# SCHOLARLY PROJECT: SUGAMMADEX AND HORMONAL BIRTH CONTROL EDUCATION

By
Justice Edmond

A doctoral scholarly project submitted to the faculty of
The University of North Carolina at Charlotte
in partial fulfillment of the requirements
for the degree of Doctor of Nursing Practice

Charlotte
2023

Approved by:

_____
Lufei Young PhD, ACNP-BC

_____
Zhuo Job Chen, PhD

_____
Danielle Brown DNAP, CRNA

_____
Scott Strassels, PharmD, PhD

_____
Crystal Piper, PhD

©2023
Justice Edmond
ALL RIGHTS RESERVED

ABSTRACT

JUSTICE EDMOND. Scholarly Project: Sugammadex and Hormonal Birth Control Education (Under the Direction of DR. LUFEI YOUNG, PH.D.,ACNP-BC)

**Background**

Sugammadex is a useful reversal agent of neuromuscular blockade during surgery. However, its interaction with hormonal contraceptives could lead to undesirable outcomes in surgical patients using birth control pills. PACU nurses are responsible for patient education related to the interaction between Sugammadex and hormonal contraceptives. The feasibility and effectiveness of web-based education targeting post-anesthesia care unit (PACU) nurses is limited.

**Purpose**

The purpose of the project is to examine the effect of a web-based education on PACU nurses' awareness and knowledge about the interaction between Sugammadex and hormonal contraceptives.

**Methods**

A quantitative, quasi-experimental, pre-/post-test design study was conducted among PACU nurses who work at a healthcare facility located in the southeast region of the United States. An online survey was used to investigate the effect of web-based education on PACU nurses' knowledge about the interaction between Sugammadex and hormonal contraceptives.

**Results**

27 PACU nurses were included in the study, their years of experience ranged from 0 to 26 years ($4.43 \pm 6.65$). There was a significant pretest-posttest difference on Question 1 (the mechanism of action of Sugammadex) ($\chi 2\ (1) = 6.22$, $p = .013$). After the educational intervention, the average number of correct answers increased from $4.00 \pm 0.87$ to $4.70 \pm 0.54$ ($t = 3.99$, $p < .001$).

## Conclusion

The web-based education was effective in improving PACU nurses' knowledge of drug interactions. This finding may contribute to the development of a standardized online education program for PACU nurses, enhancing their skills and competence in providing patient education on anesthetic agents.

# ACKNOWLEDGEMENTS

I want to formally thank everyone who played an important role in the success of this project. I want to begin by expressing my gratitude to Dr. Lufei Young who has made this long journey so pleasant with her continued support and dedication. Dr. Zhou Chen, I want to give a special thank you to you for your dedication, knowledge, and expertise. Next, I would like to send a thank you to all other members of my committee: Dr. Scott Strassels, Dr. Daniel Brown and Dr. Crystal Piper. The support, suggestions, and input from all committee members were greatly appreciated. Last, but certainly not least, I would like to thank my group members Ashley Burch and Madison Gallo for their hard work and collaboration.

# DEDICATION

This paper is dedicated to all my family and friends who have supported me throughout my entire academic career. Specifically, I want to dedicate this to my mother, Justine Hale. All that I am I owe to my mother; I couldn't have done any of this without you. My mother has been by my side and given me much needed strength throughout this long difficult journey. To my family, if I could name all of you specifically I certainly would, but I want to thank every one of you for supporting me, believing in me, and giving me the courage to finish strong. Finally, I want to dedicate this project to my father, Charles Edmond, I love you and you are greatly missed.

TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# LIST OF ABBREVIATIONS

| | |
|---|---|
| CRNA | Certified Registered Nurse Anesthetist |
| FDA | Federal Drug Administration |
| HIPPA | Health Insurance Portability and Accountability Act |
| PACU | Post Anesthesia Care Unit |
| QI | Quality Improvement |
| QR | Quick Response |
| SD | Standard Deviation |
| SPO | Structure Process Outcome |

# SECTION I: INTROCUDTION

## 1.1 Background

Sugammadex is a drug that provides a rapid and dose-dependent reversal of profound neuromuscular blockade. More specifically, Sugammadex is a cyclodextrin that binds selectively to the steroidal neuromuscular blocking agents where it encapsulates and inactivates the neuromuscular blocking agent in the plasma, rendering it incapable of binding with receptors. Sugammadex is the most ideal reversal agent on the market right now due to its ability to reverse any depth of neuromuscular blockade. Dubovoy et al. (2020) developed a retrospective observational study conducted across 24 institutions in the United States to discover the prevalence of Sugammadex use. Researchers discovered that out of 934,798 cases that received a neuromuscular blocking agent, an average of 40% of the cases were administered Sugammadex Dubovoy et al. (2020).

Sugammadex is a highly effective neuromuscular blocking reversal agent, but it has one very important drug-drug interaction: hormonal contraception. Similar to the effects Sugammadex has on neuromuscular blocking agents, it also binds progesterone with a strong affinity and may reduce the efficacy of hormonal contraceptives. According to Hartman et al. (2019), "this interaction binds the prostagenic compound found in many hormonal contraceptives, decreasing the plasma level of progesterone" (p. 352). Richardson and Raymond (2020) state "studies indicate that Sugammadex binds progesterone, thereby reducing hormone levels to an extent that is equivalent to missing doses of oral contraceptives" (p. 1632). The FDA label for Sugammadex contains a warning, advising that women taking hormonal contraception use a back-up contraceptive method or abstinence for seven days after exposure to Sugammadex. According to Daniels and Abma (2018), approximately 26% of women aged 15 to 49 use

hormonal birth control and, “the most common contraceptive methods currently being used were female sterilization (18.6%), oral contraceptive pill (12.6%), long-acting reversible contraceptives (10.3%), and male condoms (8.7%)” (p. 2). Unfortunately most women undergoing surgery are not orally informed about the side effects of Sugammadex, Lazorwitz et al. (2019) conducted a retrospective chart review at the University of Colorado Hospital and found the following:

> Where out of 1000 charts reviewed, 134 were found to be women utilizing hormonal contraception at the time of Sugammadex exposure. After review of the documentation, it was revealed that only one patient received counseling. They also found one patient who did not receive education regarding Sugammadex endured an unintended pregnancy within three months of Sugammadex administration (p. 296).

Unintended pregnancy can have serious health consequences to the mother and the baby. These health risks include low birthweight, increased risk of postpartum depression, and physical or psychological abuse. “Up to half of women who experience pregnancy due to contraception failure opt for termination” (Richardson & Raymond, 2020, p. 1633). Pregnancy termination may be accompanied by psychological discomfort, depression, and posttraumatic stress disorder in addition to facing escalating access difficulties (Richardson & Raymond, 2020).

Approximately 37% of pregnancies resulting in live births in the U.S. are unintended (Mosher et al., 2012). The effects of an unintended pregnancy, if carried to term, on one's health, finances, and relationships are also significant (Richardson & Raymond, 2020). According to the World Health Organization (2019), “globally, 74 million women living in low and middle-income countries have unintended pregnancies annually. This leads to 25 million unsafe abortions and 47,000 maternal deaths every year.” According to The Commonwealth Fund,

maternal morbidity conditions such as hypertensive disorders, hemorrhage, gestational diabetes mellitus, and mental health conditions cost around 32.3 billion dollars from conception through age five, with the healthcare system enduring over half of these costs (O'Neil et al., 2021). Monea and Thomas (2011) state "taxpayers financed a total of about 1.25 million unintended pregnancies in 2001 and that the average cost per publicly financed unintended pregnancy ranges from about $7,700 to about $10,000" (p. 90).

### 1.2 Problem Statement

Women of childbearing age who receive Sugammadex perioperatively are not receiving proper education about the need for secondary birth control for up to seven days postoperatively. One of the reasons patients do not receive proper medication education is the lack of knowledge, competency, and confidence in post-anesthesia care unit (PACU) nurses when it comes to providing patient medication education (Dahlberg et al, 2022). Unintended pregnancies may occur in women of reproductive age who receive Sugammadex during the perioperative period and who are not properly informed about the need for supplemental birth control for up to seven days after the procedure. At the study site, there were no standardized or evidence based guidelines specifying nursing education regarding the delivery of discharge instructions about Sugammadex drug interactions.

### 1.3 Purpose

The purpose of this project is to examine the effectiveness of a web-based provider education program on PACU nurses' knowledge about the drug-drug interaction between Sugammadex and hormonal contraception. The project highlights the need for a standardized web-based education program centered around Sugammadex and its adverse effects on

hormonal contraceptives. Empowering nurses with proper education can lead to accurate dissemination of discharge teachingand ultimately promotes positive patient outcomes.

### 1.4 Clinical Question

Compared to current nursing education (C), is a web-based education program (I) more effective at improving knowledge (O) on the drug-drug interaction between Sugammadex and hormonal contraception in PACU (T) nurses (P) who are providing Sugammadex discharge teaching for childbearing age women?

## SECTION II: LITURATURE REVIEW

### 2.1 Existing Guideline and Education Program

While it seems intuitive to educate patients and nurses about the risks of pregnancy after receiving Sugammadex, there is a lack of a formalized process to address the issue of effective postoperative discharge teaching regarding Sugammadex and hormonal birth control. We found three articles in current literature suggesting an education program designed to improve nurses' knowledge and counseling rate regarding drug-drug interactions with hormonal contraceptives (Hartman et. al., 2021; O'Driscoll & Parrott 2019; David et al., 2023). In a performance improvement project conducted at a Naval Hospital the investigators looked at the efficacy of an interactive education program to improve knowledge and confidence among perianesthesia nurses; after education was provided, they found a significant increase in confidence scores among the participants (O'Driscoll & Parrott, 2019). Hartman et al. (2021) found similar results in their study of 59 post anesthesia care unit (PACU) nurses at a tertiary hospital. David et al. (2019) conducted a similar study with a different drug that affects hormonal contraception, Aprepitant (Emend), and found a significant increase in nursing knowledge after implementing an educational in-service.

The results of these studies indicate that delivering a standardized educational program may enhance the PACU nurses' capacity to communicate important details regarding drug-drug interactions such as the requirement that patients utilize a supplementary method of birth control. After expanding our search to find education programs designed to teach nursing staff about drug interactions with contraceptives, it was unsuccessful. This suggests a gap in the literature and a need for the implementation of a standardized process aimed at increasing nurses' knowledge regarding drug-drug interactions.

### 2.2 Evaluation of Effectiveness

Researchers implemented a pre and posttest design to assess knowledge improvement among PACU nurses (Hartman et. al., 2021; O'Driscoll & Parrott 2019; David et al., 2023). The questions were the same for the pretest and posttest. All studies performed immediate posttest following a face-to-face educational in-service and subsequent posttest to assess for long-term learning. O'Driscoll and Parrott (2019) performed their subsequent posttest 2 weeks following education in contrast to David et al. (2023) who performed theirs 90 days after education. The longest duration between education and subsequent post testing was performed by Hartman et al. (2021) at 30 weeks. O'Driscoll and Parrott (2019) and David et al. (2023) employed a multiple- choice format with five questions via paper format and seven questions sent out via email, respectively. In contrast, Hartman et al. (2021) developed a five question 5-point Likert scale to assess nursing knowledge via email. All of the studies showed increased scores on the posttests as compared to the pretests. Utilizing the pretest-posttest design, researchers were able to conclude that educational in-services empower PACU nurses with the knowledge and confidence to provide effective discharge teaching. The addition of subsequent post testing further proved the longevity of the educational sessions.

### 2.3 Effectiveness of Web-based Programs

Technology advancements like web-based education have improved nurses' ability to learn new information by offering engaging content in a flexible setting. The abundance of computer-facilitated learning alternatives suggests that nurses are becoming more interested in this type of learning. Berger et al. (2009) conducted a study in which they gave the participants the choice between a web-based format versus a face-to-face format, and, out of 1661 participants, 1544 chose the web-based training style. In addition, learner's enjoyment of the

material is essential to their participation and motivation of learning new concepts. Several studies found that learners who participated in web-based continuing education conveyed satisfaction with the educational format (Harris et al., 2022; Moattari et al., 2014; Berger et al., 2009). In a study involving around 6,000 participants, over 80% indicated satisfaction with the web-based training (Harris et al., 2022). Likewise, a Quasi-experimental research study was performed across 5 teaching hospitals and discovered similar satisfaction rates among participants in regard to the web-based training format at over 80% (Moattari et al., 2014). Berger et al. (2009) questioned participants on their satisfaction with the web-based training and the results were 72% of participants indicated that they were satisfied. However, Rosvall and Carlson, (2017) and Bond et al. (2017) experienced criticism from their participants noting a lack of face-to-face interaction with colleagues and received suggestions for combining both formats for the best educational experience.

Not only are web-based programs favored for their flexibility, they are also a cost-effective alternative to traditional face-to-face learning. Multiple studies have shown that web-based programs offer a beneficial alternative to classroom teaching (Berger et al., 2009; Rosvall & Carlson, 2017; Lim & Yeojin, 2021). Due to the large number of nurses needing continuing education, Berger et al. (2009) found that web-based training was the most cost-effective method. Utilizing a convergent mixed-method design, Rosvall and Carlson (2017) also discovered that educating large groups through web-based training is the most flexible and cost-effective strategy. Researchers also found that "learning in digital environments allows the individual to study at his/her own pace since the educational material is available 24 hours a day" (Rosvall & Carlson, 2017, p. 4778). In a randomized control trial conducted across three hospitals, Lim and Yeojin (2021) found "unlike offline training, web-based education has the

advantages of greater accessibility and self-directed repetitive learning without limitations regarding time and place" (p. 2). Web-based learning offers many advantages to learners and facilities and is seen as an effective means of education.

Reaching the target audience effectively is vital to assure their competency so they can deliver patient-centered care. Liaw et al. (2016) found that the knowledge and abilities of hospital nurses in assessing, managing, and reporting were dramatically improved by a web-based educational program. A number of studies found that in comparison to face-to-face learning, web-based learning was just as effective (Berger et al., 2019; Lahti et al., 2014). Berger et al. (2019) discovered that "the achievement of learning objectives with web-based instruction has been reported to be similar with that of traditional face-to-face instruction for equivalent participants" (p. 128). Lahti et al. (2014) found that there were no statistically significant differences between the web-based learning participants and the face-to-face learning participants in terms of comprehension. Nursing comprehension is the first step in ensuring effective patient comprehension of discharge teaching.

**2.4 Development and Implementation of Patient Education**

There are barriers preventing patients from understanding the side effects of Sugammadex. One obstacle is the timing of discharge teaching. According to Hartman et al. (2021), anesthesia providers do not know if Sugammadex will be given until the time of surgery which leads to inconsistency in discharge teaching to women of childbearing age. Patients receive many medications throughout the perioperative time which leads to unpredictable recall. Hospitals are challenged to determine when teaching is most effective and at what point of the perioperative continuum should these patients receive this vital information. "Current recommendations are to wait up to two hours after the end of anesthesia

to deliver discharge instructions and that verbal instructions should be supplemented with written instructions" (Hartman et al., 2021, p. 352).

Given the various degrees of health literacy among patients and caregivers, understanding discharge instructions is a crucial factor to take into account. DeSai et al. (2021) states, "studies have shown that approximately one-third of Americans have low health literacy" (p. 1). A patient's health literacy can determine whether or not they are compliant with discharge instructions. In this instance, non-compliance can lead to adverse events, such as pregnancy. There have been many studies aimed at uncovering effective discharge teaching strategies. Implementing standardized discharge processes that focus on nurse's expertise in the delivery of postoperative teaching is important for patient retention.

One method that has been supported by substantial evidence is the teach back method. This approach involves asking patients to rephrase teaching material previously discussed in an effort to determine adequacy of teaching. This method has been shown to significantly increase patient comprehension, validate information, and enhance health outcomes (Nurhayati et al., 2019; Hartman et al., 2021). In addition to the teach back method, written instructions are a great supplement and resource for patients upon discharge. "The Joint Commission recommends a fifth-grade reading level for all health care documents" (Hartman et al., 2021, p. 352). Simplicity is a crucial component in enhancing comprehension of discharge materials. In order to categorize discharge instructions, simplification is characterized as using shorter sentences, simpler terms, bullet points, and bolded font (Choudhry et al., 2019). Simplifying discharge instructions, eliminating medical jargon, and utilizing the teach back method are all effective strategies for increasing patient comprehension and ultimately decreasing the risk of adverse events.

## 2.5 Theoretical Framework

Donabedian's quality framework, also known as Structure-Process-Outcome (SPO), was used to guide this quality improvement project. The SPO model has been widely utilized in healthcare quality research for six decades (Ayanian & Markel, 2016). This model is flexible and comprehensive enough to be applied in various healthcare organizations. It consists of three interrelated concepts. First, the structures of healthcare are defined as the physical and organizational aspects of care settings. Second, the processes of patient care are positioned in the middle of the model because they rely on the structures to provide resources and mechanisms for healthcare providers to carry out patient care activities. The third concept, on the far right, is the outcomes of patient care.

In the context of this project, the 'structure' referred to the tertiary acute care hospital surgical unit selected for this study. The 'process' involved developing and implementing a web-based education program on the drug-drug interaction between Sugammadex and hormonal contraceptives. Therefore, the specific 'outcome' was the increased nursing knowledge (see Appendix A). Patient outcomes depend on the quality of care delivered to the patients. Discharge teaching plays a vital role in providing high-quality care to surgical patients. It is reported that the frequency and quality of discharge mediation teaching are significantly associated with the knowledge and competency of PACU nurses regarding drug information (Hayajneh, Hweidi, & Abu Dieh, 2020). To improve patient outcomes, an online education program was developed to enhance PACU nurses' knowledge, competency, and confidence in providing accurate, evidence-based, and patient-centered discharge drug education.

# SECTION III: METHODOLOGY

## 3.1 Study Design

A quantitative, quasi-experimental project was conducted using a pretest posttest design. The project included 3 phases: 1) pre-education survey, 2) web-based education session, and 3) post-education survey. The purpose of this project was to examine the effectiveness of a web-based provider education program on PACU nurses' knowledge regarding the drug-drug interaction between Sugammadex and hormonal contraception. The project investigated the following PICOT question: Compared to current nursing education (C), is a web-based education program (I) more effective at improving knowledge about the drug-drug interaction between Sugammadex and hormonal contraception (O) in PACU (T) nurses who provide discharge teaching for childbearing age women receiving Sugammadex (P)? The scores on pre- and post-education tests were compared to assess intervention effect. SQUIRE 2.0 guidelines were used to organize and report the project findings (Ogrinc et al, 2016). Institutional Review Boards (IRB) approvals were obtained from both the study site and the university prior to the implementation of the project (Appendix B and Appendix C for both IRB approval letters).

## 3.2 Sample/Population

The study used a convenience sample that consisted of approximately 30 PACU nurses at a tertiary acute care hospital. The reason PACU nurses were chosen as the study participants was because PACU nurses are the primary providers of patient education at discharge. It is suggested that increasing knowledge among PACU nurses about the drug interaction of Sugammadex might lead to a higher quality and frequency of patient education on drug interactions prior to discharge. This, in turn, could potentially reduce preventable birth control failures due to a lack of awareness about the need for a secondary form of birth control for up to seven days after the

administration of Sugammadex. The study included PACU registered nurses with any amount of experience at the facility working full or part time in the adult PACU. The study excluded registered nurses employed in the pediatric PACU and any ancillary staff who were not responsible for patient discharge teaching.

### 3.3 Setting

This project was implemented at a tertiary acute care hospital. The facility has 185 beds and 17 operating rooms. They provide approximately 60 anesthetics per day. This facility's PACU consists of 20 beds. The facility focuses on women's pelvic health, bariatric surgery, foot and ankle surgery, hip and knee surgery, and geriatric care. This facility was chosen based on the patient population and the use of Sugammadex. The hospital utilized Sugammadex in female patients between the ages of 18-65 approximately 970 times per year..

### 3.4 Interventions

For the web-based education, an animated educational video was designed. The website Animaker (2015) was used to create the animated educational video. Animaker is a video animation software that utilizes fully customizable characters and templates that users can produce animated videos with. Once the animated educational video was created it was embedded into Survey Monkey. The video began with an introduction to Sugammadex, followed by Sugammadex's mechanism of action, side effects, drug-drug interactions, and patient teaching recommendations. The video consisted of sound and subtitles to accommodate different learning styles. The content validity of the education intervention was established by the dissertation committee member who was a licensed pharmacist with doctoral level education and extensive teaching experience, as well as Certified Registered Nurse Anesthetist (CRNA) faculties. The video was available in English. It took participants approximately five minutes to complete.

Participants accessed the video via a quick response (QR) code with a smartphone device. Participants were given six weeks to access the educational session.

The following strategies were used to enhance and maintain the intervention fidelity. For study design, a clear and detailed intervention protocol was developed that outlined specific education components and expected outcomes. Standardized education materials that align with the intervention protocol were developed. To improve the intervention fidelity, all team members participated in developing online surveys and web-based education modules. To ensure the delivery and receipt, the average time spent on completing the online education modules was regularly monitored and scheduled team meetings were used to identify and troubleshoot any challenges encountered by the participants in completing the online learning module. Emails were sent to encourage active participation and completion and provided guidance on how to access the web-based learning module. The emails also identified areas that needed further clarification. For enactment, the online animated video encouraged participants to apply the knowledge and skills they gained into their clinical practice. By addressing each of these components in the design, training, delivery, receipt, and enactment stages of the educational intervention, the intervention fidelity was improved, ensuring that the intervention was implemented as intended and produced meaningful outcomes.

**3.5 Data Collection**

Both pre- and post-education surveys were constructed to collect participants' clinical and demographic information including gender, age, years of experience, and educational background. The subsequent portion of both surveys comprised five questions to assess PACU nurses' knowledge of Sugammadex, its effects on hormonal contraception, and their current practice in proving Sugammadex related discharge teaching. One question was in yes or no

format, whereas the other four questions were multiple choice format (See Appendix D). A scoring system was utilized to quantitatively measure the survey responses. All surveys were scored the same. A correct answer was given a one and an incorrect answer was given a zero. The content validity of the surveys were confirmed by all committee members and CRNAs before being distributed. The pre-education survey was administered among PACU nurses before the education intervention in an effort to assess their baseline knowledge of Sugammadex. Survey Monkey was used to create and administer surveys. The participants users had access to the pre-education survey test by scanning the provided QR code provided. Following the pre-education survey, participants completed self-paced online educational material. Immediately following the educational session, participants were prompted to complete a post-education survey, which was identical to the pre-education survey. The survey results were collected electronically via a QR code that was linked to Survey Monkey website. All responses submitted through Survey Monkey were confidential and collected in real time. Once the data collection period ended, all responses were made anonymous.

To increase participation and completion rates, weekly reminders were sent out. Once a week, an email was sent to the PACU manager providing an update on the project's current participation count. The PACU manager encouraged their staff to participate during the daily huddle sessions. At the study site, there were 30 total PACU nurses. Out of these 30 participants, 27 completed both the pre and posttest. The completion rate was 90% at the study site.

**3.6 Data Management and Security**

The online education module was preset to only show the computer IP address the participants used to complete the learning module. Each participant was assigned a unique study ID, which was used for data entry, tracking, and analysis. Each participants' ID was stored in a

secured, IRB approved web-based folder. This web-based folder was password protected and only accessible by the project personnel. A consent form was provided to participants prior to completing the module. This consent informed participants that their years of experience and provider role would be used for study purposes. Participants were reassured that their identity remained confidential and secure.

Furthermore, Survey Monkey, an online password protected site, was utilized to store data. Survey Monkey was only accessible to the project personnel, the sponsor of this research, IRB, and any other persons required by law. Both university and the participating healthcare facilities shared a uniform policy on the protection of patient privacy that satisfied all the requirements of the Health Insurance Portability and Accountability Act of 1996 (HIPAA). The project team abided by both organizations' policies, and strictly adhered to the detailed human subject protection regarding data analysis, which was utilized throughout this project period to preserve participants' privacy and security. Participants were provided the option to opt out of participating in the project.

**3.7 Data Analysis/Evaluation**

All statistical analyses were performed using R (version 4.0.2, R Foundation for Statistical Computing, Vienna, Austria) with a significance level of $< 0.05$ (Micheaux et. al, 2013). Pre-analysis data screening was performed prior to statistical analysis to examine coding errors, outliers, and data skewness to determine if any data cleaning procedures were needed. Coding errors often occur when the questionnaires are used as assessment tools. To reduce coding errors, the statistician was consulted, and statistical procedures were used to recode the study questionnaires. Additionally, the missing data caused by unanswered questions was reviewed for patterns that would introduce bias in the result. Participants were asked to go back

and fill out the questionnaires completely. If some data items remained missing, these issues were resolved via consultation with the statistician and major advisor.

Descriptive statistics (means, standard deviations, or median, interquartile range, or number, percentages, and frequencies) were calculated for all variables. Demographic characteristics of the study population were analyzed as means and standard deviations (SD) for continuous variables and as frequencies and percentages for categorical variables. All statistical tests are 2-tailed. The variables were checked for normality and the mean and standard deviation were used as a measure of central tendency since the data are normally distributed.

The $\chi 2$ were performed to describe and compare frequencies. The Student t-test was utilized to test for significant differences between pre and post-survey scores. Pearson's correlation coefficients were used to determine the relationships between key concepts. Univariate and multivariate logistic regression or linear regression analyses were performed to determine the relationships between the pretest and posttest.

**3.8 Timeline**

The project topic was finalized in December 2022. A literature review was conducted in March 2023. The proposal defense was successfully completed in April 2023. Following the proposal defense, approvals from both the clinical site and the university Institutional Review Boards were obtained in July 2023. Data collection and intervention took place in August and the first part of September 2023. Data analysis and report generation were finished at the end of September 2023.

# SECTION IV: RESULTS

## 4.1 Sample Characteristics

A total of twenty-seven individuals participated in this study. All participants were PACU nurses. Among them, 93.3% were female and 6.7% were male. Their age ranged from 23 to 59 years old (M = 35.83, SD = 11.35, Mdn = 30). Their years of experience ranged from 0 to 26 years (M = 4.43, SD = 6.65, Mdn = 2) (see figure 1). In terms of education, 13.3% had an associate degree, 83.3% had a bachelor's degree, and 3.3% had a master's degree (see figure 2).

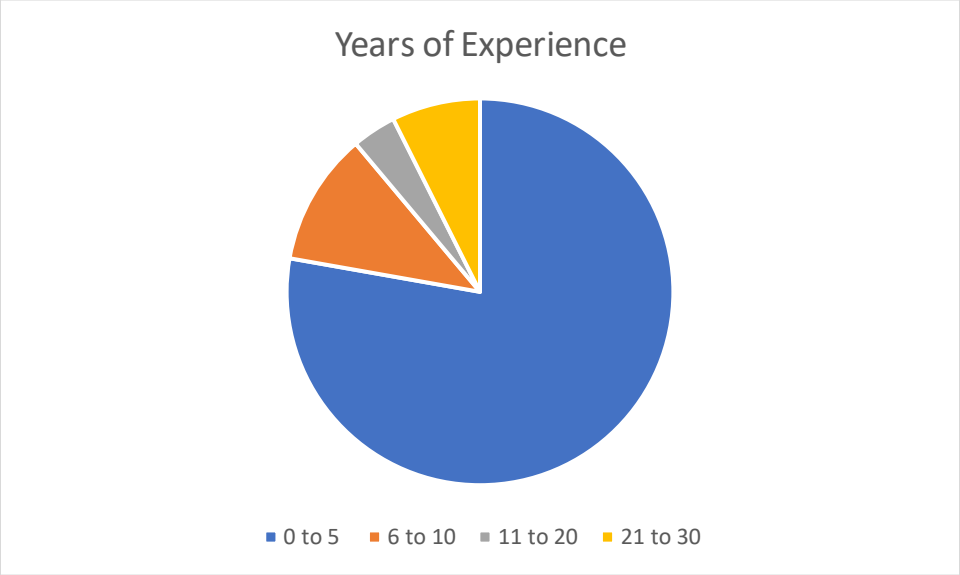



*Figure 1*

Years of Experience Among Participants

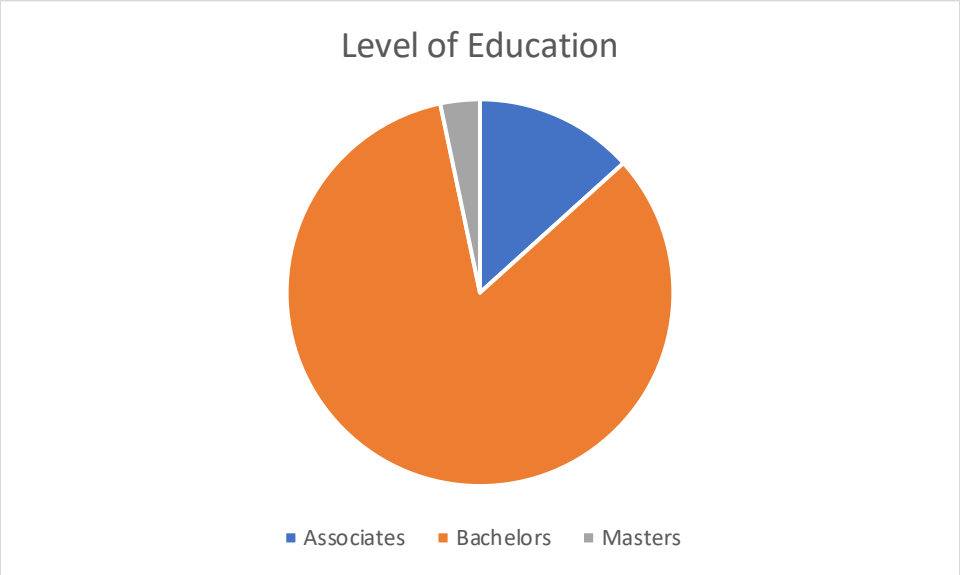



*Figure 2*

Degree Held Among Participants

**4.2 Survey Results**

Table 1

Pre- and Post-Education Survey Comparison

| | Pretest (*n* = 30) % correct | Posttest (*n* = 27) % correct | *p*-value |
|---|---|---|---|
| 1. What is the mechanism of action of Sugammadex? | 70.0 | 81.5 | .486 |
| 2. Which form of birth control does Sugammadex NOT affect? | 80.0 | 92.6 | .325 |
| 3. If given Sugammadex, how long should women of childbearing age use additional birth control for? | 66.7 | 96.3 | .013 |
| 4. How does Sugammadex render hormonal birth control ineffective? | 93.3 | 100 | .519 |
| 5. Do you offer additional discharge teaching about Sugammadex to women of childbearing age? | 90.0 | 100 | .274 |
| **Total score** | 4.00 (0.87) | 4.70 (0.54) | < .001 |

Note. *P*-values for the individual questions were based on chi-squared tests. The p-value for testing total score difference was based on paired t-test.

The percentage of correct responses are listed in Table 1. The first question showed that 30% of participants didn't know the mechanism of action prior to the educational material. The second question showed an insignificant improvement in knowledge between the pre and post survey. The third item showed a significant improvement in knowledge about the duration additional birth control should be used following exposure to Sugammadex ($p = .013$). Overall, the average number of correct answers increased from 4.00 (SD = 0.87) to 4.70 (SD = 0.54), $t = 3.99$, $p < .001$. Table 1 presents the percentage of correct answers for each question.

# SECTION V: DISCUSSION

## 5.1 Summary

This QI project was the first reported project that examined the effect of a web-based education module on PACU nurses' knowledge regarding the drug-drug interaction between Sugammadex and hormonal contraception. Despite the FDA label for the warning of drug-drug interaction between Sugammadex and hormonal contraceptives, less than 1% of women using hormonal contraception received appropriate education regarding this interaction (Devov et al., 2023; Lazorwitz et al., 2020). Without proper education, the unwanted pregnancies may occur in female patients taking combined oral contraceptive pills and Sugammadex. One of the reasons patients do not receive proper medication education is the lack of knowledge, competency, and confidence in nurses who are responsible to provide patient medication education (Bowen el al, 2017). To improve quality and frequency of patient medication education, we conducted this project aimed to examine the effectiveness of a web-based provider education program on PACU nurses' knowledge about the drug-drug interaction between Sugammadex and hormonal contraception. The main finding showed the web-based education was feasible and effective to enhance PACU nurses' overall knowledge about the drug-drug interaction between Sugammadex and hormonal contraception.

## 5.2 Interpretation

The findings of this project align well with the current literature. The review revealed that web-based learning was found to be successful in teaching health care providers. There were improvements with post test scores following the self-guided educational module. Each question revealed a different suggestion regarding the participants. The first question reveals a knowledge deficit among participants regarding the mechanism of action of Sugammadex. This could

indicate the reason that many nurses fail to provide adequate teaching. The lack of confidence and knowledge could be the reason that nurses don't feel comfortable enough to properly educate patients. This supports the claim that arming providers with adequate knowledge can aid in proper discharge education. Following the additional knowledge there was an increase in participants who offered discharge teaching to their patients. It can be argued that the increase in education to patients was due to proper preparation by the nurses. This also highlights the need for a formalized process for educating nurses who provide discharge teaching.

### 5.3 Strengths

There are many strengths regarding this quality improvement project. There were 27 participants who took the survey from a sample size of 30, yielding a 90% response rate. The study participants range over a variety of ages and educational backgrounds. The variety of the backgrounds of the survey participants proved that the educational intervention was great for all learning styles. The survey identified a knowledge gap among PACU nurses and highlighted the need for Sugammadex education. The survey revealed that wed based education is a successful means of education and can be used in the clinical setting to expand on the PACU nurses knowledge.

### 5.4 Limitations and Challenges

There are several limitations in this project. A pretest-posttest study design was employed. The most significant limitation of this type of design is the lack of a control group, potentially introducing bias and threats from confounding factors. The results may not be generalizable to all healthcare settings, as it was a QI project conducted in one institution. A small convenient sample of PACU nurses from one urban hospital was used, which could affect the validity of the results. The study is limited by measuring the short-term effect of the online

education program. Due to feasibility and time constraints, we were unable to assess the long-term effect of the online education program. There were many successes and difficulties that came with implementing this scholarly project. One difficulty that was faced in the beginning was participation. It took constant reminders from leadership to gain participation and the data collection period had to be extended. Luckily enough at the end of data collection the survey had great participation. Another issue that was encountered was participants starting the survey and not finishing leaving incomplete data. This was unfortunate because incomplete data wasn't used in the results.

**5.5 Implications and Recommendations**

Sugammadex is a widely used medication in the perioperative setting at many hospitals. There is a significant drug-drug interaction between Sugammadex and hormonal contraception. As a result, the FDA even issues a warning about the need for additional birth control for up to seven days after receiving Sugammadex. Otherwise, unwanted pregnancy may occur, emphasizing the necessity of a standardized education program on Sugammadex and its negative effects on hormonal contraceptives. To date, there has been no evidence-based guideline on the best approach and timing to provide patient education about Sugammadex drug interaction. PACU nurses play a crucial role in providing discharge teaching related to Sugammadex drug interaction and reducing the risks of birth control failure. In order to provide accurate medication education, PACU nurses must be knowledgeable, feel competent, and be confident in delivering medication education. This study adds evidence that may help develop and implement a standardized educational session for PACU nurses about Sugammadex drug interaction, thus improving patients' discharge education and preventing negative patient outcomes. This project has also highlighted the need for adequate nurse education regarding different drugs patients may

receive during the perioperative course. To continue with this project, it would be beneficial to increase the sample size and expand the location. The post survey should also include more questions. Long term knowledge is the key to ensure that patients will continue to receive proper discharge teaching. It is recommended that there be a second posttest survey two weeks after initial education to ensure knowledge retention.

## Conclusion

Properly educating patients on drug interactions is an essential part of the post operative education. Ensuring that nurses are equipped with the correct amount of information and education to educate their patients is vital. Empowering nurses with knowledge gives them the needed confidence to effectively educate their patients. A web-based educational program provides the means to educate nurses and has been shown to be effective. In the future there should be an effort to provide standardized teaching for nurses and patients receiving medications with significant drug interactions.

## REFERENCES

Ayanian, J. Z., & Markel, H. (2016). Donabedian's lasting framework for health care quality. The New England journal of medicine, 375(3), 205-207.

Berger, J., Topp, R., Davis, L., Jones, J., & Stewart, L. (2009). Comparison of web-based and face-to-face training concerning patient education within a hospital system. *J Nurses Staff Dev*, *25*(3), 127-132; quiz 133-124. https://doi.org/10.1097/NND.0b013e3181a56ba0

Bond, S. E., Crowther, S. P., Adhikari, S., Chubaty, A. J., Yu, P., Borchard, J. P., Boutlis, C. S., Yeo, W. W., & Miyakis, S. (2017). Design and implementation of a novel web-based e-learning tool for education of health professionals on the antibiotic vancomycin. *J Med Internet Res, 19*(3), e93. https://doi.org/10.2196/jmir.6971

Bowen, J. F., Rotz, M. E., Patterson, B. J., & Sen, S. (2017). Nurses' attitudes and behaviors on patient medication education. Pharmacy Practice (Granada), 15(2).

Choudhry, A. J., Younis, M., Ray-Zack, M. D., Glasgow, A. E., Haddad, N. N., Habermann, E. B., Jenkins, D. H., Heller, S. F., Schiller, H. J., & Zielinski, M. D. (2019). Enhanced readability of discharge summaries decreases provider telephone calls and patient readmissions in the posthospital setting. *Surgery*, *165*(4), 789-794. https://doi.org/10.1016/j.surg.2018.10.014

Dahlberg, K., Sundqvist, A. S., Nilsson, U., & Jaensson, M. (2022). Nurse competence in the post-anesthesia care unit in Sweden: a qualitative study of the nurse's perspective. *BMC nursing*, *21*, 1-12.)

Daniels, K., & Abma, J. C. (2020). Current contraceptive status among women aged 15-49: United states, 2017-2019. *NCHS Data Brief*(388), 1-8.

David, A. C., Pereira, K., Hartman, E., Dear, G., Thompson, J., & Funk, E. (2023). Improving nursing knowledge and patient education about aprepitant's effects on hormonal contraception: A performance improvement project. *Journal of Perianesthesia Nursing*. https://doi.org/https://doi.org/10.1016/j.jopan.2022.09.008

De Micheaux, P. L., Drouilhet, R., & Liquet, B. (2013). The R software. Fundamentals of Programming and Statistical Analysis, 978-1

DeSai, C., Janowiak, K., Secheli, B., Phelps, E., McDonald, S., Reed, G., & Blomkalns, A. (2021). Empowering patients: Simplifying discharge instructions. *BMJ Open Qual, 10*(3). https://doi.org/10.1136/bmjoq-2021-001419

Devoy, T., Hunter, M., & Smith, N. A. (2023). A prospective observational study of the effects of sugammadex on peri-operative oestrogen and progesterone levels in women who take hormonal contraception. Anaesthesia, 78(2), 180-187.

Dubovoy, T. Z., Saager, L., Shah, N. J., Colquhoun, D. A., Mathis, M. R., Kapeles, S., Mentz, G., Kheterpal, S., & Vaughn, M. T. (2020). Utilization patterns of perioperative neuromuscular blockade reversal in the united states: A retrospective observational study from the multicenter perioperative outcomes group. *Anesth Analg, 131*(5), 1510-1519. https://doi.org/10.1213/ane.0000000000005080

Harris, S. B., Idzik, S., Boasso, A., Neunie, S. Q., Noble, A. D., Such, H. E., & Van, J. (2022). The educational impact of web-based, faculty-led continuing medical education programs in type 2 diabetes: A survey study to analyze changes in knowledge, competence, and performance of health care professionals. *JMIR Med Educ, 8*(4), e40520. https://doi.org/10.2196/40520

Hartman, E., Funk, E., Dear, G., Wellman, C., & Pereira, K. (2021). Sugammadex effects on hormonal contraception effectiveness: Implementation of uniform postoperative teaching. *Journal of Perianesthesia Nursing*, *36*(4), 351-358. https://doi.org/10.1016/j.jopan.2020.10.007

Hayajneh, A. A., Hweidi, I. M., & Abu Dieh, M. W. (2020). Nurses' knowledge, perception and practice toward discharge planning in acute care settings: a systematic review. Nursing open, 7(5), 1313-1320.

Lahti, M., Hätönen, H., & Välimäki, M. (2014). Impact of e-learning on nurses' and student nurses knowledge, skills, and satisfaction: A systematic review and meta-analysis. *International Journal of Nursing Studies, 51*(1), 136-149. https://doi.org/https://doi.org/10.1016/j.ijnurstu.2012.12.017

Lazorwitz, A., Dindinger, E., Aguirre, N., & Sheeder, J. (2020). Pre- and post-operative counseling for women on hormonal contraceptives receiving sugammadex at an academic hospital. *Journal of Anesthesia, 34*(2), 294-297. https://doi.org/10.1007/s00540-019-02725-2

Liaw, S. Y., Wong, L. F., Ang, S. B. L., Ho, J. T. Y., Siau, C., & Ang, E. N. K. (2016). Strengthening the afferent limb of rapid response systems: an educational intervention using web-based learning for early recognition and responding to deteriorating patients. *BMJ Quality & Safety, 25*(6), 448-456. https://doi.org/10.1136/bmjqs-2015-004073

Lim, H., & Yi, Y. (2021). Effects of a web-based education program for nurses using medical malpractice cases: A randomized controlled trial. *Nurse Education Today, 104*, 104997. https://doi.org/https://doi.org/10.1016/j.nedt.2021.104997

Moattari, M., Moosavinasab, E., Dabbaghmanesh, M. H., & ZarifSanaiey, N. (2014). Validating a web-based diabetes education program in continuing nursing education: knowledge and competency change and user perceptions on usability and quality. *Journal of Diabetes & Metabolic Disorders, 13*(1), 70. https://doi.org/10.1186/2251-6581-13-70

Mosher, W. D., Jones, J., & Abma, J. C. (2012). Intended and unintended births in the United States: 1982-2010. *Natl Health Stat Report*(55), 1-28.

Nakamura, S., Takeuchi, S., Hoshino, T., Okubo, N., & Horiuchi, S. (2022). Effects of web-based learning for nurses on their care for pregnant women with hiesho (sensitivity of hands or feet to cold): A randomized controlled trial. *Japan Journal of Nursing Science, 19*(4), 1-10. https://doi.org/10.1111/jjns.12490

Nurhayati, N., Songwathana, P., & Vachprasit, R. (2019). The quality of discharge teaching perceived by surgical nurses working in public hospitals of Indonesia. *International Journal of Caring Sciences, 12*(1), 100-106. https://search.ebscohost.com/login.aspx?direct=true&AuthType=shib&db=ccm&AN=136698175&authtype=shib&site=ehost-live&scope=site&custid=s5822979

O'Driscoll, L., & Parrott, J. (2019). Performance-improvement project: Increasing nursing knowledge of the impact of sugammadex in female patients taking steroidal contraceptives. *Journal of Perianesthesia Nursing, 34*(3), 576-586. https://doi.org/https://doi.org/10.1016/j.jopan.2018.10.003

Ogrinc, G., Davies, L., Goodman, D., Batalden, P., Davidoff, F., & Stevens, D. (2016). SQUIRE 2.0—Standards for Quality Improvement Reporting Excellence—revised publication

guidelines from a detailed consensus process. Journal of the American College of Surgeons, 222(3), 317-323

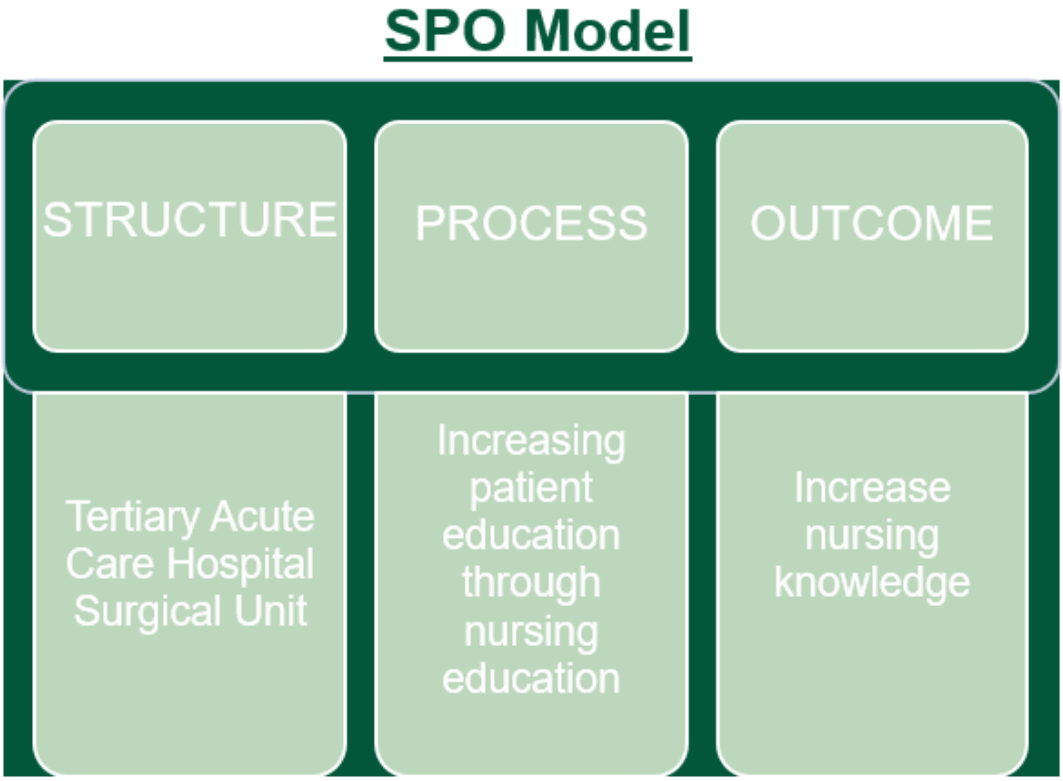
O'Neil, S., Platt, I., Vohra, D., Pendl-Robinson, E., Dehus, E., Zephyrin, L., Zivin K. (2021). The high costs of maternal morbidity show why we need greater investment in maternal health. *The Commonwealth Fund.* https://doi.org/10.26099/nz8s-4708

Richardson, M. G., & Raymond, B. L. (2020). Sugammadex administration in pregnant women and in women of reproductive potential: A narrative review. *Anesthesia and Analgesia, 130*(6), 1628-1637. https://doi.org/10.1213/ANE.0000000000004305

Rosvall, A., & Carlson, E. (2017). Registered nurses' perception of self-efficacy and competence in smoking cessation after participating in a web-based learning activity. *Journal of Clinical Nursing, 26*(23-24), 4777-4785. https://doi.org/https://doi.org/10.1111/jocn.13831

World Health Organization. (2019). *High rates of unintended pregnancies linked to gaps in family planning services: New who study*. World Health Organization. Retrieved October 11, 2022, from https://www.who.int/news/item/25-10-2019-high-rates-of-unintended- pregnancies-linked-to-gaps-in-family-planning-services-new-who-study

**APPENDIX A: SPO MODEL**



## APPENDIX B: UNCC IRB APPROVAL LETTER


**To:**
**From:**
**Approval Date:**
**RE:**
**Exemption Category: Study #:**
**Study Title:**
Ashley Burch
University of North Carolina at Charlotte
Office of Research Protections and Integrity 21-Jul-2023
Notice of Determination of Exemption
1
IRB-24-0008
Sugammadex and Hormonal Birth Control
This submission has been reviewed by the Office of Research Protections and Integrity (ORPI) and was determined to meet the Exempt category cited above under 45 CFR 46.104(d). This determination has no expiration or end date and is not subject to an annual continuing review. However, you are required to obtain approval for all changes to any aspect of this study before they can be implemented and to comply with the Investigator Responsibilities detailed below.

## APPENDIX C: WAKE FOREST IRB APPROVAL LETTER

# MEMORANDUM

**To:** Danielle Brown
Atrium/Carolinas Healthcare System

**From:** Douglas Yoder, Chair
Institutional Review Board

**Date:** 6/22/2023

**Subject:** Exempt Protocol: IRB00097769
Sugammadex and Hormonal Birth Control Education- A Quality Improvement Project

No protected health information will be used or disclosed in this research proposal; therefore the requirement for individual Authorization does not apply.

Note that only the Wake Forest University School of Medicine IRB can make the determination for its investigators that a research study is exempt. Investigators do not have the authority to make an independent determination that research involving human subjects is exempt. Each project requires a separate review and approval or exemption. The Board must be informed of any changes to this project, so that the Board can determine whether it continues to meet the requirements for exemption.

The Wake Forest School of Medicine IRB is duly constituted, has written procedures for initial and continuing review of clinical trials; prepares written minutes of convened meetings, and retains records pertaining to the review and approval process; all in compliance with requirements of FDA regulations 21 CFR Parts 50 and 56, HHS regulations 45 CFR 46, and International Conference on Harmonisation (ICH) E6, Good Clinical Practice (GCP), as applicable. WFSM IRB is registered with OHRP/FDA; our IRB registration numbers are IRB00000212, IRB00002432, IRB00002433, IRB00002434, IRB00008492, IRB00008493, IRB00008494, and IRB00008495.
WFSM IRB has been continually fully accredited by the Association for the Accreditation of Human Research Protection Programs (AAHRPP) since 2011.

## APPENDIX D: SURVERY QUESTIONS

Survey Questions

**Demographic questions:**

1. What is your gender?
    a. Male
    b. Female
    c. Non-binary
2. What is your age?
    a. FILL IN THE BLANK
3. How many years of experience do you have as a PACU nurse at Atrium?
    a. FILL IN THE BLANK
4. What is your educational background?
    a. Associate's degree
    b. Bachelor's degree
    c. Master's degree
    d. Doctorate degree

**Survey Questions:**

1. What is the mechanism of action of Sugammadex?
    a. It opens up sodium channels to allow entrance of sodium into the nerve ending
    b. It adheres to postsynaptic cholinergic receptors of the motor end plate
    c. It encapsulates the steroidal neuromuscular blockers and prevents them from binding to Nicotinic receptors

   d. It noncompetitively binds to the NMDA receptor and blocks the influx of calcium

2. Which form of birth control does Sugammadex NOT affect?
   a. Hormonal Intrauterine device (IUD)
   b. Oral birth control
   c. Nexplanon
   d. Condom
3. If given Sugammadex, how long should women of childbearing age use additional birth control for?
   a. 3 days
   b. 7 days
   c. 24 hours
   d. 28 days
4. How does Sugammadex render hormonal birth control ineffective?
   a. It encapsulates the progesterone and estrogens contained within hormonal birth control
   b. It encapsulates the sodium contained within hormonal birth control
   c. It prevents ovulation
   d. It promotes follicular development.
5. Do you offer additional discharge teaching about Sugammadex to women of childbearing age?
   a. Yes
   b. No