) offer similar recommendations but go into greater detail into how the planners and presenters of GRs can increase their interactivity and enjoyment. Firstly, GR topics should be based upon the input of both presenters and participants—what topics do residents want to learn and discuss? Once these topics are established, planners should format a series of GRs that will cover these in a logical order and invite necessary speakers to provide “expertise and perspective”. Further perspective can be accomplished by the integration of clinical scenarios with current, relevant research.

A study by Glauser et al. (2013) similarly found that the use of case-study based scenarios, presented by experts in the field, led to improvements in clinical practice. This research was conducted at a networking event for oncology providers, where expert oncologists utilized interactive case-scenarios to not only increase audience participation, but to teach the correct diagnosis and treatment of rare lymphomas. After one month had passed, the principal investigators administered case-scenario based surveys to 157 participants—71 who had attended the networking event, and 86 who had not. Participants were tested on the correct diagnosis of various lymphomas, disease characteristics, treatment modalities, and their perceived confidence level in their ability to manage these patients. While the participant confidence levels were comparable between the experimental and control group, those that had attended the networking event were more likely to correctly diagnose rare lymphomas (77% vs. 53%), recognize characteristics of the disease (60% vs. 33%), and appropriately treat (87% vs 50%). Glauser et al. (2013) concluded that “interactive educational initiatives” using expert presenters and case-scenarios led to “durable improvements” in practitioner practice.

Residents as Teachers

At the same time, research has consistently spoken to the advantage of resident-led education in medical institutions. Specifically, that medical students and junior residents greatly benefit by being taught by senior residents, based upon the senior residents' experiences and knowledge level. Additionally, the informal nature of the relationship between upperclassmen and underclassmen lends to a more relaxed environment where residents can "relate to students and identify knowledge, skill, or attitude gaps" (Kandiah, 2017; Melvin et al., 2014; Rigby et al., 2012). Melvin et al. (2014) found that when residents serve as teachers, the best teaching methods they can employ include scenario/case-based learning from their practice, summarization of what is most clinically relevant, and the demonstration of technical skills.

Kandiah (2017) evaluated 76 medical students who participated in student-led, case-based GRs over the course of a school year. Investigators found an overwhelmingly positive response to student-led educational opportunities, with the majority of participants rating the GRs as worth their time, and appropriate in content and length. In the free text comments section of the evaluation, students expressed their appreciation of the collaboration between student presenters and expert "consultants", noting this as a necessary component of effective student-led GRs. Expert facilitators can provide a level of validity to the content being presented, while student presenters are able to adapt the content to the learning needs of their peers. Other respondents noted the benefit of case scenarios, which "explore differential diagnosis as the case unfolds" (Kandiah, 2017, p. 9).

Knowledge Retention

Medical education should incorporate teaching methods that seek to build greater gist memory (Lloyd & Reyna, 2009). As previously suggested, this can be done by providing

students with learning opportunities that “connect-the-dots” between verbatim knowledge and the current clinical scenario. GRs can serve as a means of bridging the gap between verbatim and gist knowledge and have been shown to increase knowledge retention over long periods of time (Winton et al., 2016). In order to ensure that SRNAs have the best opportunities provided for them to develop gist memory, GRs should incorporate educational formats which have been shown to lead to greatest retention of knowledge—namely the use of clinically-based scenarios, presenter-participant interaction, discussion, and expert opinion (Glauser et al., 2013).

Winton et al. (2016) directly measured the impact of GRs on knowledge retention, by testing 66 participants on nine months’ worth of GR lectures. Two questions were chosen from each of the 26 GRs over the nine-month period, for a total of 52 questions. Students first encountered these questions in an optional self-assessment (SA) survey at the end of each GR session. It was found that those who completed the weekly SA surveys scored 59.6% on the questionnaire, vs. 38.3% for those that did not participate in the SA. Winton et al. (2016) concluded that active participation in questions at the time of GRs, as well as overall attendance at GRs, was responsible for higher scores on the 52 questions. This included content that was tested over ten months after the time it was initially presented. Therefore, there was a direct correlation between participation/attendance and long-term knowledge retention in this study’s population.

Technology and Learning

McCarthy and Kelly (2018) describe a model learning environment as engaging and interactive. Equally important for the learner, are time for response and reflection which can improve memory retention. The authors encourage the use of technology to achieve this ideal environment. In their mixed method study, 26 postgraduate anesthesia students use ARS to

augment a series of three lectures. Using an In-class Engagement Measure (IEM) tool, an observational tool used to assess interaction and engagement between learners and presenters, it was subjectively identified by observers that learner engagement was enhanced. Qualitative data was generated at subsequent interviews with some of the participating graduate students ($n = 8$) using the “4 Rs of Learner Engagement” as outcome measures. The interviews showed participant perceptions reflected improved “readiness, reflection, recap and retention” after the ARS integrated lecture.

A 2014 randomized controlled trial (RCT), designed by Mains, Cofrancesco, Milner, Shah and Goldberg, evaluates user response to ARS and shares similar findings. Johns Hopkins first year medical students were stratified into groups to watch a video lecture, of an unknown subject, with or without the use of ARS question-and-answer interaction. Knowledge retention was assessed, using an online questionnaire both immediately post-intervention and at a two-week follow-up interval. Participants in the experimental group ($n = 45$) scored 10% higher in knowledge retention immediately post intervention and at the 2-week post-intervention assessment, compared to the control group ($n = 47$) ($p = 0.001$). This p value indicates the information generated is probably statistically significant as the $p < 0.05$.

Interactive Learning

A qualitative study by Rigby, Schofield, Mann, and Benstead (2012) gathered data from various neurospecialists in Canada ($n = 32$) to determine respondents’ opinions on the necessary components of effective GR presentations. After anonymous analysis of the responses, participants were able to modify or support their former arguments, until a consensus of opinion was reached. As a result, neuroscientists rated interactive learning, with residents as teachers, as

highly valuable in case-based GR presentations. The respondents also supported the inclusion of audiovisuals (AV) to enhance audience interaction.

Rajan et al. (2016) completed a prospective, quasi-crossover cohort study to determine the effectiveness of simulator-based session (SBS) software compared to in-person problem-based learning discussions (PBLD) on knowledge retention in anesthesiology residents at the Cleveland Clinic (n = 27). Two case-studies were presented through the software, and a baseline exam was completed by all participants. Each resident completed the PBLD session and then the SBS. Although a 5-point Likert scale analysis found residents rated computer simulation as useful, post-intervention exams revealed that the SBS method did not improve mean exam scores. For this specific population, the study supports the use of interactive problem-based discussion to improve knowledge retention.

Low-Stress Learning

In 2008, a descriptive study using survey methodology for data collection invited all Canadian anesthesiology residents (n = 599) to complete an online questionnaire. Of those that responded (n = 167), 81% rated their anxiety levels as “higher” or “much higher” during peer-viewed high-fidelity simulation (HFS) compared to actual in-hospital experience with the same peers present (Price, Price, Pratt, Collins & McDonald, 2010). Student respondents suggested creation of “safer learning environments”, such as an introductory course for junior residents, to expose them to the knowledge behind common anesthetic case-based emergencies. The continuation of interactive GRs may prove useful in easing the transition from didactic student into clinical resident. The improved transfer of verbatim knowledge into gist knowledge may not only be useful in HFS scenarios, like simulation lab, but may also lead to an improvement in

participants' perceptions of clinical preparedness as well. Enhanced perceptions in clinical preparedness may ultimately lead to better patient care and outcomes.

Theoretical Framework

The Revised Ottawa Model of Research Use (OMRU) framework, a modification of the original 1998 framework, outlines a dynamic method rather than a step-by-step process for the successful implementation of innovations that require knowledge translation in health-care (Graham & Logan, 2004). The model includes “assessing, monitoring, and evaluation” phases. Specific elements considered in the assessing phase are the identification of potential innovation adopters, the implementation environment, barriers and supports to the innovation, and most importantly, the transfer of evidence-based information. Monitoring includes the creation and maintenance of tailored implementation strategies, and the identification of any unforeseen barriers that prevent participant adoption of the innovation. The monitoring process of the model is an integral component of the dynamic nature of the theory, as it determines if potential adopters have responded positively to the innovation. The evaluation phase generates data that measures KT and if the efforts of the innovation were worthwhile (Graham & Logan, 2004).

This Doctor of Nursing Practice (DNP) project contains the essential components needed to use the OMRU framework as a tool to enhance knowledge retention, and clinical practice through improved engagement in interactive GRs. By the identification of barriers and adopters, the use of supporters, modifications made during the implementation phase, and the evaluation of outcomes, the data generated helped assess the effectiveness of interactive GR lectures on student engagement in the RNAP. In this project, a proposed barrier to success was whether SRNAs, who represent the adopters, view peer-lead GRs as a means of useful knowledge acquisition. SRNA interest and involvement was paramount to the success of [REDACTED] nursing

anesthesia GRs. Another proposed barrier was limited free time in the RNAP for implementation of GRs.

Supporters of this initiative included clinical faculty members and non-faculty CRNAs. The non-faculty CRNAs participated in presentations as experts from the anesthesia community. During the implementation phase, the presentations included case-studies with subjects that were relevant to SRNAs. The initial time limit was planned for 30-minute, once-monthly meetings in order to appeal to the study's potential adopters. The use of case-studies, ARS technology, expert input, and student-lead presentations in the GR lecture design reflect evidence-based intervention strategies generated from the literature review. The post-GR exams and survey allowed the investigators the ability to interpret feedback and modify the GR framework for any future lectures, as the OMRU framework supports continual changes to implementation guidelines in order to enhance KT. See *Appendix C* for this study's adapted framework.

Methodology

This DNP project has a quantitative study design. Correlational data was generated regarding interactive GRs and knowledge retention within the RNAP. Knowledge retention itself was evaluated using pre post posttest exams to measure the level of change the GR initiative produced. Content for these exams was generated from material referenced in the GRs presentations themselves. Additional quantitative data regarding the practicality and potential continuation of GRs in the RNAP was assessed through a corresponding survey.. The information gathered from these Likert scale-based surveys, provided the investigators with a more in-depth view of the usefulness of GR through the valuable perceptions of the participating individuals.

Setting

The presentations took place in the [REDACTED], located at [REDACTED], in the 3rd floor auditorium after the September and October 2019 [REDACTED] monthly meetings.

Study Population

The study population included any first, second, and third year SRNAs in the [REDACTED], who decided to attend either interactive GR lecture in the Fall 2019 semester. The total number of SRNAs asked to participate was 65.

Subject Recruitment

Subject recruitment occurred using an advertising flyer electronically sent to all prospective SRNAs by Sandra Romero, the RNAP program's administrative assistant. This advertisement was also posted on the RNAP social media platforms (Facebook and Instagram). The flyer in *Appendix D* informed the intended audience of the study's purpose, design, benefits, risks, and time requirements. Contact information for the principle investigator and co-investigators was provided. The potential participants were also made aware of GR lectures verbally, by the investigators, at the August 2019 RNAP meeting.

Consent Procedure

Consent for participation in the study (see *Appendix E*) was digitally acquired using a secure Qualtrics link. The consent addressed the GR series and provided information regarding GR participation, and the subsequently offered online exams and survey. No identifying information was collected at any time. Participants were not obligated to attend the presentations or complete any of the exams and were free to withdraw participation during any portion of the study.

Risks/Harms

There were not any perceived risks to participation in this doctoral project and none were identified through the implementation process. The review of the literature revealed positive impacts after implementation of similar GR initiatives at other academic medical institutions (McCarthy & Kelly, 2018; Mains, et al, 2014; Winton et al., 2016).

Subject Costs and Compensation

GRs incurred no cost on the subjects, nor was compensation offered to participants in this study. Students that attended the first presentation were provided with breakfast—the cost of which was covered by the co-investigators.

Study Interventions

In the Fall 2019 semester, two GR sessions were presented following the monthly RNAP meetings with all (three) nursing anesthesia cohorts in attendance. Prior to the first GR presentation, topics of interest were generated in an informal manner, via group messaging which the RNAP cohorts use for unofficial communication. All three cohorts expressed interest in case studies that identify and treat anesthetic emergencies in the operating room, including laryngospasm, massive transfusion protocol, and management of the difficult airway.

Each presentation included SRNA residents (the two co-investigators in this study) and one non-Rutgers faculty CRNA. In total, two CRNAs were asked to volunteer their time and fulfill the role of expert presenters. The non-faculty CRNAs were invited to participate after discussions between the primary and co-investigators. Both interactive lectures included the use of ARS cell-phone technology and were allotted 30 minutes total (20 minutes for the interactive presentation, 10 minutes for further discussion). The GR presentation itself was designed from a research-based GR framework constructed by the co-investigators (see *Appendix F*). This

guideline was formatted after completion of the literature review in order to create the most effective GR presentation, and to maintain cohesiveness throughout the GR series.

Outcomes Measured

Knowledge retention was measured through a 12-question exam offered at three different points in time—before the first GR presentation, after the October GR session, and in the first week of December, which was approximately two months after completion of the GR lecture series. The 12 test questions (see *Appendix G*) were developed alongside RNAP faculty in order to increase their validity, as well as reflect the teaching objectives of GRs. All questions were verified for accuracy using emergency manuals available through Stanford Anesthesia Informatics and Media Lab (2016), as well as the anesthesia textbooks by Barash et al. (2013), Miller (2015), and Nagelhout and Plaus (2014). Each exam was administered in digital format via Qualtrics survey technology, which also ensured participant anonymity.

During GRs presentations, ARS technology was utilized via participants' personal smartphones or computers and the website <http://www.polleverywhere.com>. This allowed the investigators to determine the number of active participants during each presentation, and ultimately measure the percentage of SRNA engagement. After the first presentation in September, students were offered the opportunity to complete an additional Qualtrics survey on their perceptions of the usefulness of GR on clinical practice—see *Appendix H*. The survey includes questions from a validated tool by Wittich et al. (2013), which was originally developed to measure the efficacy and usefulness of continuing medical education (CME) opportunities. This original tool can be found in *Appendix I*. The results of this survey helped contribute both quantitative and qualitative data which includes attendees' views on the continuation of GRs after conclusion of the project.

Project Timeline

Project planning on this DNP study concluded with a proposal presentation on May 13, 2019, followed by submission to the Rutgers IRB on May 31, 2019. When IRB approval was obtained in June 2019, two expert CRNAs were invited to participate, and then provided with the GR presentation format. The format was used to prepare the interactive GR presentation alongside the co-investigators.

GR presentations were presented after the RNAP's monthly meetings in September and October of 2019. Data collection began in September, right before the initial GR session, with administration of the pretest, and continued through December, when the final posttest was administered. Data analysis began during the month of December and continued through January. The final written project paper will be completed in 2020 and will be presented at a time to be chosen by the RNAP faculty. A graphic display of this project timeline can be seen in *Appendix J*.

Resources Needed/Economic Considerations

The primary resource for this study was the support of the RNAP faculty, which allowed the co-investigators the time and space necessary for GRs. Additionally, the support of expert CRNAs was paramount to the success of this project, as they offered their time on a volunteer basis.

The resources necessary to create the GR presentations and perform data collection and analysis included the co-investigators' personal computers, as well as the use of Qualtrics and polleverywhere.com software. These technological means allowed for the construction of interactive, ARS-based presentations. Additionally, the large lecture halls utilized at the RNAP program meetings easily accommodated the invited 65 participants. The lecture halls also

provided free use of a computer system and projector, which were used to run visual and audio portions of the presentation. Attendees were provided with breakfast at the first GR presentation, the cost of which was covered by the co-investigators in the amount of \$200.

Results

Data Maintenance/Security

All data collected from subjects was anonymous and free of personal identifiers. Information was collected and stored via Qualtrics, within a password protected account only able to be accessed by the co-investigators and the project chairman. Any downloaded data was password protected and stored securely.

Data Analysis

Data Analysis was completed using Qualtrics and Microsoft Excel software technology. Demographic data and the responses to Likert scale-based perception surveys are presented using frequencies and percentages. The 12-question exams were scored from 0 - 12 points, with unanswered questions being worth zero points. In order to have the same amount of responses per SRNA cohort, per exam, at all three points in time, missing data was filled in by assigning the mean score to the missing participants. This was necessary in order to run analysis of the mean scores for each cohort, using the paired t-test.

Findings

A total of 65 SRNAs were invited to participate in the study. 65 of the participants completed the pretest (100% response rate), 48 participants completed the first posttest (74% response rate), 58 participants completed the second posttest (89% response rate). Additionally, 47 nurse anesthesia residents completed the perception survey (72% response rate).

Cohort Demographics			
	Pre	Post	Post-Post
First Year	24	15	20
Second Year	21	22	21
Third Year	20	11	17
Total	65	48	58

Data analysis of the 12-point pre post posttest exams revealed mixed results as to whether long-term memory retention was increased through the implementation of research-drive, interactive grand rounds. The first year SRNA mean knowledge scores for the pre post posttest surveys were 4.1, 6.9, and 5.6, respectively. For second year SRNAs, the mean pre post posttest exam scores, were 7.1, 9.7, and 7.6. Third year residents had mean knowledge scores of 7.0, 9.0, and 8.1.

	Pre-Test	Post-Test	Post/Post-Test
First Year Mean:	4.1	6.9	5.6
Second Year Mean:	7.1	9.7	7.6
Third Year Mean:	7	9	8.1

All three cohorts demonstrated a significant increase in mean knowledge scores from the pretest through the first posttest period, which indicates knowledge acquisition and knowledge retention during this period. Differences in mean scores between first to third year cohorts were found to be 2.83, 2.59, and 2, respectively (as shown below). Paired samples t-tests were run for each cohort between pretest and posttest scores, revealing statistically significant p-values of 0.0, 0.0, and 0.003, respectively.

Pre Post Test Analysis					
	Pre-Test	Post-Test	Mean Difference	Std Deviation	P-value
First Year Mean:	4.1	6.9	2.83	2.64	0.000
Second Year Mean:	7.1	9.7	2.59	2.34	0.000
Third Year Mean:	7	9	2	2.64	0.003

However, while shorter-term knowledge retention was found to be statistically significant between all three cohorts, long-term knowledge retention did not have the same results. Differences in mean scores between first to third year cohorts were found to be 1.52, 0.5227, and 1.12, respectively (see below). Paired samples t-tests were run for each cohort between pretest and post posttest scores, revealing a statistically significant p-value of 0.005 for only first year students. Second and third year students did not have statistically significant increases in mean knowledge scores, with p-values of 0.295 and 0.1.

Pre Post/Post Test Analysis					
	Pre-Test	Post-Post-Test	Mean Difference	Std Deviation	P-value
First Year Mean:	4.1	5.6	1.52	2.4	0.005
Second Year Mean:	7.095	7.619	0.5227	2.28	0.295
Third Year Mean:	7	8.115	1.12	2.88	0.1

The 47 respondents of the perception survey contributed to the generation of both qualitative and quantitative information through Likert scale responses and a free text comment section (see *Appendix K*). More than half of the participants responded, “definitely yes”, when asked if the GR initiative should continue. Over 70% of those that completed the survey found the SRNA presenters either “extremely effective” or “very effective” in meeting the objectives of

the GR educational opportunity. Additionally, around 95% of respondents either “strongly agree” or “somewhat agree” that attending grand rounds caused them “to consider ways to improve my clinical practice”. Both positive values reflect the initial aims of the project – to enhance both knowledge retention and student perception of clinical preparedness.

Limitations

In the initial proposal, the study was designed to include a unique identifier code to correlate each individual respondent with their pre post posttest and survey responses, however, this was not feasible using Qualtrics technology. Instead, mean knowledge scores were reported by cohort. With baseline knowledge assessment scores correlated to individuals rather than cohorts, the investigators could have eliminated contributing factors and provided more detailed insight into knowledge translation trends in this group of participants.

This study population was a convenience sample that represents students in a diverse, urban population, in order to further increase the generalizability of the results additional studies should be completed with larger samples sizes of nurse anesthesia residents, in a variety of geographical settings. A randomly selected group of participants with sample size larger than 329 would help to ensure statistically sound results.

Discussion

The pre posttest knowledge exam scores in all cohorts showed an increase in short term knowledge retention with correlating significant p values. One of the reasons to consider for the increase in the pre post mean knowledge exam scores for all cohorts can be due to test timing. It was offered immediately after the first GR session on the difficult airway. The exam questions pertaining to that subject had just be presented and short term knowledge recall was likely easier.

While comparing the pretest to the post posttest, it was determined that only first year SRNAs had a significant p value associated with their cohort's increased knowledge exam score ($p = 0.005$). The authors would like to note that in the beginning of the second GR lecture, there were prolonged technical difficulties due to user error, attendees may have lost interest in the presentation and were unable to recall the planned MTP learning objectives.

The pre post posttest exam reflects knowledge retention over a two to three month period. Material on the unanticipated difficult airway was first presented in September of 2019. The grand round lecture on massive transfusion in anesthesia was given on October of 2019 – the post posttest exam was given in December 2019. The intervention may simply have not as effective for long term knowledge retention. But one can consider that second and third year nurse anesthesia students are dedicating a lot of time to clinical rotations in general anesthesia and various anesthesia specialties, it is possible that, compared to didactic only first year students, rotational and academic demands may have been a factor in memory longer term memory retention for those later in the curriculum.

Overall the process was an excellent learning experience that was both challenging and rewarding. The most important lesson to be learned, was the need for organization. It was no easy task to sift through the wealth of textbook and research driven information for GR content, in order to present in the most succinct and relevant information to SRNA peers. However, by using the framework and goals developed for this DNP project, the principal researchers were able to offer two well received GRs, despite obstacles that were met. In the end, the feedback from peers was mostly very positive. Comments showed common themes, such as appreciation of the case study, effectiveness of the senior residents as lecturers, and ARS augmentation.

The biggest challenge was obtaining CRNA guest presenters; once volunteer CRNAs were found, it was difficult to coordinate schedules, as GRs were early in the morning on Mondays. Based upon the experience of the SRNA presenters, and the comments offered from their peers, it may be beneficial if future GRs were offered by only SRNAs. This would decrease the stress of the senior residents in both finding CRNA lecturers, and in finding the time to collaborate GR content with the expert CRNAs in advance. Similarly, it would allow GRs to be shorter in length, as both GR lectures did go over the planned timeframe. This was also a critique offered by peers—that GRs were too long, and that too much info was offered at once. Since it was already difficult to fit in interactive lecture, demonstration of equipment, and ARS technology without the addition of another speaker, GRs offered by only SRNAs for SRNAs, might allow presenters to better fit within the time given in the framework. However, in attempt to maintain input from expert CRNAs, presentations could be reviewed by Rutgers faculty for accurateness and cohesiveness prior to GRs.

Implications for Clinical Practice

GR provide a means of proven knowledge retention and perceived increased clinical awareness in this nurse anesthesia resident population. This may ultimately lead to better clinical practice during the educational period and beyond. New improvements in medication education should continue to be sought in order to provide our nation's patients with better prepared anesthesia providers.

Implications for Healthcare Policy

Policies regarding patient specific healthcare can be a challenge to change. Policy directed towards specific mandatory educational requirements may be within reach. Policy that

include technology augmented learning to serve the diverse needs of millennial learners may be considered.

Implications for Quality/Safety

With education better tailored to current learners, novice providers will have an increased knowledge base which can improve the quality of care they provide. This improvement in care may have positive effects on patient safety as well.

Implications for Education

The impact of these findings is quite positive for the RNAP and others like it—a relatively low-cost GRs program has the potential to improve the knowledge and practice of resident nurse anesthetists. Furthermore, the framework for GRs developed for this study can be shared with expert CRNAs and clinical nurse resident facilitators, in order to positively influence SRNAs beyond the period of interest to this study. This allows for GRs to continue as a legacy project within the nursing anesthesia community at [REDACTED] as well as the SRNA community at large should other programs hope to adapt this research-based model for their own purposes.

Plans for Future Scholarship

The survey was designed to determine the participants' perceptions on the usefulness of ARS technology-based GRs in the RNAP. If feedback was positive, the plan was to potentially continue GR presentations as a doctoral legacy project, which serves as means of increased interaction amongst cohorts, as well as the professional CRNA community. These GRs were also intended to provide an alternative method of scholarly research exposure to incoming cohorts without any clinical experience.

Conclusion

There are many ways that a student can learn. While preferred methods may vary from person to person, there exists a body of research which demonstrates the benefits of technology-based, interactive learning on a generation of millennial learners. The goal of implementing the GRs described within these pages was to reach and engage the current cohorts of resident SRNAs with a mode of education geared towards their learning needs. This is a service not only to the SRNA community at [REDACTED] but more importantly to the patients who will receive care at the hands of these future nurse anesthesia providers.

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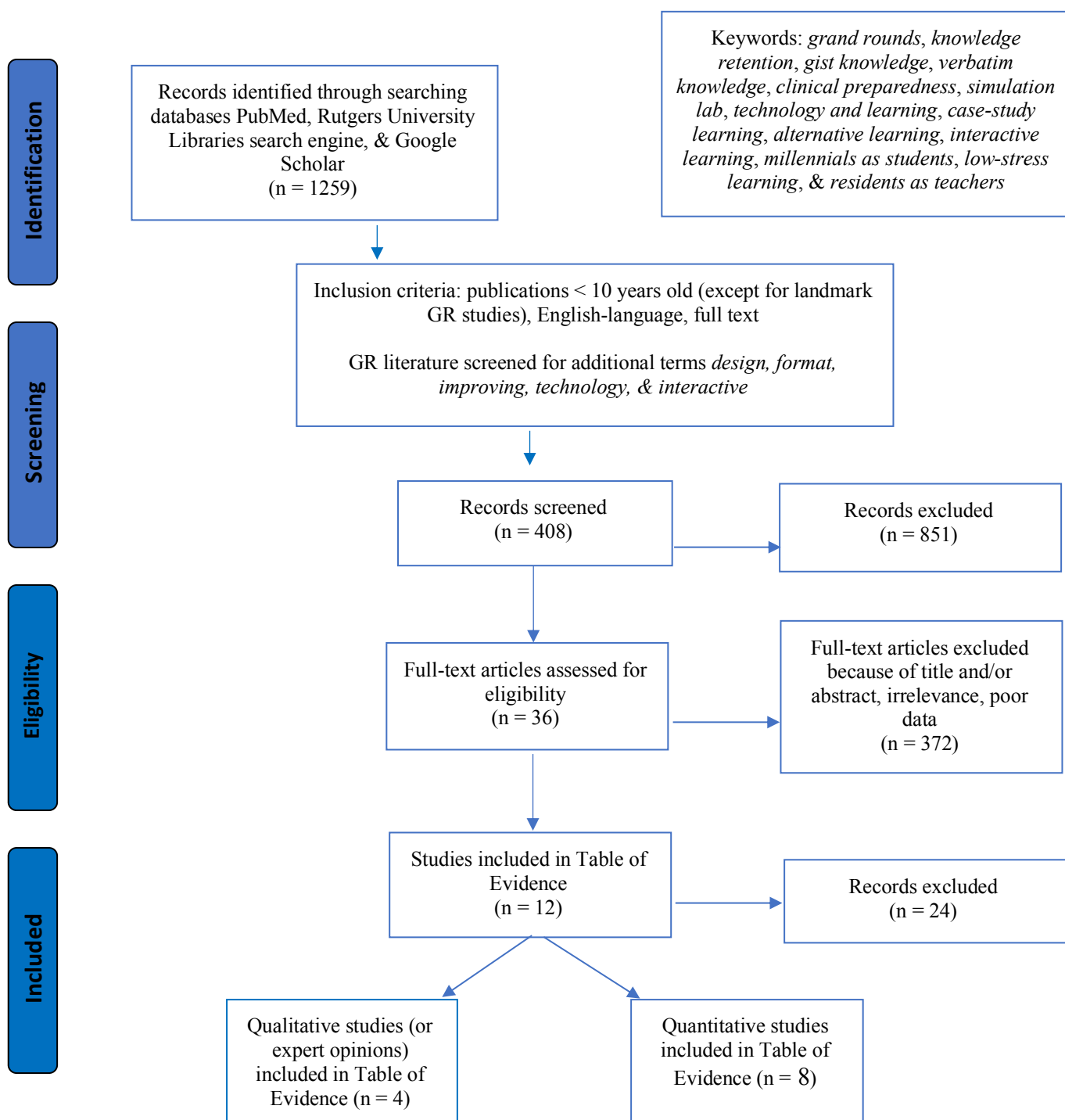
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Appendix A

Literature Search Strategy



Appendix B

Table of Evidence

Article number	Author and date	Evidence type	Sample, sample size, and setting	Study findings that help answer EBP question	Limitations	Evidence level and quality
1.	Glauser, A., Nevins, N., Williamson, J., & Tomlinson, B. (2013).	Quasi-experimental, quantitative study	Oncology healthcare professionals, n = 157, via email/faxed surveys	Participants that met regularly to discuss lymphoma in a large forum setting that involved oncology experts and interactive case-studies, were more likely than non-participants to correctly understand, diagnose, and treat various lymphomas	Surveys were based on self-evaluation of one's own ability to effectively treat with lymphoma. No actual patients or patient outcomes were evaluated. Participants were also given an honorarium.	Level II Good quality
2.	Hoof, T., Monson, R., Majdalany, T., Giannotti, E., & Meehan, T. (2009).	Non-experimental, qualitative study	Sample size undisclosed; qualitative data acquired from program planners, GR participants, and direct observation of GR by researchers at an institution's medical GRs	Discusses the large deficits that exist with GRs—namely that GRs need to move away from classroom-like PPT presentation format, with little to no audience participation.	This study only included a GRs program at one institution. A qualitative study was completed rather than a quantitative one. Study participants also had a limited amount of time to participate in focus-groups/debriefing that was needed for the qualitative data.	Level III High quality
3.	Kandiah, D. (2017).	Descriptive quantitative pilot study	A focus group of medical students participated in a formal presentation, n = 76 at a University in Australia. Presentation time limit was 30 minutes (20/10 lecture/discussion)	100% response rate - participants responded positively to student led grand rounds. Secondary outcomes include development of a “knowledge network,” and enhancement in individual value.	The small sample size, from a single University contributes to decreased transferability of findings for different populations.	Level III High quality
4.	Lloyd, F., & Reyna, V. (2009).	Expert opinion	n/a	Medical education should incorporate teaching methods that seek to build greater gist memory. This can be done by providing students with more opportunities to “connect-the-dots” between classroom	Does not offer very many concrete suggestions for how to better incorporate gist memory into medical education, except that educators should incorporate case-studies that are different from each other, but share clinical commonalities, so that	Level V Good quality

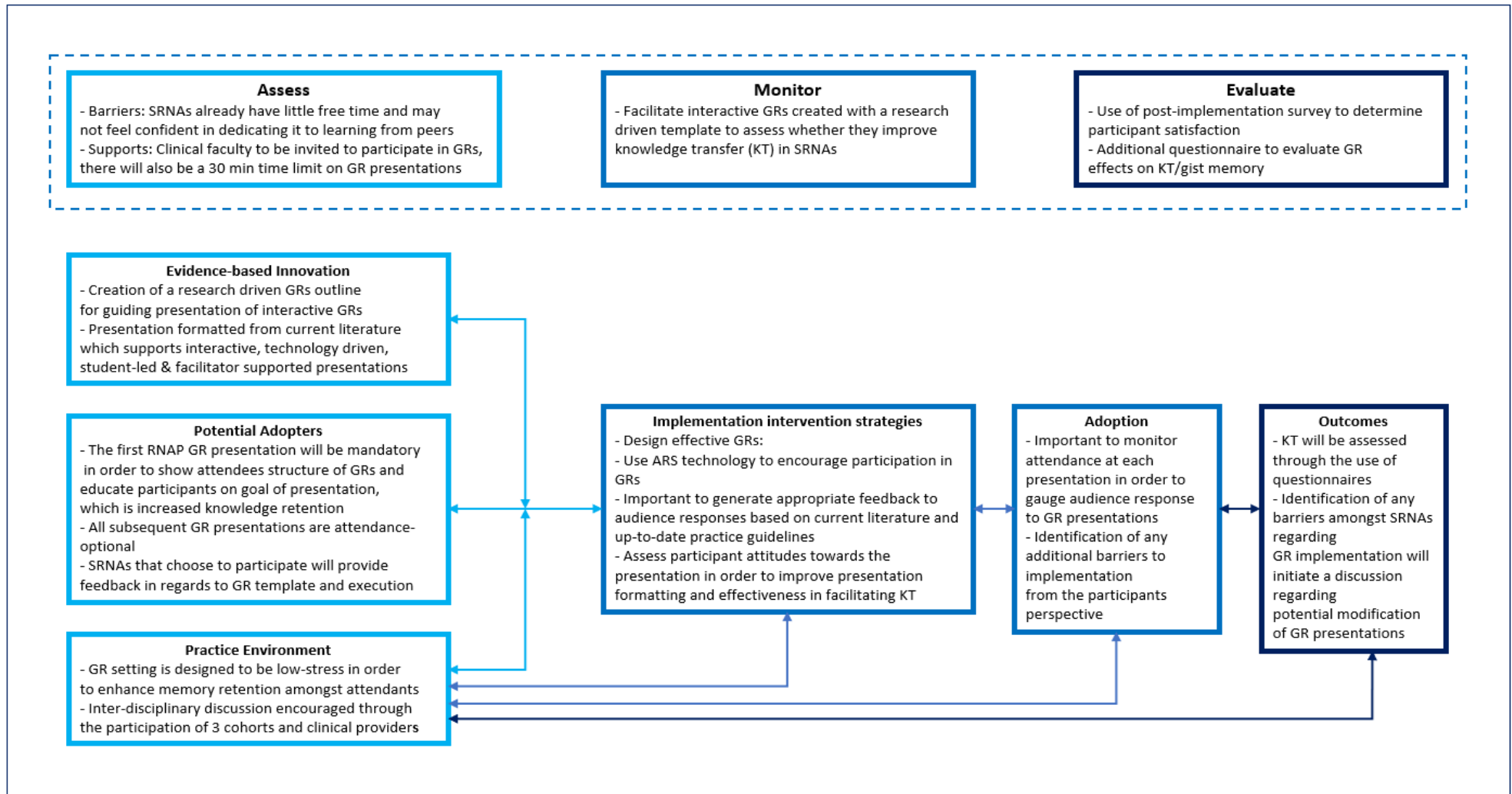
				learning and clinical practice via context/clinical-scenario based learning.	students begin to connect-the-dots.	
5.	Mains, T, Cofrancesco, J., Milner, S., Shah, N., Goldberg, H. (2015).	Randomized Controlled Trial, quantitative	first year medical students (n = 92) were randomized to watch a lecture on an unknown subject with or without ARS question/answer interaction	Those that were randomized into the ARS group had 10% improved knowledge retention immediately post-intervention and at a post 2-week interval assessment	Decreased generalizability of results due to participant pool from a single program at a single University.	Level I High Quality
6.	McCarthy, C., & Kelly, M. (2018).	Mixed quantitative & qualitative	n = 26, postgraduate student anesthesia providers for quantitative data portion n = 8 qualitative data portion though in-person interview, to identify barriers to attendee participation & what affect ARS use has on learner involvement	Use of ARS during 3 lectures enhance learning, In-class Engagement Measure (IEM) tool used to assess participant and lecturer engagement. Overall goal to assess learner “readiness, reflection, recap and retention”. Qualitative data generated supports quantitative results.	The IEM measurement tool is primarily qualitative and based on personal observation of participation and involvement which is subjective – reliability and validity of data collection cannot be guaranteed Subfactor in participation attendance rates and involvement includes free breakfast as a possible incentive	Level II Good quality
7.	Melvin, L., Kassam, Z., Burke, A., Wasi, P., & Neary, J. (2014).	Non-experimental, quantitative study	90 student participants from various internal medicine programs at hospitals located in Ontario	Medical students complete surveys on the efficacy of residents as teachers, and on the qualities that made residents successful. Students reported that scenario/case-based learning, summarizing of relevant information, and demonstration of procedures to be the most efficacious teaching methods. Enthusiastic, knowledgeable residents that were able to tailor teaching to the level of the student, were most preferred	Researchers felt that some of their terminology on surveys may have been misinterpreted, based upon some unexpected survey results. Also, students that responded were only from an internal medicine background—and were sampled at a conference, thus may have been limited to the type of highly motivated students that attend such events.	Level III Good quality

8.	Price, J., Price, J., Pratt, D., Collins, J., & McDonald, J. (2010).	Descriptive – survey method, quantitative	All Canadian (n = 599) anesthesiology residents invited to complete, an anonymous 10-minute online survey regarding stress levels during simulation. Response rate n = 167	About 81% of anesthesia residents rated their anxiety level as “much higher” or “higher” during simulation in front of peers compared to clinical OR experiences. These residents also suggested creation of a safer learning environment.	Gift card incentive to complete survey may influence participant truthfulness/time spent completing online survey answers. Assessment was completely online, cannot guarantee validity in data collection. Non-responder bias should be considered.	Level III High Quality
9.	Rajan, S., Khanna, A., Argalious, M., Kimatian, S., Mascha, E., Makarova, N., ... Avitsian, R. (2016).	Prospective, quasi-crossover cohort study (non-blinded)	Anesthesiology residents at the [REDACTED] (n = 22) take a baseline test on 2 case scenarios, the resident then completes a problem-based learning discussion (PBLD) and lastly a simulator-based session (SBS). Posttest completed at 4 and 8-week intervals to assess short-term and long-term memory (respectively)	Results determined that SBS was not more effective than PBLD in improving knowledge retention at both the 4-week and 8-week interval. Students subjectively (via Likert scale) find value in SBS.	Study completed at a single institution, with a small sample size, which decreases generalizability of results. Cannot account for confounding variables in knowledge retention (supplemental studying, online sources)	Level III Good Quality
10.	Rigby, H., Schofield, S., Mann, K., & Benstead, T. (2012)	Qualitative study	Various neuro-specialists, n = 32, from a single University in Canada, completed questionnaires regarding their opinions on effective GRs. Post-questionnaire, the Delphi technique was used to generate a ‘group opinion’ among the specialists.	Respondents rated interactive learning, case-based learning and “residents as teachers” as highly valuable in GRs. Inclusion of audiovisuals was also supported.	Study includes a sample of participants from a single institution, findings may not be transferable to other provider populations.	Level III High Quality

11.	Weigelt, J. (2009).	Expert opinion	n/a	A summary of the current state of GRs—which include presenters that fail to engage, only PPTs are used, and participants don't pay attention. Whereas GRs should avoid the didactic format, use alternate learning methods, with expert presenters, and time for audience engagement.	This article only begins to offer concrete suggestions for how to go about fixing GRs. It could be improved by going into greater detail, or by including research on what types of GR formats have been shown to improve engagement or positively challenge the didactic status quo.	Level V High quality
12.	Winton, L., Ferguson, E., Hsu, C., Agee, N., Eubanks, R., O'Neill, P., Goldberg, R., Kopelman, T., Nodoro, J., Caruso, D., & Komenaka, I. (2016).	Quasi-experimental, quantitative study	66 surgery residents, medical students, and attendings at [REDACTED] Phoenix, Arizona	Medical residents that attended a year's worth of GR presentations retained around 40% of the "key learning goals and objectives stated by the presenters". Also used a control group of those that had not consistently attended rounds, and found that their intervention group scored 50% higher than the control group.	Study took place at only one institution, with a relatively small sample size. Also, the control group was also only quasi-controlled, because the researchers weren't able to have a control group that never attended GRs – and rather had to rely on 52 survey questions that were specific to each week's topics.	Level II Good quality

Appendix C

Theoretical Framework (Adapted from the Revised Ottawa Model of Research)



Appendix D

Nurse Anesthesia Program Grand Rounds Advertisement

Nurse Anesthesia
Program
Grand Rounds Lecture Series



Fall 2019 Semester

Immediately following the September & October [redacted] meetings
- DONUTS, BAGELS & COFFEE provided

CONTACT: Lynne Panzica at [redacted] & John Tomasello at [redacted]

.....

Research Purpose: This DNP project goal is to encourage student participation & increase knowledge retention through the implementation of interactive grand rounds (GRs) in order to enhance [redacted] SRNAs' clinical preparedness

Research Design:

- Two, 30-minute grand rounds sessions will be offered & augmented by audience-response systems (ARS) cell-phone polling, & adjunct CRNA lecturers
- Prior to the presentation a confidential pre-intervention test will be offered to assess baseline knowledge on the subject, followed by two confidential post-intervention exams
- After participation, attendants will be invited to complete a confidential questionnaire to determine their opinions on the usefulness of the GR sessions

Eligibility: Any current [redacted] nurse anesthesia resident

Benefits: Participation in GRs that are interactive, enriching & research-driven. Attendees will be exposed to best research-practices & will have the opportunity to discuss case-studies with SRNAs & CRNAs

Post-grand rounds surveys will be sent from: www.qualtraics.com/TBD

Appendix E

Online Questionnaire Research with Adults

CONSENT TO TAKE PART IN A RESEARCH STUDY

TITLE OF STUDY: The Benefits of Implementing Grand Rounds in the Rutgers Nurse Anesthesia Specialty Track

Principal Investigator: Maureen McCartney-Anderson, DNP, CRNA/APN

This consent form is part of an informed consent process for a research study and it will provide information that will help you decide whether you want to take part in this study. It is your choice to take part or not. Your alternative to taking part in the research is not to take part in it.

Who is conducting this research study and what is it about?

You are being asked to take part in research conducted by Lynne Panzica and John Tomasello who are graduate students in the Dept. of Nursing. The purpose of this study is to enhance student participation and memory retention through the implementation of interactive grand rounds (GRs) in order to improve [REDACTED] student registered nurse anesthetists (SRNAs) clinical preparedness.

What will I be asked to do if I take part?

Subjects will be invited to attend two, 30-minute interactive lectures. Participants may attend any or none of the GR lectures. The pre post posttest data collection includes three online exams. Each exam will be allotted 15 minutes time once opened; these exams are not mandatory. Participants will also be invited to complete a post-GR survey; this survey will not be timed.

Participants will voluntarily access the pre and post exams, as well as the post-GR series survey, using a device of their choice (ie. Smartphone, computer). A Qualtrics link will be provided during the September program meeting that will allow access to all questionnaires. Each of the knowledge retention tests will have questions testing information on Massive Transfusion Protocol (MTP) and airway emergencies. The first exam will be offered in September, the second will be available in October, along with the GR opinion survey, and the final knowledge retention exam will be offered in December. Each questionnaire can be accessed for the period of one week. We anticipate 65 subjects will take part in the study.

What are the risks and/or discomforts I might experience if I take part in the study?

Breach of confidentiality is a risk of harm, but a data security plan is in place to minimize such a risk. Also, some questions may make you feel uncomfortable. If that happens, you can skip those questions or withdraw from the study altogether. If you decide to quit at any time before you have finished the questionnaire your answers will NOT be recorded. If you choose not to participate students' academic status will NOT be affected. Decision to participate bears no outcomes on grades or clinical eligibility.

Are there any benefits to me if I choose to take part in this study?

The benefits of participation in this study include attendance at grand rounds that are interactive, enriching and research driven. Attendees will have the opportunity to discuss case-studies with SRNAs and CRNAs. You will also be contributing to knowledge generation about the participants' perceptions on the usefulness of Audience Response System (ARS) technology-based GRs in the [REDACTED] Nurse Anesthesia Program.

Will I be paid to take part in this study?

You will not be paid to take part in this study.

How will information about me be kept private or confidential?

All efforts will be made to keep your responses confidential, but total confidentiality cannot be guaranteed.

- We will use Qualtrics to collect and forward your anonymous responses to us. We will not receive any information that can identify you or other subjects. We will download your responses to a secure file that requires a password to access. Only study staff will have access to the password. Responses will be deleted from the file in March of 2020 after analysis is complete and study findings are professionally presented or published.
- No information that can identify you will appear in any professional presentation or publication.

What will happen to information I provide in the research after the study is over?

- The information collected about you for this research will not be used by or distributed to investigators for other research.

What will happen if I do not want to take part or decide later not to stay in the study?

Your participation is voluntary. If you choose to take part now, you may change your mind and withdraw later. If you do not click on the 'submit' button after completing the form, your responses will not be recorded. You may also choose to skip any questions that you do not wish to answer. However, once you click the 'submit' button at the end of the form, your responses cannot be withdrawn as we will not know which ones are yours.

Who can I call if I have questions?

If you have questions about taking part in this study, you can contact the Principal Investigator: Dr. Maureen McCartney-Anderson at [REDACTED] or co-investigators Lynne Panzica at [REDACTED] and John Tomasello at [REDACTED], graduate students in the Department of Nursing.

If you have questions about your rights as a research subject, you can call the IRB Director at: Newark HealthSci (973)-972-3608

Please print out this consent form if you would like a copy of it for your files.

If you do not wish to take part in the research, close this website address. If you wish take part in the research, follow the directions below:

By beginning this research, I acknowledge that I am 18 years of age or older and have read and understand the information. I agree to take part in the research, with the knowledge that I am free to withdraw my participation in the research without penalty.

Click on the link that will take you to the questionnaire:

www.qualtraics.com/TBD

Click on the "I Agree" button to confirm your agreement to take part in the research.

[Be sure "I Agree" links them to the survey/questionnaire" and "I Do Not Agree" closes the website.]

I Agree

I Do Not Agree

Appendix F

Grand Rounds Format

SRNA presenter(s):

CRNA presenter(s):

Subject:

- State the aims and objectives of presentation and introduce participants to Audience Response System (ARS) technology using <https://www.polleverywhere.com>
- **Case Scenario augmented by Microsoft PowerPoint and ARS (30 minutes)**
 - Present patient
 - PMH, PSH, current medications, allergies, METS, ASA score, MP score
 - Include any pertinent lab work, imaging, studies, outside consults
 - Present surgical case and anesthetic plan
 - Ask participants for feedback and/or questions via verbal engagement or ARS for those who might prefer anonymous Q&A
 - Present the case scenario and include 7 – 10 ARS opportunities using the site [polleverywhere.com](https://www.polleverywhere.com)
 - ARS question formats should include multiple-choice, open-ended questions, word clouds, rank order charts, and clickable images
 - Post-case scenario discussion/evidence based discussion
 - Includes at least 2 references from recent literature (less than 5 years old) with rationale for anesthetic choices
 - Discuss quality of literature, and any discrepancies between common practice and current recommendations

- **Additional time for open discussion (15 minutes)**
 - Demonstration of any special equipment relevant to the case scenario (i.e. level 1 rapid transfuser, fiber optic scopes, etc.)
 - Ask participants for feedback and/or questions via verbal engagement or ARS for those who might prefer anonymous Q&A

Appendix G

Qualtrics Pre/Post/Post Grands Rounds Knowledge Assessment Exam

Demographics:

Date of birth _____

Year of Schooling:

- ☐ First Year
- ☐ Second Year
- ☐ Third Year

1. The triad of death in trauma includes (select 3):
 - a) **Hypothermia**
 - b) Hypovolemia
 - c) Hypoxia
 - d) **Acidosis**
 - e) **Coagulopathy**
 - f) Transfusion reaction
2. Liberal crystalloid transfusion is associated with improved clinical outcomes in massive hemorrhage
 - a) True
 - b) **False**
3. Which of the following blood products need to be administered with a fluid warmer during MTP?
 - a) Cryoprecipitate and platelets
 - b) RBCs and cryoprecipitate
 - c) FFP and platelets
 - d) **FFP and RBCs**
4. Which electrolyte disturbance is most common during MTP?
 - a) Hyperkalemia
 - b) Hypokalemia
 - c) **Hypocalcemia**
 - d) Hypercalcemia
5. For every 6 units of RBCs, __unit(s) of FFP should be given, and __unit(s) of platelets
 - a) 1, 6
 - b) **6, 1**
 - c) 3, 1
 - d) 4, 1
 - e) 1, 4
6. Performing a type and screen:
 - a) Tests for only ABO and RH compatibility
 - b) **Tests for ABO and RH compatibility, and most commonly found blood antibodies**
 - c) Involves mixing patient blood with donor blood
 - d) Tests for only ABO compatibility
7. Tranexamic acid should be given within __ hours of bleeding starting, and with a bolus of __ gm.
 - a) 6, 2
 - b) 4, 1
 - c) 4, 4
 - d) **3, 1**
8. Which methods are not appropriate first-line treatments for laryngospasm after extubation (select all that apply):
 - a) Lidocaine IV
 - b) Positive pressure ventilation
 - c) **Reintubation**
 - d) **1-2 mg/kg of succinylcholine**
 - e) Jaw thrust
9. You run into an unanticipated difficult airway. The patient is paralyzed and you have been unable to place an ETT, you attempt two-person BMV with an oral airway in place and are unable to ventilate. You then opt to place an LMA. Is this an appropriate next step?
 - a) **Yes**
 - b) No
10. How many attempts should be made to DL before proceeding with the difficult airway algorithm (i.e. using a bougie introducer or video assisted laryngoscopy)? **2**
11. What is the name of the following maneuver used to break a laryngospasm: fixed pressure applied to the "laryngospasm notch" (posterior to the earlobe), for 3-5 seconds? **Larson's**
12. Which of the following are risk factors for laryngospasm following extubation (select all that apply):
 - a) **Airway secretions**
 - b) Hypercapnia
 - c) **Light plane of anesthesia**
 - d) MAC > 1.0
 - e) Hypoventilation

Appendix H

Qualtrics Grands Rounds Student Perception Survey

Objective: The objectives of the program are to create a series of case-based Grand Rounds that are interactive, engaging, and research-driven, in order to improve SRNA knowledge retention and clinical practice

1. The CRNA presenter was effective in meeting the objectives of this educational opportunity

- ☐ Extremely effective
- ☐ Very effective
- ☐ Moderately effective
- ☐ Slightly effective
- ☐ Not effective at all

2. The SRNA presenter was effective in meeting the objectives of this educational opportunity

- ☐ Extremely effective
- ☐ Very effective
- ☐ Moderately effective
- ☐ Slightly effective
- ☐ Not effective at all

3. Comprehending these grand rounds did not require much attention

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

4. As a result of these grand rounds, I have reflected on my actions to improve my clinical practice

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

5. Attending grand rounds caused me to consider ways to improve my clinical practice

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

6. The use of smartphone technology helped to make Grand Rounds engaging

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

7. Grand Rounds will help me better recall this knowledge in my clinical practice

- ☐ Definitely yes
- ☐ Probably yes
- ☐ Might or might not
- ☐ Probably not
- ☐ Definitely not

8. Grand Rounds were delivered in a relaxed, low-stress environment

- ☐ Definitely yes
- ☐ Probably yes
- ☐ Might or might not
- ☐ Probably not
- ☐ Definitely not

9. Grand Rounds are worth my time

- ☐ Definitely yes
- ☐ Probably yes
- ☐ Might or might not
- ☐ Probably not
- ☐ Definitely not

10. I would highly recommend that Grand Rounds continue every month

- ☐ Definitely yes
- ☐ Probably yes
- ☐ Might or might not
- ☐ Probably not
- ☐ Definitely not

11. Overall evaluation of Grand Rounds

- ☐ Excellent
- ☐ Good
- ☐ Average
- ☐ Poor
- ☐ Terrible

12. Any suggestions or comments?

Appendix I

Wittich et al. (2013) Validated Questionnaire

TABLE 1. Participant Reflection on Medical Grand Rounds: Factor Analysis and Item Loadings

Item	Reflection level ¹³	Item loadings	
		Factor 1	Factor 2
1. Comprehending this medical grand rounds did not require much attention.	Habitual action	−0.416	0.646
2. I did not have to think too much about this medical grand rounds to understand it.	Habitual action	−0.419	0.653
3. Understanding this medical grand rounds required me to concentrate on the concepts taught by the presenter.	Understanding	0.307	0.348
4. I needed to understand the information presented at the medical grand rounds to apply it to my practice.	Understanding	0.496	0.270
5. As a result of this medical grand rounds, I have reflected on my actions to improve on what I do.	Reflection	0.827	0.017
6. Attending this medical grand rounds caused me to consider ways to improve my own work.	Reflection	0.822	0.086
7. As a result of this medical grand rounds, I have changed my normal way of thinking about things.	Critical reflection	0.617	0.201
8. As a result of this medical grand rounds, I have discovered faults in what I previously believed to be correct.	Critical reflection	0.328	0.280

Column 1 shows each item. Column 2 shows the original levels of reflection of Kember et al¹³ and how these levels correspond to the factors of low (factor 2) and high (factor 1) reflection found in the current study. Items 3 and 8 loaded ambiguously onto both factors and were thus dropped from the final model.

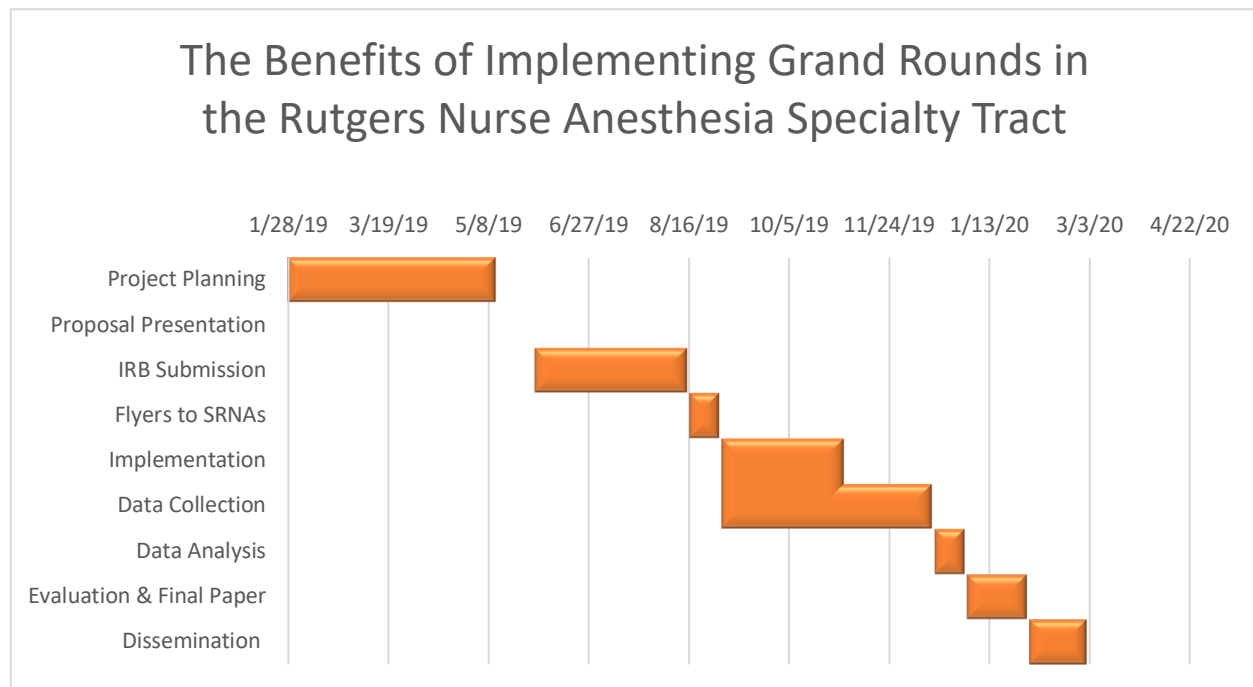
TABLE 2. Participant Reflection on Medical Grand Rounds: Factors, Mean Scores, and Reliability^a

Item	Mean (SD)	Intraclass correlation coefficient (95% CI)
Factor 2 (eigenvalue, 1.19; Cronbach α , 0.77) (Minimal Reflection)		
Comprehending this medical grand rounds did not require much attention.	3.09 (1.26)	0.58 (0.31-0.78)
I did not have to think too much about this medical grand rounds to understand it.	2.97 (1.17)	0.73 (0.56-0.86)
Factor 1 (eigenvalue, 2.51; Cronbach α , 0.81) (High Reflection)		
I needed to understand the information presented at the medical grand rounds to apply it to my practice.	3.67 (0.93)	0.76 (0.61-0.88)
As a result of this medical grand rounds, I have reflected on my actions to improve on what I do.	4.01 (0.83)	0.88 (0.80-0.94)
Attending this medical grand rounds caused me to consider ways to improve my own work.	3.97 (0.81)	0.87 (0.78-0.93)
As a result of this medical grand rounds, I have changed my normal way of thinking about things.	3.72 (0.87)	0.73 (0.56-0.86)

^aFactors with eigenvalues greater than 1 were retained.

Appendix J

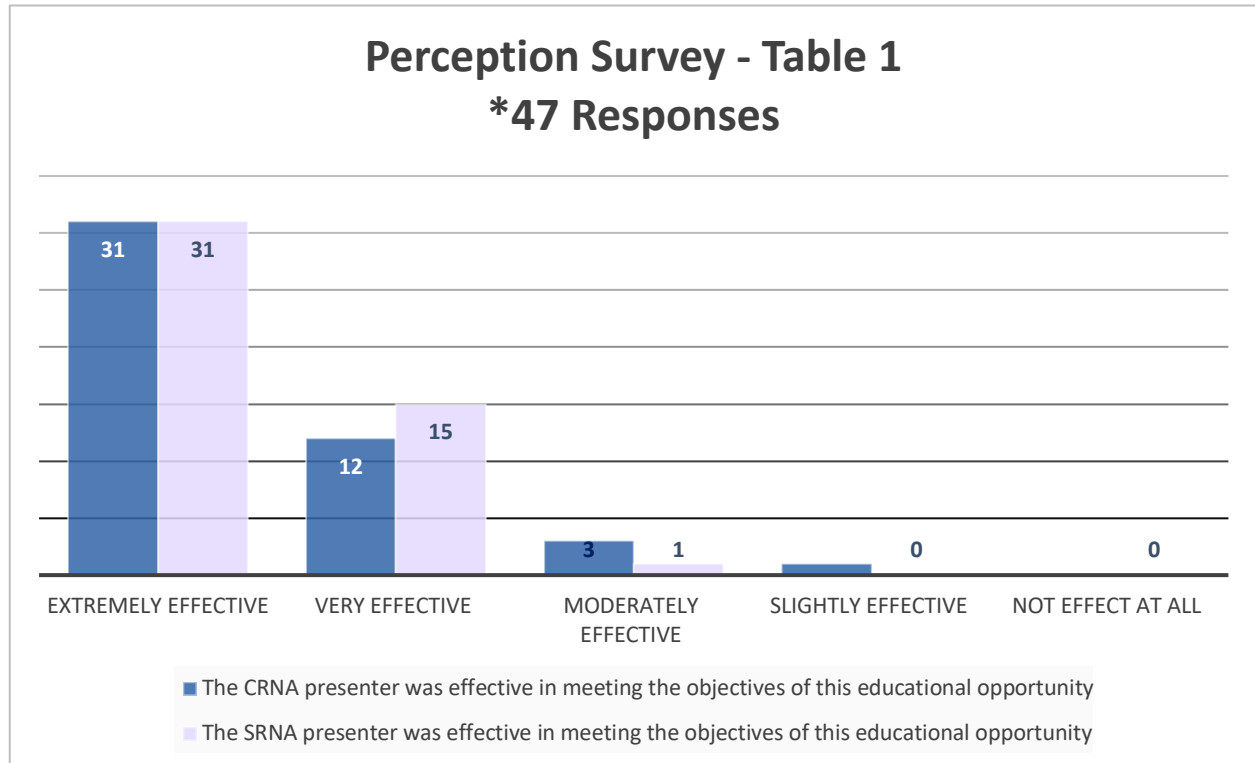
Project Timeline



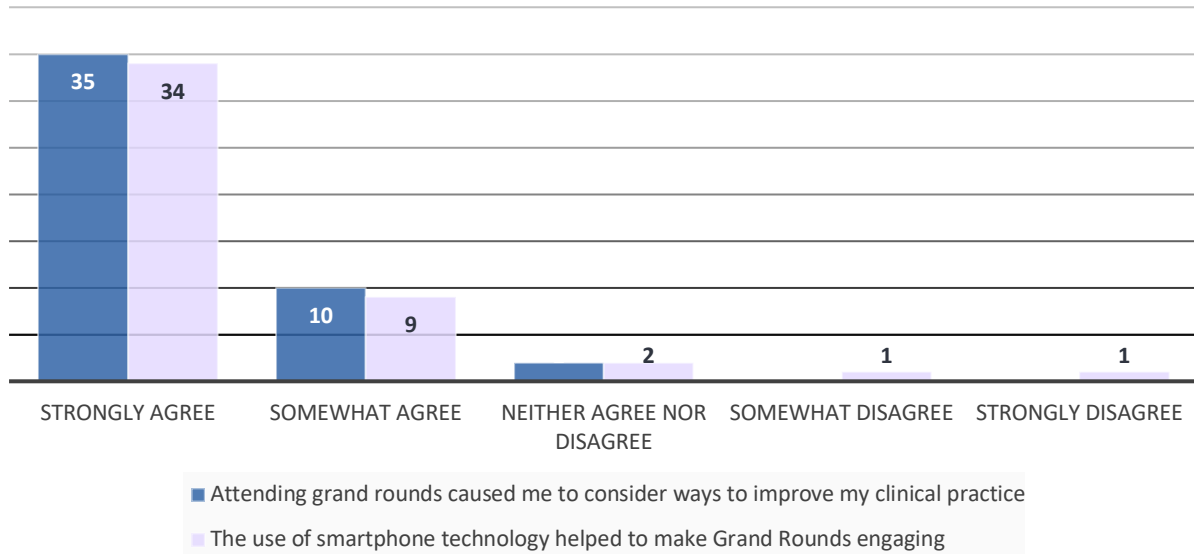
Task	Start Date	End Date	Duration (in days)
Project Planning	1/28/19	5/12/19	104
Proposal Presentation	5/13/19	5/13/19	1
IRB Submission	6/01/19	7/03/2019	(down)28
Flyers to SRNAs, obtain consent, & assess topics of interest	8/16/19	9/09/19	(up)25
Implementation	9/1/19	11/1/19	(change this?)65
Data Collection	9/09/19	12/15/19	
Data Analysis	12/16/19	12/31/19	15
Evaluation & Final Paper	1/1/20	1/31/20	30
Dissemination	2/1/20	3/1/20	29

Appendix K

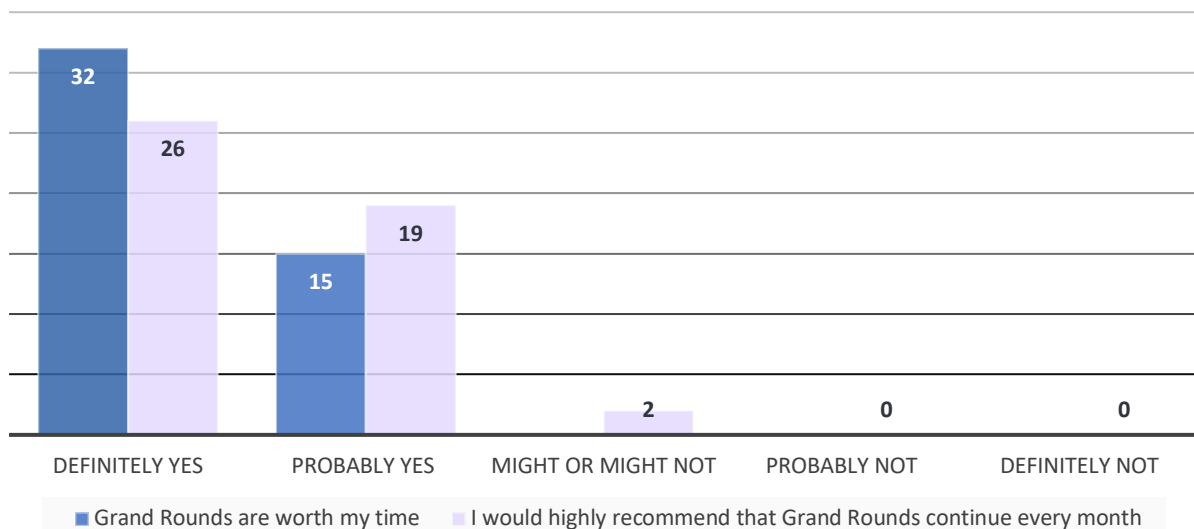
Perception Survey Results



Perception Survey - Table 2
***47 Responses**



Perception Survey - Table 3
***47 Responses**



Free Text Responses

a little bit shorter, less info at once, done more often
Maybe make them shorter?
To have the poll application functional and consistent
CRNA presenter is not necessary for all presentations
It was really fun and interactive!
would love to see this continue at every program meeting, perhaps faster, and just run through a topic with interactive questioning. Don't really see the need for a guest lecturer. Student-led part of the presentation was more informative.
Great presentation! Actual clinical experiences presented and demonstration presentation were very effective and creative.
This should be apart of every program meeting. Grand rounds it utilized throughout medicine. We should be doing this too to improve our practice.
I really enjoyed this! Very interactive and engaging
Make it shorter, have some topics that are a bit harder that we would need refreshing on (aka regional, ob, peds)
The SRNAs and CRNAs were extremely professional and engaging. Grand rounds was a unique and interesting way to discuss core concepts to prepare us in the operating room setting.