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## Addressing the Gaps: Pain Management, Multimodal Analgesia, and CRNA Education

Hunter Niemeyer

*Barnes Jewish College, Goldfarb School of Nursing*

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Addressing the Gaps: Pain Management, Multimodal Analgesia, and CRNA Education

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## Abstract

**Background and Review of Literature:** Opioid consumption, addiction, and narcotic-related deaths are a prevalent public health issue in the United States. Opioids are often administered throughout the perioperative period, and their utilization can lead to unwanted side effects and negative patient outcomes. Certified Registered Nurse Anesthetists (CRNAs) are strategically placed in hospital systems; these clinicians may advocate for the responsible administration of opioids and utilize multimodal pain strategies.

**Purpose:** This project assessed the knowledge and attitudes of CRNAs before and after the implementation of an educational program based on the prevention of operative pain, multimodal approaches, and the perioperative use of opioid versus nonopioid medications. The goal was to improve the integration and utilization of multimodal analgesia among CRNAs.

**Methods:** Pre- and post-surveys were used to examine the knowledge and attitudes on perioperative pain management and multimodal analgesia. Both quantitative and qualitative data was collected.

**Implementation/Procedure:** A virtual educational program was carried out in October 2021. During this time, pre- and initial post-survey data was collected. Approximately two weeks later, in November 2021, an additional post-survey was implemented.

**Implications/Conclusion:** The knowledge of CRNAs significantly improved after the implementation of the educational program; moreover, CRNAs were more likely to incorporate multimodal analgesia into their practice after undergoing the education. Multiple barriers to the utilization of multimodal analgesia were identified. This project demonstrates an increased need for multimodal analgesia education and nonopioid optimization in the perioperative setting.

**Keywords:** anesthesia, pain, opioid, multimodal, analgesia, education, knowledge, attitude

## **Addressing the Gaps: Pain Management, Multimodal Analgesia, and CRNA Education**

As the opioid epidemic surges throughout the United States, evidence-based leadership methods are needed to educate and empower health care providers on the utilization of multimodal pain management approaches and nonopioid medications (DeWeerd, 2019). As experts in pain management, Certified Registered Nurse Anesthetists (CRNAs) can play a role in advocating for the use of alternative pain strategies throughout the operative continuum.

### **Background**

The groundwork for the opioid crisis was laid in the 1980s, when research studies began advocating for opioids as the primary management strategy for pain. Although these studies were supported with limited data and encompassed small sample sizes, they emphasized the safety, efficacy, and low addiction potential of opioids. As a result, the studies were published in trusted journals of medicine throughout the United States, influencing health care providers to treat pain with controlled substances (Rumman et al., 2018). From the late 1990s to 2000s, millions of prescription opioids, such as hydrocodone and oxycodone, were dispensed to patients nationwide. At the same time, the high addiction potential of opioids became evident (Stoicescu et al., 2019).

Perioperative pain management refers to pain control before, during, and after a surgical procedure. Acute postoperative pain, present in more than 80% of patients who undergo surgery, can lead to significant medical complications when unresolved. To elaborate, postoperative pain contributes to pneumonia, deep vein thrombosis, infection, delayed wound healing, and the development of chronic pain. This, in turn, leads to delayed discharges, worsened patient outcomes, and considerable financial expense for hospital systems. Although all patients undergoing surgical procedures should receive adequate pain management, less than half of

postoperative patients report satisfactory pain relief following surgery. In turn, more opioids are administered in the postoperative period, which can trigger unwarranted side effects such as sedation, respiratory depression, vomiting, and constipation. Additionally, the use of opioids throughout the perioperative period has been directly linked to physical dependence and addiction (Kaye et al., 2020).

With the implications faced by the current epidemic, opioid use in surgical settings has undeniably raised concern among health care providers. For this reason, many studies recommend minimizing the need for opioids by introducing alternative pain strategies during the perioperative period. For instance, postoperative pain may be dramatically reduced by administering opioids with "...one or more adjunctive agents, which include nonsteroidal anti-inflammatory drugs (NSAIDs), selective cyclooxygenase-2 inhibitors, N-methyl-D-aspartate antagonists, alpha-2 adrenergic agonists, alpha-2-delta receptor modulators, and local anesthetics" (Meissner et al., 2015, p. 2137). Ultimately, pain management providers should utilize a multimodal approach, wherein they are armed with adequate knowledge and various medications at their disposal to meet the individualized analgesic needs of their patients (Gordon et al., 2016).

### **Problem Statement**

Although acute operative pain is a common clinical condition and its prevention requires an evidence-based, planned, and multifaceted approach, health care organizations are slow to integrate pain management education that will enhance health care providers' knowledge and dissipate false beliefs about perioperative pain management. Therefore, better professional education and training within various members of the pain management team would enhance knowledge, skills, and adherence to protocols; this, in turn, would improve patient outcomes,

reduce the incidence of opioid-related side effects, and prevent the development of opioid misuse.

Located at the intersection of pre-, intra-, and post-surgical care, CRNAs are strategically placed in health care systems and are largely responsible for managing pain throughout the perioperative period. Therefore, CRNAs are in an optimal position to advocate for the responsible administration of narcotics, utilize evidence-based analgesic techniques, and prevent the complications that arise with opioid utilization (Edwards et al., 2020).

### **Purpose, Aims, and Objectives**

This practice initiative took place within the Department of Anesthesiology at Barnes-Jewish Hospital. Although multimodal analgesia is encouraged in this facility, its utilization remains dysregulated and unmonitored. Moreover, CRNAs are not routinely educated on best practices and recommendations regarding pain management in the operating room. Therefore, this project sought to implement an educational program focused on perioperative pain management with the adjunct use of nonopioid analgesics and multimodal approaches; with this, the knowledge and attitudes of CRNAs were examined.

The overall objective was to improve the knowledge and attitudes of CRNAs within one month. With this, the goal was to improve the use of multimodal analgesia, positively influence organizational policies, integrate pain management education within the clinical setting, and enhance patient outcomes. It was expected that these goals and objectives would be achieved with the implementation of this educational program. As demonstrated in the literature review, educational programs based on pain management are evidence-based and effective (see Review of Literature section). Moreover, CRNA's perspectives on pain management and pain management practices are not routinely assessed.



**PICOT Question**

The PICOT question was as follows: In CRNAs (P), how does an educational program on the prevention of acute operative pain (opioid versus nonopioid) (I), compared to standard education (C), affect the knowledge of and attitude toward acute pain management during the perioperative period (O) within one month (T)?

**Significance**

Although the United States comprises 4.4% of the world's population, Americans consume 80% of the total opioid supply (Mayo Clinic Health System, 2018). According to recent data, more than 60% of drug-related deaths are due to opioid misuse, with over 30,000 citizens dying each year (Griffis et al., 2017). In 2019 alone, 10 million Americans misused opioid prescriptions, and 2 million others were diagnosed with an opioid use disorder. Subsequently, the opioid crisis cost the United States \$2.5 trillion from 2015 to 2018 (Rummans et al., 2018).

Approximately 99% of all surgical patients in the United States receive opioids at some point during their perioperative course. Of those treated with narcotics, 75% experience at least one adverse effect, such as nausea, constipation, or respiratory depression (Koepke et al., 2018). With this, patients who receive opioids postoperatively have a 44% increased risk for long-term opioid use (Meissner et al., 2015). In a retrospective study conducted by Brummet et al. (2017), 36,000 surgical patients were examined in the United States between 2013 and 2014; the incidence of chronic opioid use after surgery was a staggering 6%. From an anesthesia provider standpoint, many studies demonstrate the lack of a multimodal approach when treating acute operative pain. In over 75% of surgical cases, patients' analgesic plans consist of opioids as a first choice (Rawal, 2016).

**Review of the Literature**

## Search Methods

To assist with the developed PICOT question, a literature search was conducted with the utilization of databases such as PubMed, CINAHL, ScienceDirect, and ClinicalTrials.gov. When using PubMed, CINAHL, and ScienceDirect, search strategies proved to be similar. Essentially, various components of the PICOT question were broken up and “AND” was added in between these phrases. The following key words were used alone and in combination: certified registered nurse anesthetist, anesthesiology, anesthesia, intraoperative, postoperative, perioperative, pain, opioid, nonopioid, multimodal, knowledge, attitude, and education. Although initial results were plentiful, these were quickly narrowed down with the application of advanced filters, which ensured the articles were written in the English language, peer-reviewed, and current (i.e., within five years). Moreover, initial phrases were supplemented with MeSH terms to obtain more applicable literature; for instance, “combined modality therapy” was used instead of “multimodal AND analgesia” for a CINAHL search. While a total of 29 articles were initially identified on these databases, only 10 were selected for final review.

Regarding grey literature, ClinicalTrials.gov provided the most applicable evidence for the developed PICOT question. When searching on ClinicalTrials.gov, a simplified search was conducted. To elaborate, “multimodal analgesia” was searched, and results were limited to completed studies with final outcomes. Surprisingly, all the resultant articles were applicable to pain management in the perioperative period; moreover, all but one of these articles were published between 2016 and 2021. When MeSH terms were incorporated into subsequent searches, the same results were attained.

While all levels of evidence were considered when selecting articles for this appraisal, priority was given to articles related to perioperative pain management, multimodal analgesia,

anesthesia provider outlooks, and pain-related education. In total, 15 articles were analyzed for the purpose of this literature review. The levels of evidence contained in these articles vary; while many of the selected articles consist of cohort studies and cross-sectional studies (level III), four randomized controlled trials (level I) are also included. With this, a qualitative study (level III), a literature review (level V), and a quality improvement project (level V) were integrated. When synthesizing the evidence-based literature related to the PICOT question, five key themes emerged.

### **Common Themes and Findings**

**Surgical pain management is inadequate.** The management of acute pain throughout the perioperative period is often insufficient. In a meta-analysis of randomized controlled trials and two cohort studies, the prevalence of postoperative pain in the post-anesthesia care unit (PACU) was found to be high; moreover, pain scores were largely predicted by intraoperative modalities (Ladha et al., 2016; Ward et al., 2018; Xiping et al., 2019). In one retrospective study, 31% of all patients required moderate to high doses of opioids after cardiac electronic device implantation, which demonstrates that even patients with minimally invasive surgeries may experience severe pain postoperatively (Biocic et al., 2017). Overall, these studies confirm the high prevalence of pain in the PACU; in addition, they denote the conservative intraoperative opioid and nonopioid administration by anesthesia providers.

**Multimodal analgesia decreases postoperative pain and limits opioid use.** The intraoperative use of multimodal pain strategies is recommended to reduce postoperative pain and narcotic consumption. A recently conducted literature review found strong evidence supporting the use of "...regional analgesia, acetaminophen, nonsteroidal anti-inflammatory agents, gabapentoids, tramadol, lidocaine, and/or the N-methyl-d-aspartate class of glutamate

receptor antagonists...” (Wick et al., 2017, p. 691). In five studies, the utilization of combined traditional (opioid) analgesia and adjunctive analgesia (nonopioid) was superior to traditional techniques only. To elaborate, postoperative pain scores and narcotic use were reduced by statistically significant levels when intraoperative pain management plans included local anesthetics, corticosteroid injections, peripheral nerve blocks, and the administration of nonopioids, such as IV Ibuprofen 800 mg every six hours (Greimel et al., 2018; Martinez et al., 2016; Song et al., 2016; Ward et al., 2018; Xiping et al., 2019).

**Anesthesia providers face barriers in relation to the utilization of multimodal analgesia.** Throughout these articles, the perspectives of CRNAs and anesthesiologists on the treatment of intraoperative pain were studied. In a qualitative study by Velasco et al. (2019), two key themes emerged among CRNAs: barriers to intraoperative opioid-alternative administration and facilitators to intraoperative opioid-alternative administration. Such barriers included limited experience with nonopioids, negative experiences with multimodal analgesia, and a lack of institutional resources and support. Ladha et al. (2016) found significant variations in practice when utilizing multimodal analgesia; while some practitioners always incorporate non-opioid alternatives into their pain management plans, other anesthesia providers rarely initiate such strategies. Ultimately, these articles confirm the importance of improving education, training, and institutional policies in support of opioid-alternative medications. With this, organizations should work to address barriers and facilitate multimodal pain practices.

**Protocols augment the utilization of multimodal pain management strategies.** According to Allen et al. (2020), the implementation of an enhanced recovery pathway augments the utilization of non-opioid medications throughout the perioperative period. In two surgery centers, the application of a multimodal analgesia regimen decreased postoperative pain, reduced

narcotic consumption, and shortened hospital stays in patients undergoing shoulder arthroplasties and ventral hernia repairs (McLaughlin et al., 2018; Warren et al., 2017). Tucker et al. (2021) conducted a quality improvement project to study the effectiveness of a multimodal analgesic protocol on postoperative pain scores, opioid consumption, and post-anesthesia care unit length of stay (LOS); while LOS was not affected, all other dependent variables were significantly reduced ( $p < 0.05$ ).

**Pain management education is effective.** The lack of multimodal pain management strategies is related to insufficient provider education. According to Gordon et al. (2016), evidence shows gaps among anesthesia providers, "...including optimal methods and timing of perioperative patient education, nonpharmacological modalities, combinations of analgesic techniques, monitoring of patient response to treatment, techniques for neuraxial and regional analgesia, and organizational care delivery models" (p. 159). To address this, different approaches to educational programs were studied throughout these articles. In two separate studies, post-surgical nurses were divided into control and experimental groups. In the first study, both groups underwent traditional pain management training in the classroom setting, while the experimental group underwent additional multimedia training. In the end, the experimental group had higher satisfaction scores, demonstrated greater knowledge in pain assessment, and showed better communication regarding pain when compared to the control group (Chu et al., 2019). In the second study, the experimental group attended a one-day online course on evidence-based practices related to pain management while the control group did not. Consequently, the experimental group demonstrated a significant increase in knowledge and self-efficacy about acute pain management when compared to the control group (Yoo et al., 2019).

The authors of both studies recommend implementing educational programs focused on pain management for health care providers working in acute care settings. Although the subjects in these studies were registered nurses, the interventions and results can be applied to anesthesia providers. In relation to the proposed PICOT question, these articles demonstrate the effectiveness of pain management education, support the development of an educational program for CRNAs, and provide evidence-based implementation strategies.

### **Strengths and Limitations**

The studies included in this literature review presented many strengths, such as the control of external variables. In terms of selecting participants, specific inclusion and exclusion criteria was outlined in three studies (Allen et al., 2020; McLaughlin et al., 2018; Warren et al., 2017). In six studies, anonymity was preserved through both participant and/or researcher involvement (Biocic et al., 2017; Chu et al., 2019; Greimel et al., 2018; McLaughlin et al., 2018; Ward et al., 2018; Yoo et al., 2019). Similarly, participant randomization was achieved in four studies (Martinez et al., 2016; Song et al., 2016; Xiping et al., 2019; Yoo et al., 2019). Multiple result analyses were conducted in the studies by Ladha et al. (2016) and Xiping et al. (2019). Finally, in all but one (Wick et al., 2017) of the studies included in this literature review, methodologies were clearly outlined and defined.

This said, these studies also had limitations. To elaborate, seven studies encompassed small sample sizes and failed to overtly express power results (Biocic et al., 2017; Chu et al., 2019; Song et al., 2016; Tucker et al., 2021; Velasco et al., 2019; Warren et al., 2017; Yoo et al., 2019). Conversely, the studies conducted by Greimel et al. (2018) and Ladha et al. (2016) consisted of very large sample sizes (15,326 and 799,449, respectively), which may have skewed statistically significant data. Five studies were only conducted at a single medical center, which

limits generalizability (Allen et al. 2020; Biocic et al., 2017; Chu et al., 2019; McLaughlin et al., 2018; Tucker et al., 2021). Moreover, reliability data was only reported in three studies (Chu et al., 2019; Ward et al., 2018; Yoo et al., 2019), while validity data was only reported in four (Chu et al., 2019; McLaughlin et al., 2018, Warren et al., 2017; Yoo et al., 2019). Lastly, bias was evident in many studies; for instance, the utilization of convenience sampling was present in four studies (Chu et al., 2019; Velasco et al., 2019; Wick et al., 2017; Yoo et al., 2019).

### **Evidence**

The synthesis of current literature demonstrates the high prevalence of postoperative pain, the effectiveness of multimodal analgesia, and the need for educational programs and protocols related to perioperative pain management. Moreover, this literature review highlights the limited number of existing studies that explore CRNA's knowledge and perspectives on pain management as well as multimodal analgesic use. Therefore, these articles directly correlate with the developed PICOT question, provide evidence for gaps in current practice, and were beneficial when working to develop an educational program for CRNAs.

### **Theoretical Frameworks**

First developed in 1980, Ajzen's Theory of Planned Behavior works to predict a person's intent to engage in a behavior at a specific time and place; this model asserts that behavioral intention is based on innate attitudes, subjective norms, and perceived control (see Appendix A). For this project, Ajzen's Theory of Planned Behavior was applied to the participating CRNAs. To elaborate, if the educational program positively affected the CRNA's attitudes, idealizations, and engagement, these participants were more likely to integrate evidence-based multimodal analgesia into clinical practice (Ajzen, 2020).

The Pain Interprofessional Curriculum Design (PICD) Model was recently established to educate prelicensure health science students; this model provides a groundwork for pain management curriculum design and evaluation. In particular, the PICD encourages the educator to consider the culture, community, content, and context when developing pain management education within a facility. With this, team dynamics, competencies, interrelated concepts, and collaboration are also taken into consideration (see Appendix B). Ultimately, this model was helpful when developing a multimodal pain management education program for CRNAs. In utilizing the PICD, the team members remained guided through the educational process; in addition, there was improved focus on the goals at hand and enhanced evaluation of the scholarly project (Watt-Watson et al., 2017).

## **Methodology**

### **Project Design**

This quality improvement project consisted of an educational intervention with the collection of both quantitative and qualitative data.

According to Dang & Dearholt (2018), the identification of stakeholders is a crucial component of a change project, as these members may support decisions, offer resources, and maintain accountability; with this, each stakeholder should be assigned specific roles. In the case of this practice initiative, the stakeholders first included the leaders within the Department of Anesthesiology at Barnes-Jewish Hospital and Goldfarb School of Nursing at Barnes-Jewish College. To ensure the successful deployment of this project, these department heads offered approval, support, guidance, and expertise. Moreover, these stakeholders remained engaged and informed. Next, the CRNAs who participated in this practice initiative served as stakeholders; these staff members attended the educational session and provided valuable input. Lastly,



patients undergoing surgical procedures represent stakeholders, as they were directly affected by this initiative when receiving perioperative care.

With the implementation of this practice initiative, a budget was established. First, the salaries of CRNAs undergoing the educational program were considered. According to the U.S. Bureau of Labor Statistics (2020), the median wage for a CRNA in Missouri is \$91 per hour. A total of 14 CRNAs contributed to this project, which lasted for approximately one hour. Needed supplies, such as writing utensils, paper, and ink, were also accounted for. In terms of data collection and analysis, SPSS Statistics was used to generate conclusive data; a statistician was utilized and provided by the college. The total implementation cost was estimated at \$1,424 (see Appendix C for budget table).

### **Project Site**

This initiative took place within the Department of Anesthesiology at Barnes-Jewish Hospital. Due to the limitations faced by the COVID-19 pandemic, the education occurred virtually. Learning objectives and content were developed based on recommendations from professional pain organizations and evidence-based literature (see Methods section). To create an effective educational program, it was essential to collaborate with institutional stakeholders and consolidate important teaching points.

This project was carried out at a large, academic institution, where evidence-based change is supported and encouraged. The organization associated with this project was equipped, supportive, and open to change; this environment was ideal for maximal success. With this, the CRNAs within this organization agreed to work alongside this initiative, and the participating staff members were easily accessible. When developing an evidence-based educational program, the education was user-friendly and up to date. For example, the American Pain Society

routinely releases best practices and recommendations for the use of multimodal analgesia in treating acute pain (Gordon et al., 2016). Lastly, no significant implementation costs were associated with this project, and no risks were involved.

In terms of facility barriers, the COVID-19 pandemic affected the ability to conduct an in-person educational session. Therefore, the effectiveness of the educational program heavily relied on the intrinsic motivation of the CRNA participants. To address this barrier, it was crucial to embrace the perspectives that exist within the CRNA participants while working to foster positivity, encouragement, and support. With this, obtaining consistent feedback and listening to the concerns and needs of the CRNAs was of utmost importance.

### **Population**

All CRNAs who work with adult patients within the Department of Anesthesiology at Barnes-Jewish Hospital were included in this initiative, regardless of years of experience or operative specialties. Exclusion criteria included non-CRNA staff and MD anesthesiologists.

### **Ethical Considerations**

Washington University Institutional Review Board (IRB) approval was obtained prior to initiating this DNP project. All data collected was consolidated and free of employee identifiers. Participant confidentiality was ensured by coding the surveys with individual identification numbers; these items were kept in a secure online database and were only accessible by project committee members. All electronic data was password protected. There were no risks associated with this project.

### **Recruitment Strategies**

The use of email reminders and flyers helped to inform and recruit CRNA participants for this initiative; during this time, it was anticipated that approximately 25 CRNAs would participate in this project (see Appendix D for recruitment email and flyer).

### **Measurement Instruments**

This improvement project involved the collection of quantitative and qualitative data using pre- and post-surveys; the implementation day pre-survey was identical to the post-survey. Qualtrics was used to create online surveys for this project. In the first part of the surveys, demographic data was collected from the CRNA participants, which allowed for response comparisons. In the second part of the surveys, the CRNAs completed a test. A total of 10 questions, both multiple choice and true/false, were delivered to assess knowledge of multimodal pain management practices; these questions involved opioid-related statistics, pharmacologic therapies, and target drug receptors. All questions were developed from high quality, evidence-based literature found in databases, including PubMed and CINAHL. To elaborate, content questions were established from trusted sources, such as the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, the Anesthesia Patient Safety Foundation, and the Journal of Pain. In addition, updated practice guidelines from the American Association of Nurse Anesthetists and the American Society of Anesthesiologists were referenced in this process (American Association of Nurse Anesthetists, 2016; Bohringer et al., 2020; Chou et al., 2016; Graff & Grosh, 2018; Kumar et al., 2017).

In the final part of the surveys, CRNA viewpoints were assessed. In this self-created section, the CRNAs strongly agreed, somewhat agreed, neither agreed nor disagreed, somewhat disagreed, or strongly disagreed to a variety of statements surrounding multimodal analgesia; these statements addressed opioid-sparing techniques, provider support, and organizational

backing. In addition, the CRNAs were asked if they have ever received continuing education on multimodal analgesia. Lastly, the CRNAs answered an open-ended question regarding barriers to the utilization of multimodal analgesia. Similar post-surveys were redistributed two weeks after the intervention (see Appendix E for pre- and post-surveys).

In terms of survey strength, validity was established through evidence-based journals and articles; survey content was derived from practice guidelines developed by esteemed organizations. Moreover, survey feedback was obtained from non-participatory anesthesia clinicians at Barnes-Jewish Hospital prior to implementation. Survey reliability was established through test-retest (i.e., CRNA participants took the same survey multiple times).

### **Data Collection Procedure**

To organize data collection, a plan-do-study-act (PDSA) framework was utilized. With this, a user develops a plan to test for change, carries out the test, observes, analyzes, and learns from the results. If needed, the user may identify barriers from a given cycle, adjust, and re-implement the intervention during another cycle; PDSA cycles can be repeated an unlimited number of times (Institute for Healthcare Improvement, 2017).

**Plan.** In this stage, the intervention focus was consolidated; in particular, an educational program on perioperative pain management and multimodal approaches was developed. This was accomplished with the use of a presentation. All content in the presentation was supported with high quality, evidence-based literature from reputable anesthesia journals, organizations, and practice guidelines (American Association of Nurse Anesthetists, 2016; Bohringer et al., 2020; Chou et al., 2016; Graff & Grosh, 2018; Kumar et al., 2017). In addition, pre- and post-surveys were finalized. After this, an official date to carry out the intervention was decided. Throughout this time, flyers and emails were developed to recruit CRNA participants. Email

addresses were obtained from leaders within the Department of Anesthesiology, and flyers were displayed in the anesthesia break rooms.

**Do.** A virtual pain management educational session was carried out during this phase. A pre-survey was administered to the CRNA participants prior to the educational session. Immediately following the presentation, post-surveys were completed by participants. Two weeks after the intervention, additional post-surveys were completed. During this process, problems and unexpected observations were documented. Data was collected from online surveys and translated into a Microsoft Excel spreadsheet. Demographic-related questions assessed for cultural diversities, which could have influence outcome data; these questions were voluntary and included a “prefer not to say” option. Language barriers were not anticipated or identified among the CRNA participants.

**Study.** After responses were collected from both the pre- and post-implementation surveys, the data was analyzed; this included both quantitative and qualitative data (see Data Analysis section). In particular, the knowledge and attitudes of CRNAs were compared before and after the implementation of the educational program. After this, conclusions were made.

**Act.** In this stage, data was reported. Recommendations were made on a small- and large-scale to support non-opioid pain management education and encourage the utilization of multimodal analgesia among CRNAs. In addition, CRNA outlooks and barriers were discussed. Throughout the course of this project initiative, only one PDSA cycle occurred.

### **Data Analysis**

For this project, the independent variable included an educational program based on perioperative pain management, multimodal approaches, and the use of opioid versus nonopioid medications. The dependent variables included the knowledge and attitudes of CRNA

participants. Demographic variables included age, gender, ethnicity, number of years in practice, and the highest level of education.

For dependent variables, levels of measurement included nominal (open-ended question), ordinal (ranked statements), and ratio (percentage of correct test answers). For demographic variables, levels of measurement included nominal (gender identification, ethnicity, age ranges, and ranges for years in practice) and ordinal (highest level of education). Data was collected from one dependent group of CRNAs at pre-intervention and at two post-intervention time points. This group was not manipulated or randomized in any way.

To analyze data for this project, the utilization of statistical software (i.e., SPSS Statistics Version 26) was essential to measure and evaluate results. In addition, a statistician was consulted for assistance with data analysis. For quantitative data, knowledge-related figures were analyzed with a paired t-test and measure of effect was reported with Cohen's *d*. One attitude-related ordinal statement (i.e., "I always incorporate multimodal analgesia into my practice") was analyzed with the Wilcoxon signed-rank test. For these tests, the alpha level was set at 0.05. Descriptive statistics (i.e., percentages) were used for demographic data, other ordinal-related statements, and to quantify the proportion of CRNAs who have received multimodal analgesic education in the past. For qualitative data, common responses and themes were combined, consolidated, and described. Data was placed into comprehensive spreadsheets and displayed through graphs.

### **Procedures for Project Implementation**

The recruitment of CRNA participants began in September and October 2021, with the educational session being implemented in October 2021. During this time, the pre- and post-surveys were dispersed. A subsequent post-survey was distributed to CRNAs two weeks later, in

November 2021. All project-related data was analyzed at the time of survey collection and in the subsequent month of January 2022. In February, March, and April 2022, results were finalized, compiled, and presented (see Appendix F for timeline table).

## **Evaluation and Outcomes**

### **Results**

A total of 17 CRNAs agreed to participate in this study; of these, 14 CRNAs followed through to completion. In terms of demographics, the participating CRNAs represented the following age groups: 26-35 (43%), 36-45 (22%), 46-55 (14%), 56-64 (14%), 65+ (7%). Of these, approximately 21% were male and 79% were female. All participants (100%) identified as white/Caucasian. While many CRNAs had 0-3 years of experience (36%), the group's experience was also comprised of 4-6 years (21.5%), 7-10 years (7%), 11-14 years (14%), and 20+ years (21.5%). Lastly, 79% of the CRNAs held a master's degree, while 21% obtained a doctorate degree.

The mean pre-intervention test score was 85.7%, while the mean post-intervention test score was 97.1%. The mean difference of the test scores (i.e., mean  $\pm$  standard deviation) was  $-0.1143 \pm 0.0864$ . The mean post-intervention test score was significantly larger than the pre-intervention test score ( $p = 0.0003$ ) using a paired t-test (see Appendix G for graph).

Based on pre-intervention ordinal data, 57% of CRNAs felt well-supported by collaborating anesthesiologists when incorporating multimodal analgesia into their practice, while 36% felt somewhat supported and 7% felt somewhat unsupported. Similarly, 50% of CRNAs felt well-supported by the institution when incorporating multimodal analgesia into their practice, while 36% felt somewhat supported and 14% felt somewhat unsupported. When answering the statement, "I believe there are clear institutional guidelines that outline the

indications for and utilization of multimodal analgesia,” 36% somewhat agreed, 14% were indifferent, 36% somewhat disagreed, and 14% strongly disagreed. Regarding continuing education on multimodal analgesia, 57% of the CRNAs reported receiving education within the last two years, 14% reported receiving education more than two years ago, and 29% reported never receiving education (see Appendix H for graphs).

When analyzing the pre- and post-intervention statement, “I always incorporate multimodal analgesia into my practice,” the Wilcoxon signed-rank test found that the incorporation of multimodal analgesia was not significantly improved after the intervention ( $z = 0.707, p = 0.480$ ). Based on post-intervention ordinal data, however, approximately 64% of participating CRNAs felt they utilized more multimodal analgesia after participating in the educational session. With this, 36% of participants felt that they used less opioids and have experienced improved patient outcomes after undergoing the education (see Appendix I for graphs).

The CRNAs were asked about barriers regarding multimodal analgesia use. The responses were reviewed, and five common themes were identified: availability, cost, physician anesthesiologist preferences, surgeon pushback, and a lack of education on multimodal analgesia.

### **Discussion of Findings**

Although a small cohort, the CRNAs who participated in this study represented a multitude of ages, experience levels, and educational backgrounds. Based on the results from the pre- and post-test, the difference between the CRNA’s knowledge was statistically significant; this validates the effectiveness of the educational program on multimodal analgesia.



In terms of ordinal data, there were mixed responses regarding anesthesiologist support, hospital backing, and institutional guidelines. This said, the mere fact that some CRNAs do not feel supported in these categories suggests policies and protocols should be established or updated to encourage the use of multimodal analgesia. Moreover, although the incorporation of multimodal analgesia after the intervention was not statistically significant, a majority of the CRNAs reported utilizing more multimodal analgesia after receiving the education. With this, approximately 43% of the CRNAs reported either receiving continuing education on multimodal analgesia more than two years ago or never receiving education at all. These results demonstrate the need for recurrent training to ensure proficiency on this topic.

Lastly, the CRNA participants identified many barriers related to the use of multimodal analgesia in the operating room. Perhaps the biggest obstacle was the availability of medications; many CRNAs reported not having useful multimodal agents, such as intravenous acetaminophen and ibuprofen, on formulary at this institution. With this, some CRNAs felt reluctant to use multimodal agents to reduce patient- and facility-based costs. In a multitude of responses, physician anesthesiologist preferences were identified as a major deterrent to the use of multimodal analgesia; for instance, the assigned physician anesthesiologist may not prefer a certain multimodal agent based on beliefs or past experiences. Moreover, physician anesthesiologists may be hesitant or uncomfortable with certain medications or infusions, such as ketamine or dexmedetomidine. In addition, obstacles are faced with surgeons, who may prevent the administration of certain multimodal agents due to side effects (i.e., bleeding), rush the operative team, or inhibit the regional team from performing peripheral nerve blocks. Lastly, CRNAs identified a lack of education as a major hurdle when working with multimodal agents.

Participants felt that institutional pain management protocols were limited or hard to find and stated that education on this topic is not routine.

### **Strengths and Limitations of Findings**

There were many strengths of this project, including cost effectiveness, sustainability, and replicability; this study can be recreated in a variety of clinical environments. In addition, specific inclusion and exclusion criteria were outlined, which enhanced the cohesiveness of the CRNA group. In terms of validity, evidence-based resources and expert clinicians were utilized to support and verify survey content. Test-retest was utilized to ensure survey reliability.

This project had some limitations. Recruiting a large group of CRNAs for the educational session proved difficult; therefore, the sample size is inherently small, and generalization is limited. Moreover, due to the small sample size, correlations between responses and demographic variables (i.e., age, gender, ethnicity, years of experience, and level of education) were not fully analyzed. Lastly, misinterpretation of participant responses and transcription errors were possible. Due to convenience sampling, bias and confounding results could have also occurred.

### **Process Evaluation**

Because multimodal analgesia encompasses a large variety of therapies and CRNAs work in a multitude of specialties, challenges arose when developing concise content for the educational program. Despite the virtual setting, the implementation process did not meet a significant number of obstacles. The PDSA cycle was carried out as intended, and CRNAs completed the study as directed. On a few occasions, initial participant feedback was not prompt; additional emails were sent to remind CRNAs to complete study surveys. All project timeline objectives were met on time.

## **System and Practice Impact**

### **Implications for Organizational and Systems Change**

With the implementation of this practice initiative, many opportunities arise. This project may allow for better professional education and training within the institution's pain management team. This, in turn, would enhance knowledge, skills, and adherence to pain management protocols. In terms of patient-specific outcomes, this project may reduce adverse events, decrease the incidence of opioid-related side effects, and prevent the development of opioid misuse. Lastly, this project may inspire positive change and motivate other institutions to initiate similar educational programs within their anesthesia departments.

### **Recommendations for Nursing Practice**

Based on the results of this project, multimodal analgesia education should be carried out to maintain the knowledge and competency of CRNA staff; per evidence-based guidelines, this education should be occurring on an annual or semi-annual basis (Gordon et al., 2016). Moreover, barriers regarding multimodal analgesia use should be addressed and mitigated to enhance the utilization of nonopioid modalities. This includes increasing the number of multimodal agents on formulary, developing or updating facility-based multimodal analgesic protocols based on evidence-based science, and enhancing communication between the surgical and anesthesia teams.

### **Sustainability**

This project is extremely sustainable. The benefits of this project could include enhanced knowledge and attitudes regarding multimodal analgesia; in turn, evidence-based pain modalities may be utilized to their fullest extent, which could improve staff satisfaction, reduce opioid-related costs, and enhance patient outcomes.

## **Summary and Conclusion**

### **Project Summary**

With the implementation of an evidence-based educational program on pain management, CRNAs may positively influence the utilization of multimodal strategies. In doing so, these nurse leaders may inspire constructive change, improve the health of patients, and help combat the opioid crisis that exists in the United States.

### **Plan for Dissemination**

The results of this project will be distributed to Goldfarb School of Nursing at Barnes-Jewish College and the Department of Anesthesiology at Barnes-Jewish Hospital via a virtual presentation. Moreover, conclusions will be consolidated and presented at a research conference hosted at Goldfarb School of Nursing at Barnes-Jewish College in April 2022. Lastly, this project will be submitted for publication in *Pain Management Nursing*.

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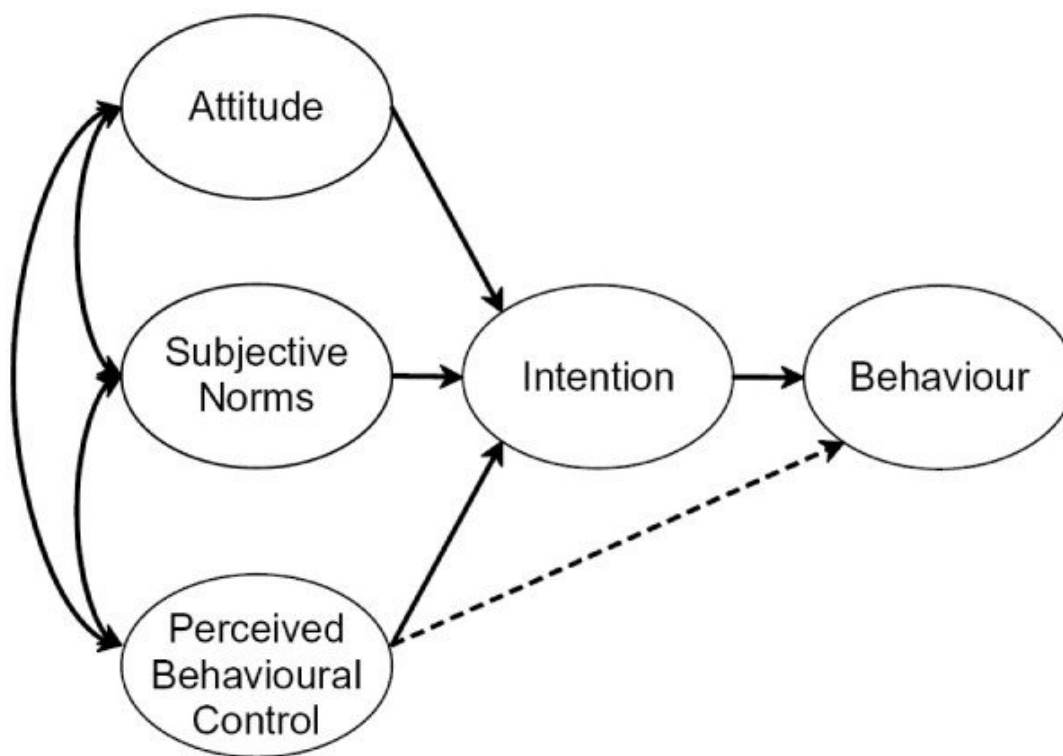
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## Appendix A

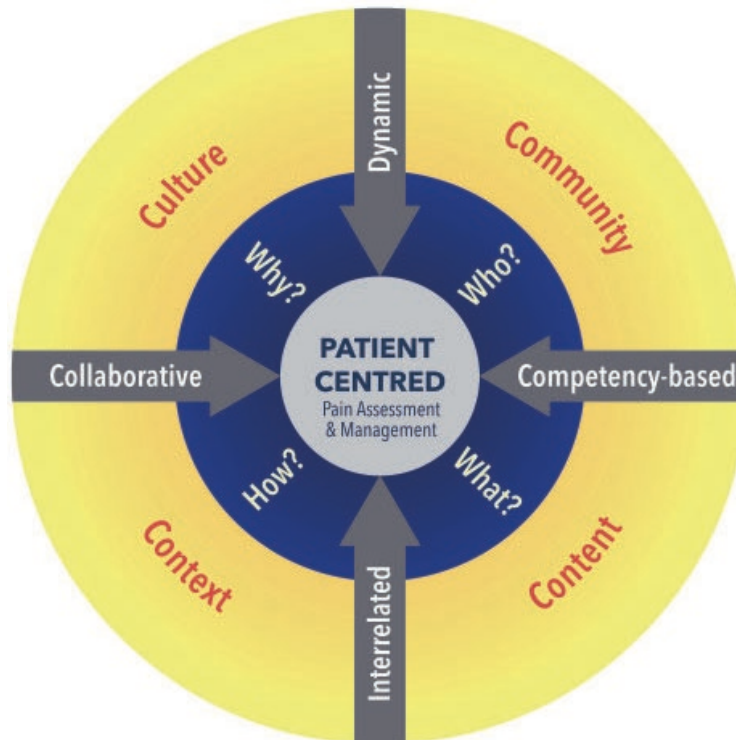
### Ajzen's Theory of Planned Behavior



*Note.* Image obtained from Psychology (n.d.).

## Appendix B

### Pain Interprofessional Curriculum Design Model



*Note.* Image obtained from Watt-Watson et al. (2017).

## Appendix C

### Budget Table

Expenditure/Item	Cost per Unit	# Units	Estimated Cost
<b>Personnel</b>			
Certified Registered Nurse Anesthetists	\$91 (per hour)	14 (x 1 hour)	\$1,274
<b>Materials/Supplies</b>			
Writing utensils	\$20	1	\$20
Paper	\$30	1	\$30
Ink	\$50	1	\$50
<b>Technology/Software</b>			
SPSS Statistics	\$50	1	\$50
Statistician	\$0 (provided by college)	1	\$0
<b>TOTAL</b>	-	-	<b>\$1,424</b>

*Note.* Salary-related data obtained from U.S. Bureau of Labor Statistics (2020).

## Appendix D

### Recruitment Email and Flyer

Dear CRNAs,

My name is Hunter Niemeyer, and I am a second year SRNA at Goldfarb School of Nursing at Barnes-Jewish College. I am seeking involvement in my DNP project entitled, "Addressing the Gaps: Pain Management, Multimodal Analgesia, and CRNA Education."

In short, I am assessing the knowledge and attitudes toward acute pain management and multimodal analgesic use in the operating room. This project involves your participation in a pre-recorded virtual educational session and the completion of pre- and post-surveys.

If you are interested, please add your name to the attached spreadsheet; you may also contact me directly at [huntern@wustl.edu](mailto:huntern@wustl.edu) or (618) 317-4774.

Your involvement is much appreciated!

Thank you,

Hunter Niemeyer

## Addressing the Gaps: Pain Management, Multimodal Analgesia, and CRNA Education

Seeking CRNAs for participation  
in DNP research!

Will require attendance to virtual  
educational session and  
completion of pre- and post-  
surveys.



**If interested, contact  
Hunter Niemeyer, SRNA at  
huntern@wustl.edu or  
(618) 317-4774**



## Appendix E

**PRE/POST-SURVEY (DAY OF INTERVENTION)**

Addressing the Gaps: Pain Management, Multimodal Analgesia, and CRNA  
Education

**PART ONE: DEMOGRAPHICS**

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Please enter the first three letters of your **MIDDLE NAME** and the last two digits of your **BIRTH YEAR** (ex. MAR85). This is for survey pairing purposes only. \_\_\_\_\_

**1. Which category represents your age?**

- 18-25       26-35       36-45       46-55       56-64       65+

**2. How do you identify your gender?**

- Male       Female       Non-binary/third gender       Prefer not to say

**3. Which of the following best describes you?**

- White/Caucasian       Black/African American       Hispanic/Latino  
 Asian/Pacific Islander       Native American       Prefer not to say

**4. How many years have you practiced as a CRNA?**

- 0-3 years       4-6 years       7-10 years       11-14 years  
 15-19 years       20+ years

**5. What is your highest level of education as a CRNA?**

- Certificate       Bachelor's       Master's       Doctorate

## **PART TWO: TEST**

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- 1. What percentage of patients experience chronic opioid use after surgery?**
  - a. 4%
  - b. 6%
  - c. 10%
  - d. 12%
  
- 2. Postoperative pain may be reduced by administering opioids with each of the following EXCEPT:**
  - a. Ketorolac (Toradol)
  - b. Magnesium sulfate
  - c. Calcium chloride
  - d. Gabapentin (Neurontin)
  
- 3. Clinical effects of non-steroidal anti-inflammatory drugs (NSAIDs) are due to their inhibition of what chemical synthesis in the body?**
  - a. Prostaglandin
  - b. Corticosteroid
  - c. Progesterone
  - d. Adrenocorticotrophic hormone (ACTH)
  
- 4. Which of the following is a nonopioid known for providing both analgesic and sedative effects?**
  - a. Magnesium sulfate
  - b. Acetaminophen (Tylenol)
  - c. Dexmedetomidine (Precedex)
  - d. Ketorolac (Toradol)
  
- 5. Corticosteroids act as powerful agents in pain management when used for their \_\_\_\_\_ effects.**
  - a. Anti-oxidant
  - b. Anti-emetic

- c. Anti-cholinergic
  - d. Anti-inflammatory
- 6. Which of the following intraoperative approaches would allow for improved recovery in the postoperative period?**
- a. The use of long-acting medications for both induction and post-operative pain control
  - b. The sole use of nonopioid analgesics
  - c. Short-acting opioids and opioid sparing multimodal analgesic agents
  - d. The sole use of opioid analgesics
- 7. Ketamine (0.25-0.5 mg/kg) works to prevent pain and central sensitization by which mechanism of action?**
- a. Peripherally mediated pathways
  - b. NMDA receptor antagonism
  - c. COX-2 enzyme inhibition
  - d. Opioid ( $\mu$ ) receptor agonist
- 8. Although beneficial, spinals and epidurals containing local anesthetics are not considered a form of “multimodal analgesia.”**
- a. True
  - b. False
- 9. Ketorolac (Toradol), 30 mg, produces equivalent analgesia to:**
- a. Fentanyl, 25 mcg
  - b. Morphine, 10 mg
  - c. Ketamine, 30 mg
  - d. Magnesium sulfate, 4 g
- 10. Characteristic of gabapentin (Neurontin) include each of the following EXCEPT:**
- a. Targets calcium channels and is useful in treating both operative and neuropathic pain
  - b. A normal dose is 300-600 mg PO (TID)
  - c. It is particularly effective when used in combination with other multimodal agents
  - d. No caution should be taken if administered to renal or geriatric patients

## PART THREE: SURVEY

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Please rank these statements accordingly.

**1. I always incorporate multimodal analgesia into my practice.**

*Strongly Disagree   Somewhat disagree   Neutral   Somewhat agree   Strongly Agree*

**2. I feel supported by collaborating anesthesiologists and CRNAs when incorporating multimodal analgesia into my practice.**

*Strongly Disagree   Somewhat disagree   Neutral   Somewhat agree   Strongly Agree*

**3. I feel supported by this institution when incorporating multimodal analgesia into my practice.**

*Strongly Disagree   Somewhat disagree   Neutral   Somewhat agree   Strongly Agree*

**4. I believe there are clear institutional guidelines that outline the indications for and utilization of multimodal analgesia.**

*Strongly Disagree   Somewhat disagree   Neutral   Somewhat agree   Strongly Agree*

**5. Have you ever received continuing education units (CEUs) related to multimodal analgesia and evidence-based pain management practices?**

- a. Never
- b. Yes, within the last 2 years
- c. Yes, more than 2 years ago

**6. What (if any) barriers limit your utilization of multimodal analgesia?**

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## POST-SURVEY (AT TWO WEEKS)

Addressing the Gaps: Pain Management, Multimodal Analgesia, and CRNA Education

Please complete this survey to the best of your ability. All information will be kept confidential. Any questions or concerns can be communicated to Hunter Niemeyer (huntern@wustl.edu). Thank you for your time and participation!

### PART ONE: SURVEY

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Please enter the first three letters of your MIDDLE NAME and the last two digits of your BIRTH YEAR (ex. MAR85). This is for survey pairing purposes only. \_\_\_\_\_

Answer the following questions by circling the most appropriate answer:

1. I always incorporate multimodal analgesia into my practice.

*Strongly Disagree   Somewhat disagree   Neutral   Somewhat agree   Strongly Agree*

2. I feel supported by collaborating anesthesiologists and CRNAs when incorporating multimodal analgesia into my practice.

*Strongly Disagree   Somewhat disagree   Neutral   Somewhat agree   Strongly Agree*

3. I feel supported by this institution when incorporating multimodal analgesia into my practice.

*Strongly Disagree   Somewhat disagree   Neutral   Somewhat agree   Strongly Agree*

4. I believe there are clear institutional guidelines that outline the indications for and utilization of multimodal analgesia.

*Strongly Disagree   Somewhat disagree   Neutral   Somewhat agree   Strongly Agree*

5. Since participating in the educational session on multimodal analgesia, I find myself incorporating more multimodal analgesia into my practice.

*Strongly Disagree   Somewhat disagree   Neutral   Somewhat agree   Strongly Agree*

6. Since participating in the educational session on multimodal analgesia, I find myself using less opioids.

*Strongly Disagree   Somewhat disagree   Neutral   Somewhat agree   Strongly Agree*

**7. Since participating in the educational session on multimodal analgesia, I feel that my patients have experienced improved outcomes.**

*Strongly Disagree   Somewhat disagree   Neutral   Somewhat agree   Strongly Agree*

**8. Have you noticed additional barriers that limite your utilization of multimodal analgesia?**

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## Appendix F

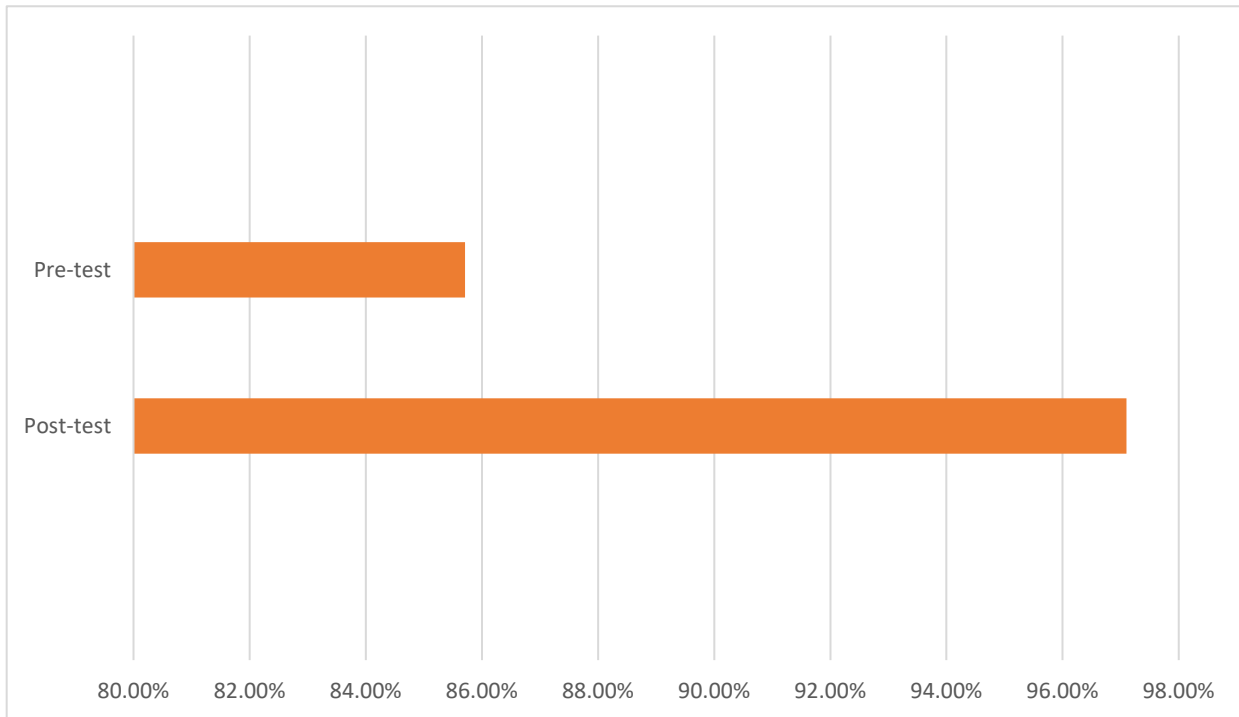
### Project Timeline

	September 2021	October 2021	November 2021	December 2021	January 2022	February 2022	March 2022	April 2022
Recruitment of eligible participants	X	X						
Educational session, pre- and post-survey implementation		X						
Re- implementation of post-survey			X					
Analysis of data		X	X	X	X			
Results finalized and/or presented						X	X	X

### Appendix G

Figure 1

*Test Score Percentages*





## Appendix H

Figure 2

*Pre-intervention Statement Rankings*

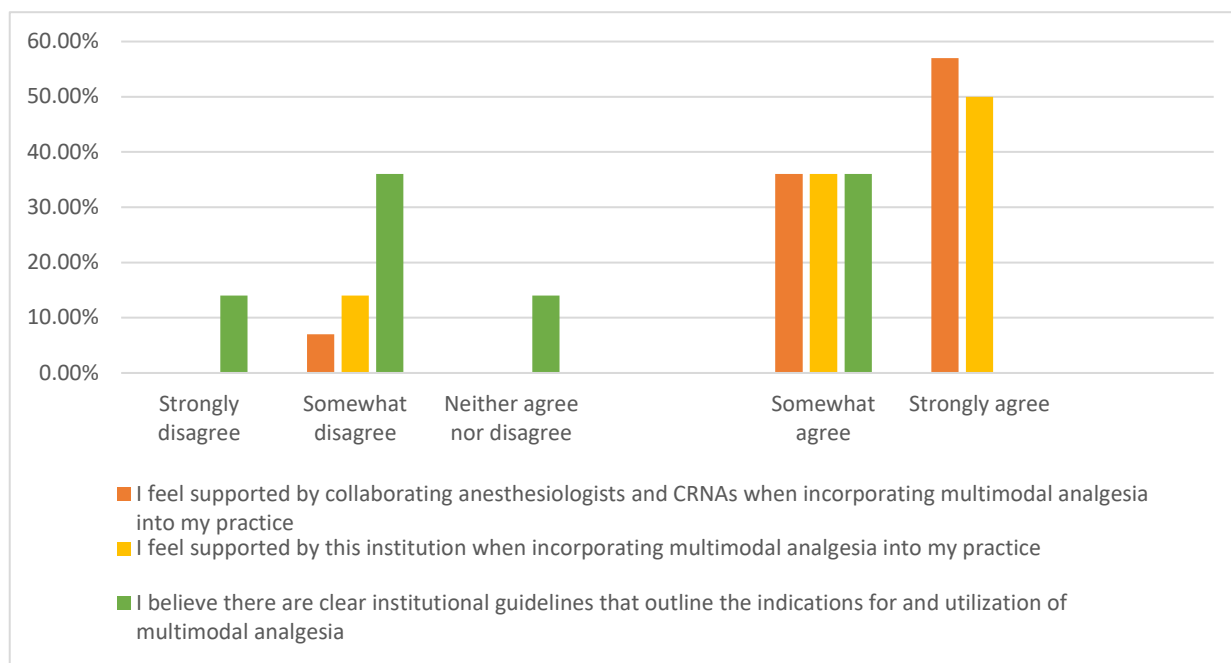
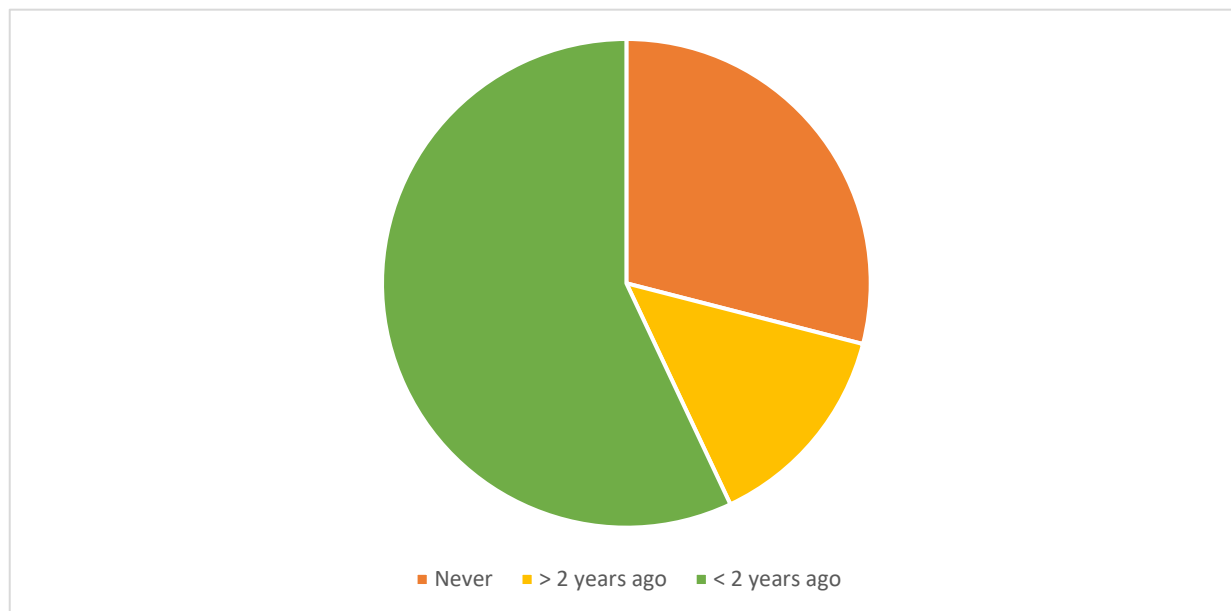


Figure 3

*Percentage of CRNAs Receiving Continuing Education on Multimodal Analgesia*



### Appendix I

Figure 4

*Response to Statement, “I Always Incorporate Multimodal Analgesia into My Practice”*

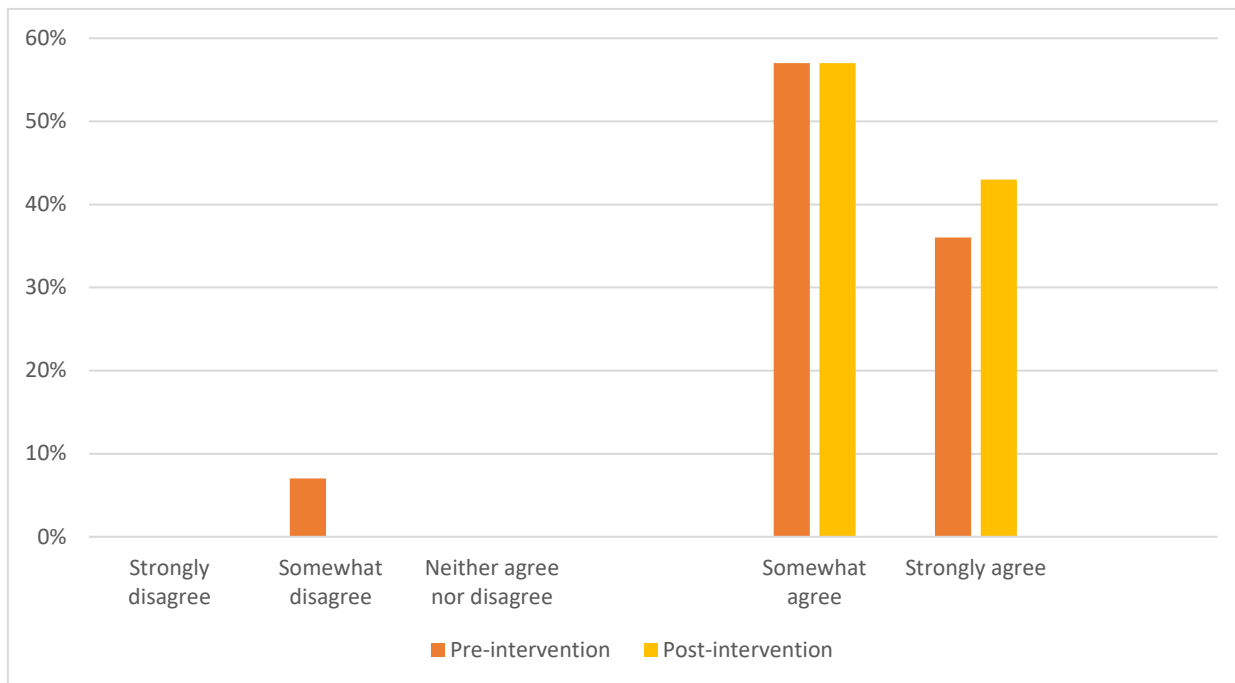


Figure 5

*Post-intervention Statement Rankings*

