SIMULATION AND SELF-EFFICACY IN THE STUDENT REGISTERED NURSE ANESTHETIST: A QUANTITATIVE, CAUSAL-COMPARATIVE STUDY

by

Joseph Craig Kiesznowski

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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ABSTRACT

The purpose of this quantitative, causal-comparative study was to determine if simulation training causes a significant increase in clinical self-efficacy in Student Registered Nurse Anesthetists. Simulation training in healthcare has been found to improve patient safety and has become a major tenet of nurse anesthetist education. Self-efficacy has been shown to correlate with improved clinical performance. This study builds on the research involving simulation training and clinical self-efficacy in the SRNA population. A convenience sample of SRNAs was taken from 49 different graduate nurse anesthesia programs across 13 different states. The Schwarzer and Jerusalem General Self-efficacy scale was used to measure perceived self-efficacy following simulation training of neuraxial anesthesia and peripheral nerve block administration. Data was collected through a survey from students with one or more sessions of the above simulated experiences prior to performing the technique in clinical, and from students with no simulated experience prior to performing the technique in clinical. Two independent *t* tests conducted showed no significant difference between SRNAs with no neuraxial or peripheral nerve block simulation versus SRNAs with one or more neuraxial or peripheral nerve block simulation sessions. However, the results of this study did indicate lower self-efficacy scores in SRNAs who had no simulation experience prior to completing either a neuraxial anesthetic or peripheral nerve block for the first time in clinical. Future research should focus on ways to implement simulation training of different anesthetic techniques and their impact on clinical self-efficacy in SRNAs.

Keywords: simulation, self-efficacy, neuraxial anesthetic, peripheral nerve block

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Dedication

This manuscript is dedicated to the following:

- My Lord and Savior Jesus Christ who has granted me the greatest privilege possible to humans- to be redeemed.
- My wife Jessica, who has stood by me, propelled me forward, kept our home in order, and has been a constant motivator to finally be done with all my schooling!
- My sons- Zachary, Levi, Jonah, and David. The greatest legacy I could ever leave is them.
- My parents and parents-in-law. Craig and Rhonda, Zak and Debbie- without their support and constant help with our kids this journey would never have succeeded.
- My church- my walk with Christ has driven everything in my life and my church family has been my constant rock.
- My anesthesia colleagues at Detroit Receiving Hospital and anesthesia faculty colleagues at Wayne State University- thank you for your support.
- My students- who continue to inspire me to learn and teach.
    - Dr. Treg Hopkins and Dr. Barry Dotson- who have guided and encouraged me throughout this entire process.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

American Association of Nurse Anesthetists (AANA)

Certified Registered Nurse Anesthetist (CRNA)

Council on Accreditation of Nurse Anesthesia Educational Programs (COA)

General Self-Efficacy (GSE)

Neuraxial (NA)

Peripheral Nerve Block (PNB)

Student Registered Nurse Anesthetist (SRNA)

CHAPTER ONE: INTRODUCTION

Overview

The purpose of this quantitative, causal-comparative study is to determine if there is a difference in clinical self-efficacy between Student Registered Nurse Anesthetists (SRNAs) who have no simulation experience in specific technical procedures and SRNAs who have one or more sessions of simulation experience in specific technical procedures before clinical rotations where these procedures will be performed. Self-efficacy and simulation experience will be introduced with a focus on the background, historical overview, societal impact, and theoretical foundation. The problem statement will be discussed along with a noticeable gap in research. The purpose and significance of the study will show why this study is needed. Finally, the specific research questions will be noted, along with basic definitions.

Background

When a patient requires general anesthesia for surgery, the last person he or she sees is the anesthesia provider who is tasked with monitoring the patient and keeping the patient safe throughout the entire surgical procedure (AANA.com, n.d). When patients require specific procedures performed by an anesthetist such as central placement, arterial line placement, or a regional anesthetic, the skill and competence of the provider will impact the patient outcome (Staender, 2010). In the event that there is a crisis in the operating room, the anesthesia provider takes the lead in quickly resolving the crisis the patient is experiencing (Gaba et al., 2014, p.3). Anesthesia providers must be competent in the job they perform if they are to keep the patient safe (Murray, 2012). Measuring the competency of an individual anesthesia provider may be enhanced by considering the provider's self-efficacy gained through simulation training (Nishisaki et al., 2007).

Self-efficacy is a needed trait for anesthesia providers to manage anesthetic complications and keep patients safe (Miller et al., 2020). There is a gap in education among other healthcare providers regarding managing emergencies that occur when patients are under general anesthesia or receiving sedation and monitored anesthesia care (Covington et al., 2019). When a crisis emerges, all members of the healthcare team must work to prevent a negative outcome. Managing anesthetic complications begins with those delivering the anesthetic, including Student Registered Nurse Anesthetists (SRNAs). The goal of the SRNA is to graduate as a competent provider who can intervene in the event of a crisis, and who is able to perform to the full extent of the scope of practice outlined by the American Association of Nurse Anesthetists (AANA). Before graduating, SRNAs must demonstrate both academic and clinical success (COA.org, n.d). Self-efficacy has been demonstrated to lead to greater academic and clinical success (McLaughlin et al., 2008; Opacic, 2003). Building self-efficacy in students is a challenge for nurse anesthesia faculty and clinical preceptors. Simulation training has been shown to improve self-efficacy and clinical competence (Brennan, 2022). Repeated exposure to simulation training has been shown to improve clinical skills and enhance self-efficacy (Al Gharibi et al., 2021).

Historical Overview

The use of simulation training to enhance self-efficacy has involved various disciplines and sub-specialties within healthcare. Bandura (1977) defines self-efficacy as a person's belief he can accomplish something. Imus et al. (2017) suggest that higher self-efficacy may lead to improved clinical performance in SRNAs as they are more likely to seek out complex procedures and cases that help build their experience and skill set. Anesthesia providers develop self-efficacy through clinical experience with actual patients and simulation experience (Miller et al., 2020).

Simulation training is one modality that offers education in real clinical scenarios without the risk to live patients (So et al., 2019). Using manikins and other models, healthcare students gain exposure to various procedures and clinical scenarios they may encounter in the clinical setting with actual patients. Simulation in healthcare is as old as medicine itself and has developed rapidly over the past century with advances in computer technology (Levine et al., 2013). As technology has evolved, simulation experience has expanded as a critical component of medical education. Following the simulation experience, first-year surgical residents showed improvement in self-efficacy related to performing an emergency airway procedure known as a cricothyroidotomy (Jayaraman et al., 2014). Nursing students showed increased self-efficacy when simulation experience was provided both before and after the clinical experience (Kimhi et al., 2016). This is not to say that simulation experience constantly improves self-efficacy. Mac Giolla Phadraig et al. (2017) did not find self-efficacy predictive of BLS skills in dental students. On a related note, Blum et al. (2010) recommended more research on teaching strategies to promote the transfer of self-confidence and competence from simulation experience to clinical experience.

Self-efficacy has been demonstrated to be an important marker in SRNA retention (Conner, 2015). However, while Orkaizagirre-Gómara et al. (2020) found increased self-efficacy along with academic year amongst nursing students, Imus et al. (2017) found a negative association between academic year and degree of self-efficacy amongst SRNAs. The authors noted that this might be related to increasing clinical caseload and higher academic years in their nurse anesthesia program. What was not considered in their study was any effect of the simulation experience.

Society-at-Large

During the early 20th century, anesthesiology began to change how patients undergo surgery as providing unconsciousness increasingly became an option (Klafta & Roizen, 1996). In the United States, anesthesia has historically been provided by trained nurses for over 150 years (Matsusaki & Sakai, 2011). This training begins in graduate nurse anesthesia programs where SRNAs are given both didactic and clinical instruction. Due to the nature of this profession, academic rigor has only increased for SRNAs (Burns, 2011). As graduating competent anesthesia providers should be the goal of every program, educators must consider how to prepare their students best and how to measure their competency. Self-efficacy has been shown to predict academic success (Bembenutty, 2007), while simulation training has improved clinical performance (Domuracki et al., 2009). Providing simulation experience is one way to meet the goal of graduating competent anesthesia providers.

Nishisaki et al. (2007) note that simulation experience can improve individual and team self-efficacy in medical education to improve patient safety. During the COVID-19 pandemic, simulating proper personal protective equipment (PPE) use became critical for anesthesia providers caring for COVID-19 patients (Ahmed et al., 2021). One way to protect patients and healthcare providers is by simulating the experiences they are likely to encounter with actual patients. This is true when working with potentially infectious diseases, as well as complex procedures and advanced anesthetic techniques.

Lambrecht et al. (2021) found cardiac anesthesia simulation to be better than no simulation experience among anesthesia providers. Providing anesthesia for cardiac procedures involves a complex technique that must be mastered to keep patients safe. This presents a stressful challenge to SRNAs when completing their cardiac rotation. Building self-efficacy in caring for patients undergoing cardiac surgery is a significant challenge. Staun et al. (2020) found improved cardiac anesthesia skill levels amongst SRNAs when an open-heart surgery simulation was supplemented before the student's rotation.

In addition to complex cardiac procedures, SRNAs are required to learn how to provide regional anesthesia. The regional anesthetic technique often involves using ultrasound equipment, and the provider's skill can be enhanced using simulation. Chen et al. (2017) found simulation training to improve ultrasound-guided regional anesthesia skills significantly. This is advantageous before taking part in any regional anesthetic procedures performed on live patients.

Theoretical Background

The theory that framed this study is Bandura's (1977) self-efficacy theory. Bandura (1977) measured how humans cope with difficult situations in his work on self-efficacy. General self-efficacy has been proposed as personal competence in various stressful situations (Schwarzer & Jerusalem, 1995). Bandura's (1977) social cognitive theory relates perceived self-efficacy to behavioral change. An individual's level of self-efficacy is likely to influence her actions. Schwarzer and Jerusalem (1995) developed the General Self-Efficacy Scale (GSE) to measure the perception of self-efficacy. This may be applied across various situations relevant to nurse anesthesia practice (Imus et al., 2017).

Two proposed sources for personal efficacy noted by Bandura (1977) include vicarious experience and performance accomplishments. Vicarious experience occurs through seeing others perform some tasks that may seem difficult. Simulation experience provides learning for the active participant and a vicarious experience for the observer. Even more powerful than vicarious experience, performance accomplishments allow learners to develop mastery of a task, which increases self-efficacy (Bandura, 1977). Simulation experience allows learners to develop mastery through repeated practice of the same task or procedure.

Blanié et al. (2018) found improved learning outcomes for both active participants and observers in anesthesia simulation training. When an SRNA can successfully perform while learning specific anesthetic techniques, it will likely improve their overall self-efficacy. Repeated success and high performance will likely improve self-efficacy (Bandura, 1977). As students build self-efficacy, they will probably show improved clinical performance (Opacic, 2003).

Simulation experience has the advantage of providing a less-threatening environment where mistakes may be made without greatly diminishing one's ability to succeed (Sanford, 2010). When mastery of technique or interventions for clinical scenarios are learned, this is likely to lead to improved self-efficacy (Bandura, 1977). Experience is gained through both active, hands-on participation as well as through observation of those participating. As simulation training has been shown to improve self-efficacy (Silberman et al., 2016), there remains an application to SRNA education.

Simulation experience continues to prove a useful modality in supplementing clinical education (So et al., 2019). Building on Bandura's (1977) theory of self-efficacy, measuring this construct in simulation training will help provide evidence of the need for this educational tool and its impact on clinical performance. Schwarzer and Jerusalem's (1995) General Self-Efficacy scale was developed based on Bandura's (1977) self-efficacy theory and should provide the appropriate instrument to examine SRNA self-efficacy related to simulation training.

Problem Statement

Simulation training is effective in helping to strengthen the self-efficacy of the learners involved (Al Gharibi et al., 2021). This is true across multiple specialties in healthcare, including nursing and medicine. Li et al. (2019) found an increase in communication self-efficacy of newly graduated nurses and recommended more simulation-based training for nursing students. Simulation training has also been shown as an effective way to provide training in highly technical procedures without putting a live patient at risk. Torrano et al. (2022) found successful improvement in anesthesia residents' proficiency at erector spinae regional blocks after implementing a simulation course.

The importance of self-efficacy in healthcare providers is closely related to the development of clinical competency. Adesta et al. (2021) demonstrated the effect of a lack of self-efficacy related to providing genetic testing in pharmacology. The authors found providers to have a general sense of inadequacy and competency in using pharmacogenomic data for patients. This ultimately results in patients possibly not receiving drug therapy that is best targeted towards them.

Self-efficacy has been noted to be an essential factor in student training in the healthcare professions (Imus et al., 2017). However, the accrediting body for nurse anesthesia programs notes that most studies showing the impact of simulation training are not specific to nurse anesthesia (COA.org, n.d). Simulation training may increase self-efficacy (Brennan, 2022; Lois et al., 2021). Staun et al. (2020) recommend expanding simulation training specific to SRNA specialty rotations to improve self-efficacy. Karabacak et al. (2019) considered the effect of simulation-based learning on self-efficacy and performance in first-year nursing students while noting that their study shows the need to answer the question of if self-efficacy leads to competence. Johnson and Lipa (2019) found improved self-efficacy in SRNAs after pulmonary artery catheter insertion simulation and video use and called for further research to strengthen their results. Hulsey and Culpepper (2021) found improved self-efficacy in SRNAs who participated in high-fidelity simulation experiences, but also called for further research into which types of high-fidelity simulations would be most beneficial to improving SRNA knowledge, skills, and self-efficacy. The problem is a gap in the literature comparing the SRNA population's simulation training to perceived self-efficacy in clinical rotations.

Purpose Statement

The purpose of this quantitative, causal-comparative study is to explore the effect of simulation training on clinical self-efficacy in SRNAs. This study will consider the impact of the independent variable of one or more sessions of simulation experience on the dependent variable of clinical self-efficacy. The independent variable groups will include SRNAs with no spinal or epidural (neuraxial) anesthetic anesthesia simulation experience and SRNAs with one or more sessions of neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique in clinical, SRNAs with no peripheral nerve block simulation experience before performing a peripheral nerve block in clinical, and SRNAs with one or more sessions of peripheral nerve block simulation experience before performing a peripheral nerve block in clinical. The dependent variable to be considered is clinical self-efficacy. Self-efficacy is the belief that adversity may be dealt with or that a new task can be performed (Schwarzer & Jerusalem, 1995). SRNAs must develop a personal confidence that they can competently provide anesthesia to all patients, perform anesthesia-related procedures, and make necessary interventions in routine and crisis scenarios.

Performing a spinal, epidural, or peripheral nerve block are all technical skills in which SRNAs must demonstrate proficiency (COA, n.d). SRNAs are enrolled for three years in graduate school programs where these technical skills are learned and taught through simulation and hands-on training (Erlinger et al., 2019). Doctoral nurse anesthesia programs differ as to the amount of simulation provided for students, as well as in regard to the specific type of simulation experience provided. Some anesthesia programs employ simulation training before students begin clinical rotations, while others do not.

Significance of the Study

Simulation and self-efficacy are significant factors for SRNA matriculation and, ultimately, patient safety (Shaikh et al., 2022). Self-efficacy of the anesthesia provider may lead to a decrease in adverse events for patients undergoing anesthesia-related procedures (Xu et al., 2022). Simulation experience has been found to improve self-efficacy (Mabry et al., 2020), so this critical relationship should be studied in the SRNA population.

Despite simulation training in healthcare leading to increased self-efficacy, the SRNA population has not been thoroughly studied to show the same results. Self-efficacy of SRNAs has been explored related to the academic year and clinical experience (Imus et al., 2017) and program retention of SRNAs. Still, there is a lack of research on the effect simulation experience has on the self-efficacy of SRNAs. This study will add to self-efficacy and simulation training knowledge by exploring a less-studied population. Results from this study may support the findings from other healthcare disciplines that simulation training improves the provider's self-efficacy. Patient safety standards have helped to drive the widespread use of simulation training in healthcare practice (Persson, 2017). This study may help to demonstrate the importance of simulation training to patient safety as SRNAs note their self-efficacy as a result of participating in simulation sessions that focus on specific technical procedures.

Research Questions

RQ1: Is there a difference for SRNAs in clinical self-efficacy between SRNAs with no neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique in clinical, and SRNAs with one or more sessions of neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique in clinical?

RQ2: Is there a difference for SRNAs in clinical self-efficacy between SRNAs with no peripheral nerve block simulation experience before performing a peripheral nerve block in clinical and SRNAs with one or more sessions of peripheral nerve block simulation experience before performing a peripheral nerve block in clinical?

Definitions

1. *Peripheral Nerve Block*- A type of regional anesthesia wherein local anesthetic is injected around a peripheral nerve blocking sensory and possibly motor function (Gaffney et al., 2017)
2. *Neuraxial Anesthetic*- The placement of local anesthesia in or around the central nervous system (Olawin & Das, 2022)

3. *Self-efficacy* – A person's belief that they can achieve the desired performance (Bandura, 1977)

CHAPTER TWO: LITERATURE REVIEW

Overview

Understanding the relationship between self-efficacy and simulation training can only proceed with understanding the foundational theories that ground this study. The purpose of this literature review is to describe the theory that has produced the construct of self-efficacy and its application to multiple fields. The development of simulation training will be outlined. Simulation training and its impact on self-efficacy will be discussed, along with the connection to the education of Student Registered Nurse Anesthetists (SRNAs). Finally, the call for future research in this population will be described.

Theoretical Framework

Albert Bandura was a Canadian-born psychologist who taught at Stanford University beginning in 1953 (Boeree, 2006). Bandura is considered a significant figure in the development of cognitive theory. While the prevailing psychological framework of his time favored a constructivist approach, Bandura observed how the environment affects the individual and how the individual can affect his own environment (Boeree, 2006). Based on these observations, Bandura developed the theoretical construct of self-efficacy. Self-efficacy will be described as formed by Albert Bandura and then applied to academic and clinical training, followed by a discussion on how to build self-efficacy.

Bandura's Self-Efficacy Theory

This study is grounded in Bandura's (1977) self-efficacy theory. Understanding that human beings are more than mindless machines, Bandura proposed that human agents are affected by their environment even as they cause an effect on their environment (Bandura, 2001). This has implications for how individuals change their behavior. An individual's belief regarding his ability to drive change and exercise some control over outcomes is predictive of human behavior (Bandura, 2001). How individuals perceive their ability to change or complete something relates to their success and persistence in ultimately changing or completing a task. This is the foundation of self-efficacy theory.

Self-efficacy is an individual's belief that she can accomplish a performance or task (Bandura, 1977). Thoughts about completing a task, motivation to complete a task, and actions taken to complete a task are all influenced by self-efficacy. This interplay between an individual's perception of their abilities and the external environment's effect was a novel concept in Bandura's (1977) theory. With classical behaviorism, the focus was on the environment as the leading cause of an individual's behavior (Boeree, 2006). Albert Bandura proposed that while the environment affects behavior, an individual also affects his environment- a concept he referred to as reciprocal determinism (Boeree, 2006). Bandura considered the environment, behavior, and psychological processes critical to understanding how an individual will function (Boeree, 2006). With this groundwork, self-efficacy theory could be developed by observing how a person is affected by her environment and also affects her environment.

Self-efficacy theory considers a subjective experience in a person's mind and predicts the outcome based on this experience (Bandura, 1977). The theory is not only concerned with personal experience, however, as physiologic processes also play an essential role (Bandura, 1977). Strength and stamina resulting from one's physical condition will influence an individual's perception of fatigue and pain and ultimately affect how long he or she will endure this fatigue and pain (Maddux & Stanley, 1986). Furthermore, the place of an individual's subjective experience is not untethered from the surrounding world. The personal agency of an individual operates within a societal structure that influences one's subjective experience (Bandura, 2000).

Even as the societal structure and physiologic processes in a person will affect him, self-efficacy theory proposes that the actions of human agents have real consequences.

Helping individuals understand that their choices make a difference is foundational to applying self-efficacy theory. An individual must believe she has some control over her life if she is to learn a new task, develop a skill, or overcome a phobia. If an individual feels she has no control over life circumstances, she is not likely to put forth much effort for a significant amount of time in learning a new task, developing a skill, or overcoming a phobia (Bandura, 1977).

The effort given to a particular task is determined by one's belief that this can be accomplished (Bandura, 1991). Individuals with a sense of control over their lives are likelier to take on challenging tasks than those without any power (Bandura, 1977). Jacobs et al. (1984) found self-efficacy to be a better predictor of persistence than self-awareness. Zulkosky (2009) notes that self-efficacy influences how people motivate themselves and their judgment of ability to accomplish a task. Various ways influence one's self-efficacy, including performance accomplishment, vicarious experience, verbal persuasion, and emotional arousal (Bandura, 1977).

Performance Accomplishment

Performance accomplishments may be induced through participant modeling, desensitization, exposure, and self-instructed performance (Bandura, 1977). The case studies giving rise to these types of accomplishments were derived from patients suffering from various phobias. By offering a controlled environment with exposure to the phobia through one of the mentioned modes of induction, patients were found to gain mastery over the phobia and a belief that the phobia could be overcome (Bandura, 1977). Participant modeling was more effective at overcoming a phobia than simply visualizing oneself overcoming the phobia (Bandura, 1977).

Performance accomplishment as a source of self-efficacy has been documented in various fields. Bruton et al. (2013) noted that amateur golfers had greater post-round self-efficacy after achieving a better handicap (a measure of successful golfing). Performance accomplishment was assessed as significant through the effect of prior programming experience on engineering students' self-efficacy (Kittur, 2020). Gong et al. (2021) recommend focusing on performance accomplishment supplemented by vicarious experience to improve self-efficacy in colorectal cancer patients. Van Dyk et al. (2016) found years of experience and confidence from that experience to predict self-efficacy in nurse managers. Cordero et al. (2010) found performance accomplishment combined with belief-perseverance techniques to produce higher math self-efficacy in undergraduate students.

Bandura (1977) noted self-efficacy from performance accomplishments to be generalizable across fields. If an individual was able to, by successful performance, develop self-efficacy over one phobia, then the individual may also apply this to other social situations which require a stronger self-efficacy (Bandura, 1977). Bandura (1977) also noted this generalization to be most significant in similar activities. It is essential to distinguish that self-efficacy ultimately involves beliefs about a future action (Klassen & Klassen, 2018). While the experience gained through successful performance is a vital source of efficacy in future performance and is generalizable to other areas (Bandura, 1977), self-efficacy is directed toward future action. Self-efficacy is also concerned with a belief about the capability to achieve something, not an outcome expectation. While generalizable, self-efficacy is domain-specific (Klassen & Klassen, 2018). McAvay et al. (1996) found changes in self-efficacy perceptions related to domains of healthy living in older adults.

Vicarious Experience

Vicarious experience may be induced through live or symbolic modeling (Bandura, 1977). The efficacy gained through watching another person succeed will likely be weaker and more easily changed (Bandura, 1977). However, Bandura (1977) notes that many expectations are met through vicarious experience. The critical factor in the strength of vicarious experience as a source of self-efficacy is the characteristics of the one being observed. When an effortless performance is observed, there is likely to be little change. However, when an individual is observed putting forth a real effort to attain a goal, this has a more substantial effect on building efficacy through vicarious experience (Bandura, 1977).

Vicarious experience as a sole source of self-efficacy has had mixed results. Wilde and Hsu (2019) found individuals with low general self-efficacy to benefit less from vicarious experience than individuals with high self-efficacy when completing a set task. Similarly, El-Abd and Chaaban (2021) found that classroom management self-efficacy did not improve significantly following the observation of pre-service educators. As Bandura (1977) observed, vicarious experience is likely to be more meaningful when the individual can identify with the one being observed. Kang et al. (2021) found self-identification to affect self-efficacy after a vicarious experience with a virtual reality teaching simulation.

Verbal Persuasion

Verbal persuasion with induction options of suggestion, exhortation, self-instruction, and interpretive treatment also offers a potential source of self-efficacy (Bandura, 1977). While verbal persuasion may help build self-efficacy, Bandura (1977) notes this is a weak source and can be easily disconfirmed by failing in a performance. Lunenburg (2011) suggests that verbal persuasion may be best utilized through the Pygmalion effect. This involves a person believing something to be accurate, which makes it happen- a result Lunenburg (2011) observed in studies based on teachers and their actions following perceived student IQ.

Verbal persuasion may be symbolic or direct (Howardson & Behrend, 2015). Symbolic verbal persuasion may include the symbolic meaning imbued in an individual's environment (Howardson & Behrend, 2015). Verbal persuasion may be augmented by the perceived similarity between models and recipients (Mellor et al., 2006). However, the risk with verbal persuasion is that a person may be provided the verbal persuasion but then fail at a task leading to reduced self-efficacy (Cassé et al., 2015). Wright et al. (2016) did note verbal persuasion to be more effective than vicarious experience in improving the self-efficacy of physical performance tasks. Overall, verbal persuasion contributes less to self-efficacy beliefs, partly because it is furthest removed from direct experience (Howardson & Behrend, 2015).

Emotional Arousal

Emotional arousal offers modes to induce efficacy, including attribution, relaxation, symbolic desensitization, and extended exposure (Bandura, 1977). Emotional arousal has also been referred to as physiologic arousal (Maddux & Stanley, 1986). Exposure to stressful situations in a controlled environment may decrease the emotional response that would typically result. Individuals who fear an adverse emotional reaction are likely to exhibit behavior that includes avoiding whatever situation or task causes this damaging behavior (Bandura, 1977). Individuals may show less avoidance behavior by learning to control or remove this emotional arousal (Bandura, 1977).

While these categories may increase self-efficacy, personal performance accomplishment through modeling, desensitization, exposure, and self-instructed performance has the most significant impact (Bandura, 1977). Performance accomplishments involve personal experiences that allow the participant to master a task. This may include overcoming a phobia or learning a new skill. This mastery may be applied to situations where the individual perceives a deficiency (Bandura, 1977). Performance accomplishments may be achieved through simulated events or training that allows the individual to learn a new task or skill

Social Cognitive Theory

While this study will focus specifically on self-efficacy theory, it is important to note that Bandura's (1977) self-efficacy theory grew into a larger structure known as Social Cognitive Theory (Bandura, 1986). Social Cognitive Theory considers self-efficacy beliefs alongside outcome expectancies (Bandura, 1986). Outcome expectancies are what people believe will be the consequences of their actions (Luszczynska & Schwarzer, 2015). Both self-efficacy beliefs and outcome expectancies will ultimately drive an individual's behavior.

Bandura (1986) proposed that human behavior is not deterministic based on only one factor. Instead, human behavior may be explained by three primary causations: internal personal factors, behavioral patterns, and environmental events. This is the so-called triadic reciprocal causation model (Bandura, 1986). Internal factors may include cognitive, affective, and biological events. Each causative factor may impact behavior depending on the circumstances (Bandura, 1999). Social cognitive theory is predicated on the belief that people desire control over the events that affect their lives (Bandura, 1997). Social cognitive theory has been supported by research in various contexts, including social, health, and education (Slavin & Schunk, 2021).

Applications of Self-Efficacy Theory

The theoretical construct of self-efficacy has been applied to various domains, including career choice (Taylor & Betz, 1983), rehabilitation counseling (Strauser, 1995), and even dental practice (Kakudate et al., 2010). Self-efficacy theory has been applied to many fields because these fields typically involve helping an individual with behavioral change. The concern of educators and clinicians is to help their students or patients in their behavioral change, and they have found Bandura's (1977) theory practical. The theory focuses on mastery and coping skills, which relate to any field where behavior is being modified. Maddux and Stanley (1986) note that Bandura's (1977) theory focuses on two related experiences, which include an individual's belief that behavior will lead to a particular outcome and an individual's belief that he or she is capable of performing the behavior. The focus of this research will build on the application of self-efficacy theory to simulation training, which involves the academic and clinical training fields.

Academic Self-Efficacy

While self-efficacy theory began in clinical psychology and focused on overcoming phobias (Bandura, 1977), its application to the academic world has been well established. Elias and MacDonald (2007) describe academic self-efficacy as a student's judgments about their ability to attain educational goals and note that this has been linked to grades, major selection, persistence, and motivation. Bembenutty (2007) found a high correlation between reported self-efficacy beliefs and grades in college students. McLaughlin et al. (2008) demonstrated that higher self-efficacy in nursing students led to better final academic marks. Silvestri et al. (2012) noted a positive correlation between self-efficacy and successful passage of the NCLEX in nursing school students.

Niazi et al. (2013) found that self-efficacy positively correlated with mastery and achievement goals in college students. This supports the theory that efficacy determines activity choice, effort, and perseverance in a difficult situation (Bandura, 1977). Students with higher efficacy are more likely to persevere in challenging academic programs. Torres and Solberg (2001) also supported Bandura's (1977) theory by finding an association between self-efficacy and persistence in Latino college students, demonstrating that students with higher efficacy are more likely to persevere in challenging academic programs. Hayat et al. (2020) noted the positive impact of self-efficacy on medical student learning strategies and academic performance. Students with higher efficacy are more likely to demonstrate good learning strategies that should translate into tremendous academic success. Imus et al. (2017) suggest that students with higher self-efficacy are likely to put more effort into their studies than those with lower self-efficacy. The more significant effort should produce more academic success. Talsma et al. (2018) found a reciprocal relationship between self-efficacy and academic performance.

Honicke and Broadbent (2016) note academic self-efficacy to be moderately correlated to academic performance and call for more research into longitudinal experimental studies. Schunk and Pajares (2002) also summarize academic self-efficacy as playing an essential role in achieving educational goals' persistence and outcome. Schunk and DiBenedetto (2014) relate academic self-efficacy to learning, motivation, and self-regulation, all critical to successful academic achievement. In health science programs, educational and clinical achievement must be attained, making self-efficacy a vital construct in both related areas.

Clinical Self-Efficacy

Along with academic performance, self-efficacy has been shown to positively affect clinical performance (Opacic, 2003). Clinical training is essential to many health science programs (Liljedahl et al., 2015). To succeed in health science programs, students must demonstrate academic achievement and competence in the clinical setting (Holmboe, 2016). The clinical setting is often challenging and stressful (Sanad, 2019). Self-efficacy is needed in health science students to persevere through often rigorous programs (Imus et al., 2017).

Shorey and Lopez (2021) describe clinical self-efficacy as a bridge between theory and practice that affects learning new skills, developing critical thinking, and achieving academic success. Students who demonstrate higher self-efficacy are more likely to take on challenging opportunities and will view failure as something in their control, not simply left to external factors (Imus et al., 2017). Avoiding opportunities for learning new skills may be demonstrated in students who fear failure or have failed in other areas. This could ultimately affect perseverance through clinical training as new skills are required with increasing clinical expectations. Persistence in clinical is directly related to self-efficacy because efficacy is a significant factor in how much effort an individual will exert and how long they are willing to sustain this effort (Bandura, 1977).

Mohamadirizi et al. (2015) noted that self-efficacy significantly predicts clinical performance in nursing students. On Bandura's (1977) theory, performance accomplishments influence self-efficacy to a high degree because they involve personal mastery of a task or a phobia. Success leads to more success. Repeated failure is likely to cause lower self-efficacy; however, some losses may improve self-efficacy once the obstacle is overcome (Bandura, 1977). When complex tasks are learned after the previous failure, this increases motivation and persistence (Bandura, 1977), which is needed for successful clinical performance.

How students perceive their efficacy is likely to affect their clinical performance. Opacic (2003) found a positive correlation between self-efficacy and clinical performance in physician assistant students. Clinical rotations require the mastery of new skills in often stressful environments. The successful learning of healthcare-related skills should lead to greater self-efficacy and success. Occasional failure to complete a task should eventually lead to greater self-efficacy once the job has been mastered (Bandura, 1977).

Kameg et al. (2010) found the use of high-fidelity simulation experience to enhance undergraduate nursing students' self-efficacy in communicating with mental health patients. McBride (2022) found self-efficacy to increase in speech-language pathology students throughout their clinical education. The confidence students develop through hands-on clinical training or simulation experience demonstrates the effect of performance accomplishment on self-efficacy (Bandura, 1977). Clinical self-efficacy relates to the perceived confidence one has to successfully complete the tasks assigned to the specific healthcare profession and has been described as a "Feeling that results from individual experiences" (Abdal et al., 2015, p. 2).

Building Self-Efficacy

Maddux and Stanley (1986) note that Bandura's (1977) theory proposes that self-efficacy is built on experiences that include performance, vicarious experience, verbal persuasion, or emotional arousal. As noted, performance is the most powerful of these sources (Bandura, 1977). Academic and clinical self-efficacy may be built through these experiences, but preparing for clinical training relies heavily on performance and vicarious experience. Students preparing for clinical training may have their self-efficacy heavily influenced based on their success or failure at a particular task and their observation of an instructor performing the task in education (Maddux & Stanley, 1986). These sources of self-efficacy may be employed in the education of health science students and provide a way for educators to understand better how their students learn.

Health science program educators are often concerned with assessing learning best (Eva et al., 2016). Finding new and effective teaching strategies is essential to improve retention and complete a health science program (Custers, 2010). The purpose of this study is to consider if simulation experience builds clinical self-efficacy based on Bandura's (1977) conceptualization of performance accomplishments and their impact on self-efficacy. The target population of Student Registered Nurse Anesthetists offers a sample of rigorous health science education that likely requires high self-efficacy in students. Personal efficacy is essential to completing a difficult task (Bandura, 2001). Student Registered Nurse Anesthetists (SRNAs) are faced with completing a challenging 24-36 month program (Imus et al., 2017). In general, college students with higher levels of self-efficacy are more likely to persevere and ultimately succeed in their program (Robbins et al., 2004). The simulation experience is one option that has been found to improve clinical self-efficacy (Hung et al., 2021).

If simulation experience improves self-efficacy in SRNAs, Bandura's (1977) self-efficacy theory will be further supported. In this study, the success and failure found in performance accomplishment through simulation will demonstrate ways to improve self-efficacy in this population and extend the work of Bandura. Measuring the personal efficacy beliefs of SRNAs after simulation training has been completed will test the assumption that participant modeling and performance increase self-efficacy. A positive relationship between simulation training and clinical self-efficacy will further authenticate Bandura's (1977) theory.

Related Literature

With the impact of personal self-efficacy on academic success (McLaughlin et al., 2008) and clinical success (Opacic, 2003), this construct should be studied as it relates to SRNA training with a specific focus on simulation training. A review of the literature on self-efficacy in the SRNA population will be considered, along with research on simulation training applied through various modalities, including high and low-fidelity mannequins, computer programs, and virtual reality. Specific technical procedures and management of critical anesthesia events in simulation training will be considered, along with the impact of simulation training on self-efficacy in general and SRNA simulation training and self-efficacy in particular. The gap in research will be demonstrated as it relates to SRNA self-efficacy created through simulation training.

Certified Registered Nurse Anesthetist Education

Certified Registered Nurse Anesthetists (CRNAs) are advanced practice nurses who provide anesthetics for every type of procedure and perform technical procedures such as arterial and venous line placement, advanced airway management, and ultrasound-guided regional anesthesia (AANA.com, n.d). CRNAs work in either a team model along with an anesthesiologist or are the sole provider in rural areas and are the leading provider of anesthesia for the U.S. military (AANA.com, n.d). CRNAs were the first professionals to specialize in the administration of anesthesia (Malina & Izlar, 2014). The minimum education requirements to become a Certified Registered Nurse Anesthetist (CRNA) include completing a baccalaureate or graduate degree in nursing, a minimum of one-year full-time work in an acute care setting, and graduation with a minimum of a master's degree from an accredited graduate nurse anesthesia program (AANA.com, n.d). Before graduating from an accredited program and completing the national board exam, students are often classified as Student Registered Nurse Anesthetists (SRNAs). With all of the accredited Nurse Anesthesia programs now requiring doctoral degrees and an additional year of training, most graduates complete their programs with an average of 9,369 hours of clinical experience (AANA.com, n.d). The accrediting body for the profession, the Council on Accreditation of Nurse Anesthesia Educational Programs (COA), determines the type of clinical experience students will gain (COACRNA.org, n.d).

CRNA education includes both academic and clinical training. In clinical training, SRNAs work closely with a CRNA as they gain knowledge and skill acquisition in the clinical setting (MacLean, 2022). In addition to the technical skills SRNAs must develop, there are other psychosocial areas that students must grow in to complete their respective programs successfully. Flynn (2022) found the Nurse Anaesthetists Non-Technical Skills-Norway to be a potentially helpful tool in evaluating SRNA's non-technical skills demonstrated in clinical- including cognitive, social, and personal resource skills. Both clinical and psychosocial training may be enhanced through simulation training (Shorey & Ng, 2021).

A recent position statement from the COA has highlighted the value of simulation training in the education of SRNAs (COACRNA.org, n.d). The call for simulation training in anesthesia has been introduced previously. Gaba and DeAnda (1988) noted that anesthesia simulation decreases the risk posed to patients and allows for repeated practice of routine procedures that would not be feasible in a clinical setting. Errors can be made in simulation training that do not harm a patient while providing teachable moments to the student. MacLean (2022) notes that SRNAs are required to develop technical proficiency in airway and invasive catheter skills. These are the types of technical skills that make simulation training desirable.

Measuring successful skill acquisition in SRNAs can be difficult. Elisha et al. (2020) note a need for more standardization in evaluating SRNAs on clinical rotations. Completing a task or procedure is one of many areas to consider when evaluating SRNA clinical performance. Emotional intelligence and situational awareness have been considered (Christianson et al., 2021; Wright & Fallacaro, 2011). These constructs may also be considered during simulation training as a precursor to clinical training. Measuring how confident students feel in their ability to perform a task may be regarded both through simulation and clinical training. Measuring an SRNA's confidence to complete a task or procedure is directly related to the SRNA’s self-efficacy.

SRNA Self-Efficacy

As a health science profession, nurse anesthesia programs should consider self-efficacy in their students. Self-efficacy has been considered in SRNA academic success and retention (Conner, 2015) and has also been shown to correlate with wellness (Griffin, 2017). Bandura’s (1977) theory of self-efficacy described the positive effect modeling, and vicarious experience can have on building one’s sense of ability to accomplish a task. Drawing from this, Bass (2017) found increased SRNA self-efficacy after implementing a peer mentorship program.

There are obvious implications to clinical practice based on how students perceive their ability to accomplish a task. Imus et al. (2017) note that SRNAs with higher self-efficacy are more likely to seek out challenging clinical opportunities that will improve their overall clinical performance. Conversely, students who do not believe they can learn a specific technique or take on a complex surgical procedure may avoid these opportunities. The avoidance of clinical opportunities could further cause a reduction in self-efficacy as skills are not mastered, opening the door to repeated failures with their negative impact on self-efficacy (Bandura, 1977).

Due to the impact of self-efficacy on academic performance, quality performance, persistence, retention, and approach behavior, Conner (2015) calls for more research on self-efficacy in the SRNA population. Imus et al. (2017) call for further research on the disparity they discovered between self-efficacy in didactic and clinical training for SRNAs. In the study by Imus et al. (2017), SRNAs showed lower self-efficacy as they progressed from didactic to clinical training. The authors note that the unpredictable environment of the operating room and caseload may contribute to decreased efficacy. The authors further argue that nurse anesthesia educators may benefit their SRNAs by implementing stressors into simulation training similar to what would be experienced in the operating room clinical setting.

Healthcare Simulation Training

Simulation training for healthcare may go back to the 6th century AD, when students were encouraged to practice surgical incisions on objects similar to the human body (Saddawi-Konefka & Cooper, 2020). The history of modern healthcare simulation may be dated to the 1960s when anesthesiologists in the United States and Norway worked with a toy company to create a pulseless, dying model that would need intervention (Seam et al., 2019). Since then, simulation training has improved healthcare delivery, from managing operating room fires (Kishiki et al., 2019) to improve mental health strategies in police and ambulance services (Uddin et al., 2020). Simulation training has also grown worldwide, even in places with limited resources for this educational tool (Mossenson et al., 2020).

With the growth of simulation training in healthcare education, the simulation of technical procedures in specific health disciplines has also grown. McLeod et al. (2019) developed valid and reliable metrics for ultrasound-guided interscalene nerve blocks performed on porcine or cadaver models. Chia et al. (2022) found a new emergency airway simulation program implemented for surgical residents useful for teaching trauma procedures. A systematic review by Howlader et al. (2022) noted that oral and maxillofacial surgery programs had incorporated computerized simulation training for orthognathic, maxillofacial trauma, cleft lip and palate repair, nerve block technique, endoscopic procedures, reconstructive surgery, and fiber-optic intubation.

Simulation Training in Anesthesia

While anesthesia providers were involved with healthcare simulation in the 1960s, it was only in the patient safety movement of the 1980s that led to a greater interest in providing simulation experience focused on anesthesia (Saddawi-Konefka & Cooper, 2020). Saddawi-Konefka and Cooper (2020) trace the history of anesthesia simulation through the research developments of the Anesthesia Patient Safety Foundation and the growth of technology throughout the latter half of the 20th century. As a new public focus began to center on critical incidents involving anesthesia equipment and the delivery of anesthesia, multiple stakeholders, from engineers and educators to physicians, became involved with using simulation experience to improve patient safety (Saddawi-Konefka & Cooper, 2020). One key figure, Dr. Ellison Pierce, founded the Anesthesia Patient Safety Foundation in 1986, which awarded four grants for simulation research in the first three years of its inception (Saddawi-Konefka & Cooper, 2020).

As computer technology and concern for patient safety grew, so did opportunities for developing new and advanced patient simulators for anesthesia training (Saddawi-Konefka & Cooper, 2020). The major driving force for simulation in anesthesia has always been a focus on patient safety. Gaba (2019) notes that simulation is a critical tool in improving patient safety. Another key factor in developing simulation training was rising medical malpractice costs (Pandya et al., 2021). In the 1980s, it was estimated that up to 70% of major anesthesia accidents were preventable, leading to a financial crisis in malpractice premiums (Pandya et al., 2021). Simulation experience was one key factor in improving patient safety and lowering malpractice costs.

Pandemic Simulation Training

With the advent of the COVID-19 pandemic, simulation training became necessary for surgical residents who were low on operating room cases but needed to keep their surgical skillset proficient (McKechnie et al., 2020). Doulias et al. (2022) also found simulation as an appropriate method of surgical training due to the pandemic. Pan and Rajwani (2021) note that simulation training in a New York City hospital during the pandemic helped train redeployed healthcare workers and uncover safety gaps in the hospital processes. Hedman and Fellander-Tsai (2020) found that simulation allowed orthopedic surgical residents to practice surgical tasks while case volume was low due to COVID-19. Kogan et al. (2020) also note that the pandemic has necessitated more surgical simulation training.

In the early days of the pandemic, anesthesia providers were at increased risk due to the nature of the aerosolized procedures, including endotracheal intubation (Tang & Wang, 2020). Anesthesia providers are often the front-line workers in managing a patient's airway and medical emergencies. Andreae et al. (2020) found simulation training to promote the proper management of COVID-19 patients suffering from various medical emergencies. Fayed et al. (2022) also found that most anesthesia providers in their study would prefer simulation training on emergency airway procedures during COVID-19. Daly Guris et al. (2020) noted that simulation training also assists in identifying barriers to planning for success in intraoperative emergencies involving COVID-19.

High-Fidelity vs. Low-Fidelity Simulation Training

Simulation training in healthcare education may involve using low or high-fidelity modalities. The low-fidelity simulation consists of the use of task trainers that have limited function and specific requirements for procedural skills. High-fidelity simulators are more realistic. Some models use physiologic adaptive modalities and complex scenarios that allow participants to interact with the mannequin and produce real-time changes (Massoth et al., 2019). Massoth et al. (2019) did not find high-fidelity figures to lead to greater performance or growth in knowledge in medical students compared to low-fidelity models. However, high-fidelity models have been shown to reduce anxiety and improve confidence in medical students (Yu et al., 2021).

High-fidelity simulation may provide a learning experience that allows students to participate more in their education, leading to greater satisfaction and motivation in their respective programs (Cabañero-Martínez et al., 2021). Chen et al. (2020) found training on high-fidelity models, including the dynamic haptic robotic trainer (DHRT) and central-line manikin, to improve central line insertion skills. Li et al. (2019) found high-fidelity simulation to cultivate nursing students' knowledge, skills, collaboration, caring, and learning interests. Carneiro et al. (2022) found simulation education in robotic surgery to improve performance for surgical residents with both in-person and remote proctoring.

Both modalities have been helpful in health care education, whether a low- or high-fidelity simulation. Multiple disciplines in healthcare are utilizing both options for simulation training with notable success. This has been observed in the reduction of nursing student anxiety in clinical practice (Thompson, 2021), teaching cardiac examination skills to medical residents (Osborne et al., 2022), and teaching complex airway management in pediatric patients (Lejus-Bourdeau et al., 2021). While the mentioned studies did not note a significant difference between high and low-fidelity simulation, Wilson et al. (2022) did note that complex surgical skills learned on low-fidelity models may not reliably transfer to high-fidelity models or clinical practice.

Hands-On Simulation vs. Computer Program Simulation

One simulation modality in education includes using computer software without any hands-on training. Shields and Gentry (2020) demonstrated improved transesophageal echocardiography (TEE) diagnosis in SRNAs who participated in a hands-on simulator instead of a web-based-only group. However, computer-based simulation does have its place. Aksoy et al. (2019) found web-based pediatric basic life support training more effective than standard lecture-based learning. Additionally, Barisone et al. (2019) found web-based learning to support nursing students' clinical skill development. They even argue that web-based learning may help close the gap between theory and practice.

The COVID-19 pandemic necessitated computer program simulation when the hands-on simulation was impossible (Swerdlow et al., 2020). Computer program-based simulation has also been used in place of hands-on cadaveric dissection. Washmuth et al. (2020) found no significant difference in exam scores between students who participated in a cadaveric dissection versus a student who completed a virtual dissection as part of a nurse anesthesia anatomy course. Online modules are important to healthcare education (Nelsen et al., 2020). Wise et al. (2016) found medical students to prefer web-based simulation in pulmonary artery catheter insertion to traditional lecture didactic.

Virtual Reality Simulation

Villanueva et al. (2020) note three broad types of simulators: full mannequins, task trainers, and virtual reality systems. In addition to the increased role of computer program-based simulation due to the COVID-19 pandemic, virtual reality (VR) simulation has also expanded (Foronda, 2021). Zafar et al. (2021) found VR simulation to enhance student learning of local anesthetic administration for pediatric dentistry students. VR simulation has been developed for education in anesthesia involving technical skills, including fiberoptic intubation, bronchoscopy, regional anesthesia, and central venous catheter placement (Huang et al., 2020). VR simulation may offer a realistic 3-dimensional environment for clinical and non-clinical skills. However, the increased costs can create access barriers (Huang et al., 2020).

The results considering VR simulation versus mannequin-based simulation are also mixed. McAlpin et al. (2022) noted higher test results in dental students instructed in local anesthetic administration using a mannequin versus VR simulation. Mao et al. (2021) found that immersive virtual reality improves procedural time, task completion, and accuracy and has positive user ratings and cost-effectiveness in surgical residents. Mackenzie et al. (2022) noted in their systematic review that VR simulation, in addition to augmented reality, mixed reality, and haptic interfaces in simulation, did not produce adequate evidence that these modalities could replace cadaver training for trauma surgery residents.

Artificial Intelligence in Simulation

Artifical intelligence (A.I) uses computers to complete tasks associated with human intelligence (Bowness et al., 2022). A.I. may incorporate both machine learning- dependent on algorithms and rule-based problem solving, as well as deep learning- a method of implementing machine learning (Bowness et al., 2022). Along with virtual reality simulators, machine learning techniques provide a subset of artificial intelligence that can be used in assessing performance (Winkler-Schwartz et al., 2019). A.I. machine learning has been employed to assess the psychomotor skills for neurosurgical training (Winkler-Schwartz et al., 2019), and is increasing in popularity for surgical simulation training (Park et al., 2022).

In simulation education, machine learning algorithms may be utilized to enrich anesthesia training by providing feedback on optimal dosing and prediction of complications based on pre-programmed data sets (Fara et al., 2023).

There are further applications of A.I to regional anesthesia education. Various A.I. devices have been developed to improve image acquisition in peripheral nerve scanning for regional anesthesia and may help to improve provider understanding of the relevant sono-anatomy (Bowness et al., 2022). While A.I. devices will likely continue to be developed in regional anesthesia to assist in teaching learners, this does not necessarily lead to transfer of knowledge to the learner (Prineas et al., 2021). However, A.I devices used in ultrasound guided regional anesthesia education do provide a way to augment education in anatomy while also incorporating skill development (Jacobs et al., 2023).

Simulation and Self-Efficacy

Self-efficacy is necessary for healthcare providers because it might indicate clinical success (Mohamadirizi et al., 2015; Opacic, 2003). With the advancement of simulation training in healthcare education, consideration should be given to its impact on the participants' self-efficacy. It should be noted that higher self-efficacy scores only sometimes predict success. Chan et al. (2019) discovered no difference in medication errors performed by nursing students with high efficacy scores compared with students with lower efficacy scores. However, the self-efficacy scores in this study were measured before simulated medication administration. Therefore there were no results on reported self-efficacy following the simulated learning.

What is essential to study for health science educators is what impact simulation training has on improving self-efficacy. While it is not always predictive, higher self-efficacy scores have been demonstrated to lead to more academic success (Wu et al., 2020) and clinical success (Ghofranipour et al., 2018). Berwick et al. (2019) found improved self-efficacy scores in anesthesia trainees following a simulated cannot intubate or oxygenate high-fidelity scenario. This improvement in self-efficacy following simulation experience has also been demonstrated in athletic training students (Paloncy et al., 2019), nursing students (Li et al., 2019), pharmacy students (Nebergall et al., 2021), physical therapy and occupational therapy students (Ivey et al., 2018), and medical students (Kozhevnikov et al., 2018). Pre-clinical physician assistant students were found to have increased self-efficacy scores following operating room virtual reality simulation (Francis et al., 2020), and self-efficacy was improved in OR nurses and anesthesiologists following simulation training on COVID-19-related procedures (Lois et al., 2021). Ali et al. (2020) found an improvement in nurse practitioner self-efficacy following the simulation of managing fatal dysrhythmias.

SRNA Simulation and Self-Efficacy

The proposed study seeks to examine the effect of simulation training on self-efficacy in student registered nurse anesthetists (SRNAs). The importance of simulation training in developing clinical skills in SRNAs has been demonstrated (Erlinger et al., 2019). Simulation training has also been shown to improve self-efficacy in anesthesia-related scenarios specifically. Covington et al. (2019) implemented an airway emergency simulation for staff nurses and surgical technologists in a gastroenterology clinic. The results included improved self-efficacy scores. This is similar to the findings of Johnston (2022), who found improved self-efficacy scores in CRNAs following a cricothyrotomy simulation.

While these studies were at the clinical practice level, Nurse Anesthesia educators have incorporated simulation training into SRNA education with resultant improvement in self-efficacy scores. Staun et al. (2020) demonstrated this improvement following the creation of an anesthesia simulation experience in cardiac surgery. Using high-fidelity simulation in SRNA programs improved self-efficacy in a systematic review by Hulsey and Culpepper (2021). Sudduth (2019) demonstrated an improvement in the clinical self-efficacy scores of SRNAs who completed high-fidelity simulation using cognitive aids. Tujague (2019) also noted that using high-fidelity simulation with cognitive aids increased SRNA self-efficacy, although not to a statistically significant level. Tujague (2019) proposed that low participant turnout may have generated less than statistically significant results and called for further studies.

Simulation of Technical Procedures and Cases in SRNA Training

Some of the specific technical procedures performed by Certified Registered Nurse Anesthetists (CRNAs) include instrumenting a patient's airway with standard direct laryngoscopy or video-assisted and fiberoptic-assisted techniques, placement of non-invasive and invasive catheters, neuraxial anesthetic procedures, and peripheral nerve blocks (AANA.com, n.d). These advanced techniques require competence before performing them on a live patient. The use of simulation technology has allowed medical providers to develop their knowledge and skill while decreasing the risk of harm to patients (Ziv et al., 2003). The technical anesthesia procedures mentioned can potentially put patients at risk when learners are first being instructed. Simulation training offers SRNAs the benefit of practicing advanced techniques that may decrease patient harm in two ways. SRNAs are developing advanced skills and making mistakes in a simulation instead of on an actual patient. Second, SRNAs are improving their self-efficacy, leading to greater clinical proficiency and opportunities for further learning (Imus et al., 2017). Simulation training on advanced technical procedures offers the chance of failure in a safe environment. Successful completion in a simulated environment is possible after learning from mistakes made in practice. Once the failures are overcome, and the technique is known in simulation, clinical self-efficacy should be increased (Bandura, 1977).

The opportunity for simulation training in anesthesia includes instruction in technical procedures and complex cases. Johnson and Lipa (2019) found improved knowledge and self-efficacy in SRNAs after simulation and video training on pulmonary artery (PA) catheter insertions. This advanced technique has a high potential for harm (Hadian & Pinsky, 2006). Using these catheters is also less frequent, limiting actual training opportunities (Johnson & Lipa, 2019). Providing the opportunity for PA catheter insertion in a simulated environment decreases the risk of harm to patients while the learner's self-efficacy increases (Johnson & Lipa, 2019).

Cardiac surgery represents an advanced operating room case that can be challenging and stressful to the anesthesia provider. Staun et al. (2020) found that using a cardiac surgery simulation improves self-efficacy in SRNAs before their cardiac rotation. The authors suggest using their simulated cardiac surgery template in other specialty rotations that SRNAs complete. SRNAs must have a minimum number of operating room cases involving cardiac surgery, obstetrics, and pediatrics, which are often completed while on specialty rotations in these areas (COA.org, n.d). Building self-efficacy in advanced technical procedures, complex patient populations, and complex specialty rotations challenges nurse anesthesia educators. The use of simulation training offers a way to develop self-efficacy even in difficult environments (Johnson & Lipa, 2019; Staun et al., 2020).

Simulation of Critical Anesthesia Events

In addition to the simulation of technical procedures performed by anesthetists, the simulation of critical events in anesthesia is a powerful tool in preparing the SRNA for rare but critical events that may occur. Critical anesthesia events include unexpected dangerous scenarios that happen in the operating room. These events may range from a patient experiencing a cardiac arrest to an unanticipated difficult airway requiring a surgical airway (Arriaga et al., 2019). Wunder et al. (2020) implemented a simulated operating room fire for SRNAs and found that the students demonstrated strong technical and non-technical skills in managing the critical event. Similarly, Erlinger et al. (2019) found high-fidelity and virtual simulation training useful in SRNA detection of intraoperative myocardial infarction. Simulation training was also important in maintaining advanced cardiac life support skills for nurse anesthetists (Gabbard & Smith-Steinert, 2021) and improving interprofessional interactions during the establishment of an emergency airway led by SRNAs (Dabney, 2022).

Critical anesthesia events are stressful and require time-sensitive decisions to prevent patient morbidity and mortality (Arriaga et al., 2019). Research has been conducted on the development of cognitive aids to be used in these events (Clebone et al., 2017), as well as the timing of when the cognitive aids are used. Clebone et al. (2020) found SRNAs and anesthesia residents were likely to implement first critical steps before consulting an emergency manual in simulated pediatric intraoperative critical events. The use of cognitive aids along with simulation training has grown as healthcare providers understand the potential for failure in managing rare but critical events (Hannenberg, 2020). Simulation continues to play a vital role in preparing for critical events (Weinger et al., 2017). Marynen et al. (2020) note that events with a low opportunity to experience but high urgency for medical intervention constitute areas where simulation is critical.

The simulation of critical anesthesia-related events has been used across multiple types of surgical specialties and patient populations. Rodrigo et al. (2024) found neuroanesthesia simulation a useful complement to real-life exposure to critical neurosurgical events. Gerard et al. (2024) found a reduction in maternal hemorrhage morbidity following simulation education. Similarly, Daelemans et al. (2021) found improved patient outcomes following obstetric simulation of crisis resource management. Simulation training continues to play a role in the initial education of SRNAs, as well as the continuing education of nurse anesthetists and other anesthesia providers.

Debriefing in Simulation

The addition of debriefing is critical to simulation learning experiences (Bauchat & Seropian, 2020). Decker et al. (2021) note that debriefing aims to identify and resolve gaps discovered during a simulation learning process. Coomes (2019) considers the debriefing process a time for students and faculty to reflect on what happened during the simulation and what was learned. This is an essential step in integrating theoretical knowledge with practical knowledge. Seam et al. note that learning is achieved through the simulation experience and guided debriefing following the learning experience. Additionally, Patel et al. (2021) note that debriefing after a crisis management simulation improves performance and trainee confidence.

Debriefing in simulation education occurs most commonly at the end of a simulation experience but may also take place during the experience. Schober et al. (2019) considered stop-and-go debriefing and found no adverse effect on skill acquisition compared with post-scenario debriefing. The debriefing may be faculty-led or peer-led. However, Kim and Yoo (2020) note that peer-led debriefing may be better suited to licensed professionals than unlicensed students who may demonstrate a knowledge gap. Regardless of the timing or who is leading the debrief, this discussion is critical for students to understand better the clinical knowledge needed for the appropriate decision-making process demonstrated in the simulation experience (Abulebda et al., 2019).

Progression to Clinical

Higher levels of self-efficacy should produce greater clinical success (Opacic, 2003). Simulation training may improve self-efficacy (Johnston, 2022). It is the hope of nurse anesthesia educators that successful simulation training will lead to successful clinical experiences. As mentioned, Hulsey and Culpepper (2021) noted that simulation training effectively increased clinical self-efficacy. On a related note, the overall wellness of SRNAs appears to have a positive relationship with perceived self-efficacy (Griffin, 2017). The rigorous nature of clinical experience in nurse anesthesia programs can lead to stress and burnout (Conner, 2015). A high clinical caseload may hurt SRNA self-efficacy (Imus et al., 2017), reducing wellness. Reduced wellness may ultimately impact clinical performance by reducing overall emotional and physical well-being (Griffin, 2017).

Simulation experience allows the SRNA to practice essential skills and learn to manage critical events before encountering them in an operating room (Erlinger et al., 2019). SRNAs will undoubtedly experience stress and the threat of burnout while in their training (Horvath, 2021). Exposing SRNAs to a simulated environment may help build the perceived self-efficacy needed for improved wellness among SRNAs. Rushton et al. (2021) found high-fidelity simulation to effectively enhance nursing skills in dealing with moral adversity in clinical practice.

Bandura's (1977) work on self-efficacy demonstrated that a negative physiologic response will likely lead to reduced levels of self-efficacy. Simulation experience offers education in a less-threatening environment (Liaw et al., 2019). Selected stressors may be implemented to mirror the climate SRNAs will practice in. This allows for multiple sources of self-efficacy to be accounted for through performance accomplishments and vicarious experiences while avoiding a negative physiologic response and potentially decreasing self-efficacy (Bandura, 1977).

Recognizing the importance of simulation training, the Council on Accreditation for Nurse Anesthesia programs has adopted standards for incorporating simulation training into every nurse anesthesia program (COA.org, n.d). The COA has noted the applicability of simulation training to improve patient care using the anesthesia machine, ultrasound training, central venous catheter training, cardiopulmonary bypass training, transesophageal echocardiography training, and advanced airway training (COA.org, n.d). The COA also notes that most studies showing knowledge transfer from a simulated environment into the clinical setting are not specific to nurse anesthesia programs (COA.org, n.d). This demonstrates the need for further research on the particular effect of simulation training in the SRNA population.

Simulation experience may improve clinical self-efficacy by providing training in areas not encountered frequently. Forbis (2018) found an increased perceived self-efficacy following training in managing a complex airway scenario. This corresponds to similar studies evaluating the use of simulation in lower-frequency procedures and cases and their effect on SRNA self-efficacy (Johnson & Lipa, 2019; Staun et al., 2020). By providing simulation experience in these areas, SRNAs build clinical self-efficacy before participating in these less frequent procedures and cases.

Development of Simulation Curriculum

With the need for simulation training, anesthesia educators must focus on implementing simulation scenarios into their curriculum. Kazior et al. (2021) found integrating simulation experience into their anesthesiology residency curriculum feasible by planning various critical anesthesia scenarios to be employed in a high-fidelity setting. Based on post-simulation survey results, the researchers found the simulation sessions to provide a relevant experience where the residents could effectively learn. Essential factors in creating this learning environment included providing clearly defined objectives, utilizing instructors who were knowledgeable about the material, allotting sufficient time, and covering relevant information to the learner (Kazior et al., 2021).

Development of a simulation curriculum may present a difficult task to educators not well versed in this area. However, various resources exist to help the educator build anesthesia scenarios and develop their curriculum. Wilcocks et al. (2020) found the use of the anesthesia crisis scenario builder to be easy to use even by those with limited programming knowledge. Additionally, high-fidelity simulators are not always necessary. Levy et al. (2021) found that creating an in-situ operating room multidisciplinary simulation program required a mock patient while using available operating room resources. Alinier et al. (2019) note, “Low-budget simulation is not synonymous with low-quality education” (p. 667).

Research Needed on SRNA Simulation and Self-Efficacy

While the effect of simulation experience on building self-efficacy has been demonstrated across multiple health disciplines (Francis et al., 2020; Ivey et al., 2018; Kozhevnikov et al., 2018; Li et al., 2019; Nebergall et al., 2021), there is a need to demonstrate this in the SRNA population. Preliminary studies on the impact of simulation in complex procedures and cases and simulated critical events have noted improved self-efficacy in SRNAs (Johnson & Lipa, 2019; Staun et al., 2020), but more studies are needed to validate these findings. Simulation in advanced airway techniques has been shown to increase SRNA self-efficacy (Forbis, 2018), but more research is required to generalize these results. Furthermore, the accrediting body for nurse anesthesia programs has incorporated curriculum standards that specify the needed use of simulation training (COA.org, n.d). These standards apply to nurse anesthesia programs but are not based on studies that looked explicitly at SRNAs.

The construct of self-efficacy has been considered as it relates to SRNA wellness (Griffin, 2017; Imus et al., 2017), but more research is needed to understand the connection between simulation training and clinical self-efficacy in SRNAs. Self-efficacy has also been considered as it relates to SRNA retention (Conner, 2015) and the role of self-efficacy in transitioning from SRNA to CRNA (Tracy, 2017). Self-efficacy in the SRNA population has been considered in doctoral studies focused on self-efficacy and clinical timing (Le Dang et al., 2021), the development of self-efficacy through a mindfulness program (Matthew & Padden, 2020), the use of a standardized post-anesthesia care unit handoff in improving

SRNA self-efficacy (Reniva & Matthew, 2019), the effect of cognitive aids on SRNA self-efficacy when used in the simulation of an amniotic fluid embolism crisis, and the impact of mentorship on SRNA self-efficacy during the clinical transition (Medakovich, 2019). There is a noticeable gap in considering SRNA clinical self-efficacy resulting from simulation training.

The proposed study will address the current gap in the literature by considering the impact of simulation training on the SRNA population. By focusing on complex procedures like regional neuraxial anesthetic technique, and peripheral nerve block simulation, more will be added to the body of literature demonstrating the impact of simulation experience on SRNA clinical self-efficacy. The literature has shown a positive relationship between simulation experience and clinical self-efficacy in other health professions, but more research is needed on the SRNA population specifically.

Summary

The construct of self-efficacy has been widely studied across multiple domains. Self-efficacy has been demonstrated to be a factor in successful clinical performance among health science students. Simulation training has grown from a primary use in the aviation industry to being incorporated more into health science training. Multiple studies have shown how simulation training in health science programs helps prevent patient harm by providing training before live patients are encountered. Simulation training in health sciences may be accomplished through high and low-fidelity simulators, computer programs, and virtual reality. The use of cognitive aids and debriefing has bolstered the effectiveness of simulation training. The accrediting body for nurse anesthesia programs has incorporated simulation training as a standard educational tool for all programs. Multiple studies have demonstrated the positive impact of simulation training on self-efficacy in health science programs ranging from pharmacy to physical therapy. Simulation training allows for the most significant self-efficacy source of performance accomplishment. Vicarious experience, verbal persuasion, and emotional arousal may all be considered in simulation training to build a student's self-efficacy. Preliminary studies have shown a positive effect of simulation experience on self-efficacy in nurse anesthesia programs. However, more research is needed to demonstrate this same result in student registered nurse anesthetists.

CHAPTER THREE: METHODS

Overview

The purpose of this quantitative, causal-comparative study was to explore the effect of simulation training on clinical self-efficacy in Student Registered Nurse Anesthetists (SRNAs). This study considered the cause-and-effect relationship between simulation training and self-efficacy. After a discussion of the design and the research supporting its use, all variables will be defined. The specific research questions and their null hypothesis will be described. Finally, the participants, setting, instrumentation, procedures, and data analysis will all be described in detail.

Design

For this study, a quantitative, non-experimental, causal-comparative design was used to explore if there is a difference for SRNAs in clinical self-efficacy between no simulation experience and one or more sessions of simulation experience in performing a neuraxial anesthetic technique and peripheral nerve block technique. This ex-post facto study was non-experimental and focused on a cause-and-effect relationship, which meets the definition of causal-comparative research (Gall et al., 2007, p.634). The research questions in this study were all focused on areas related to clinical practice and are suited to a causal-comparative design (Umstead & Mayton, 2018). The independent variables in causal-comparative research must not be manipulated, and they may be categorical, as well as ordinal or nominal (Gall et al., 2007, p. 306). This study considered preexistent groups that were not randomized and, therefore, not experimental. The two independent variables in this study were not manipulated, were categorical, and represented preexisting groups.

Limitations of this study included the fact that no direct inferences may be drawn from the data (Gall et al., 2007, p.314). Though a positive relationship may be found, experimental data would need to be considered to further prove the simulation experience's impact on SRNA self-efficacy. Firm conclusions were not possible, but future experimental studies may be based on this design (Gall et al., 2007, p. 306). Similar studies have used the causal-comparative design in consideration of simulation experience. Blakeslee (2020) and Darby (2017) both considered the effect of simulation experience on the critical thinking skills of nursing students through causal-comparative research. Curran et al. (2015) used a causal-comparative design in consideration of standardized patients in interprofessional simulation education. Causal-comparative studies are used when existing relationships are being explored in groups of individuals (Azalea, 2022, p. 366) as in this study.

For RQ1, the independent variable was simulation experience and included two groups: SRNAs with no neuraxial anesthesia simulation experience before performing this procedure in clinical, and SRNAs with one or more sessions of neuraxial anesthesia simulation experience before performing this procedure in clinical. The dependent variable for RQ1 was clinical self-efficacy. For RQ2, the independent variable was simulation experience and included two groups: SRNAs with no peripheral nerve block simulation experience before performing this procedure in clinical and SRNAs with one or more sessions of peripheral nerve block simulation experience before performing this procedure in clinical. The dependent variable for RQ2 was clinical self-efficacy. Healthcare simulation is defined as using a patient surrogate to teach, educate, assess, and conduct research (Levine et al., 2013).

Research Questions

RQ1: Is there a difference for SRNAs in clinical self-efficacy between SRNAs with no neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique in clinical and SRNAs with one or more sessions of neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique in clinical?

RQ2: Is there a difference for SRNAs in clinical self-efficacy between SRNAs with no peripheral nerve block simulation experience before performing a peripheral nerve block in clinical and SRNAs with one or more sessions of peripheral nerve block simulation experience before performing a peripheral nerve block in clinical?

Hypotheses

$H_0$1: There is no difference in clinical self-efficacy for SRNAs with no neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique in clinical and SRNAs with one or more sessions of neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique in clinical.

$H_0$2: There is no difference in clinical self-efficacy for SRNAs with no peripheral nerve block simulation experience before performing a peripheral nerve block in clinical and SRNAs with one or more sessions of peripheral nerve block simulation experience before performing a peripheral nerve block in clinical.

Participants and Setting

In this section, the study population will be described in detail. This will include a discussion of the participants, sampling technique, and setting description. Doctoral nurse anesthesia programs will be described along with essential considerations on clinical experience and simulation experience. There will also be a discussion of the student registered nurse anesthetist.

Population

For this study, participants were obtained from a convenience sample of SRNAs enrolled in doctoral nurse anesthesia programs in the United States. SRNAs are baccalaureate-prepared registered nurses with a minimum of one year of experience working in an intensive care unit (AANA.com, n.d). There are 130 accredited graduate nurse anesthesia programs in the United States (AANA.com, n.d). Each program is at the doctorate level and ranges from 24-51 months (AANA.com, n.d). SRNAs must gain the required amount of clinical experience and complete their respective program before they are allowed to take the national certifying exam (AANA.com, n.d).

Forty-nine doctoral nurse anesthesia programs across 13 different states participated in this study. The various programs differ in when their students begin clinical rotations. In some of the programs, clinical rotations start during the second year of enrollment and are considered front-loaded with didactic courses. Some of these "front-loaded" programs do not provide one or more sessions of simulation experience before the SRNAs begin clinical rotations. The other programs expose their students to simulation training at various times throughout the three-year program.

A convenience sample of SRNAs was taken by an electronic survey sent to 49 different program directors in the United States. The survey items were incorporated into a digital Survey Monkey and emailed through the program directors of each nurse anesthesia program being sampled. Clinical coordinators in the State of Michigan also received the survey to disseminate to their students, and an online URL invite was posted on an SRNA social media page. The survey began with a clear definition of simulation experience, and self-efficacy, and then asked for the number of specific simulation sessions before completing the procedure in clinical. SRNAs were asked to complete the self-efficacy survey based on when they first performed a neuraxial anesthetic technique and peripheral nerve block technique in clinical. SRNAs were also asked to indicate their academic year.

Participants

One hundred and four participants were sampled which exceeded the required sample size (100) for *t* test when assuming a medium effect size with a statistical power of .7 at the .05 alpha level (Gall et al., 2007, p. 145). The sample consisted of SRNAs in 49 doctoral nurse anesthesia programs across 13 different states. The SRNAs represented various levels of clinical experience and exposure to simulation training. There were 7 first-year students, 29 second-year students, and 68 third-year students.

There were 96 students in the group with one or more sessions of neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique and 8 students with no neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique. There were 80 students with one or more sessions of simulated peripheral nerve block experience before performing a peripheral nerve block in clinical and 24 students with no peripheral nerve block simulation experience before performing a peripheral nerve block in clinical.

Setting

SRNAs in this study were from 49 different doctoral nurse anesthesia programs in the United States. The SRNAs were selected from each level of their respective program (first year, second year, and third year), and all SRNAs were in the summer and/or fall semesters. These were all naturally occurring groups. The digital surveys were completed anonymously online through Survey Monkey. All data was stored in a secure file on the researcher's computer.

Instrumentation

To measure SRNA self-efficacy in the clinical setting, the Schwarzer and Jerusalem (1995) General Self-Efficacy scale was used. See Appendix A for the instrument. The purpose of this instrument was to measure general perceived self-efficacy. Studies demonstrating the reliability and validity of this instrument will be presented below.

The one-factor unidimensional GSE was initially developed in Germany to measure self-efficacy. This was based on Bandura's (1977) self-efficacy studies and social cognitive theory. There are multiple studies demonstrating the wide-ranging applicability of this instrument. Imus et al. (2017) applied the scale to SRNAs throughout a three-year anesthesia program. Tsibidaki (2021) used the GSE to measure self-efficacy in families who have members with special needs and disabilities during the COVID-19 pandemic in Greece. Francis et al. (2020) measured used the GSE to measure self-efficacy in physician assistant students who were given a virtual reality simulation.

The GSE has been used internationally and has been adapted into numerous languages. Zhang and Schwarzer (1995) used a Chinese adaptation of the GSE to measure optimistic self-belief. The scale has been used in Costa Rica (Schwarzer et al., 1997), Japan (Sakano, 1986), and other Asian nations, including Korea and Indonesia (Schwarzer et al., 1997). The wide range of application to various cultures and professions makes the scale amenable to the present study.

As the GSE has existed for more than 20 years, numerous studies demonstrate the instrument's validity and reliability (Leganger et al., 2000; Luszczynska et al., 2005; Schwarzer et al., 1999). The instrument's validity has been demonstrated based on numerous multi-national studies (Luszczynska et al., 2005). Löve et al. (2012) demonstrated the validity of the Swedish translation of the GSE by studying the factorial structure. Sakano (1986) described the validity of the GSE in depressive patients scoring significantly lower GSE scores. Schwarzer and Jerusalem (1995) note that their criterion-related validity has been shown in numerous studies where positive coefficients corresponded to favorable emotions, optimism, and work satisfaction. Additionally, negative coefficients were found with depression, anxiety, stress, burnout, and health complaints (Schwarzer & Jerusalem, 1995).

The reliability of the GSE has been demonstrated to be between .87 and .94 (Luszczynska et al., 2005), indicating high reliability (Gall et al., 2007, p. 200). Schwarzer et al. (2002) demonstrated a Cronbach's alpha of .91 in using the GSE as a measure of resource for patients following surgical procedures. Schwarzer and Jerusalem (1995) found Cronbach's alphas ranging from .76 to .90 in studies across 23 different nations. While the scale can be used across many cultures and professions, specific behavior change is not considered. This makes it necessary for researchers to add items to make the scale more particular to the respective study (Schwarzer & Jerusalem, 1995).

The construct validity of the GSE has also been demonstrated (Lazic′ et al., 2018). Positive coefficients have been described related to favorable emotions, optimism, and work satisfaction with negative coefficients associated with depression, anxiety, stress, burnout, and health complaints (Schwarzer & Jerusalem, 1995). The construct validity of the GSE has been found in global studies. Luszynska et al. (2005) found the construct of perceived self-efficacy measured by the GSE to be applicable to participants from 25 different countries. Yudhistira and Muzdalifah (2021) found the the written statements on the GSE valid based on Confirmatory Factor Analysis performed on 643 Indonesian students.

The instrument is a ten-item Likert scale that measures individual belief in ability. Each item on the scale has four possible choices, including: "Not true at all=1, Barely true= 2, Moderately true =3, Exactly true= 4" (Schwarzer & Jerusalem, 1995). The highest possible score is 40, indicating a strong perception of self-efficacy. The lowest possible score is 10, indicating a weaker sense of self-efficacy in the items tested. The questions on the scale all measure areas that indicate an individual's perceived belief in her ability to accomplish a task (Bandura, 1977).

Measuring clinical self-efficacy in SRNAs by using the GSE is appropriate based on numerous studies that have found the GSE relevant for clinical practice (Barlow et al., 1996; Koring et al., 2012; Imus et al., 2017; Luszczynska et al., 2005; Schwarzer et al., 2007). For this study, the instrument was used in the context of clinical rotations. Participants were asked to answer the questions in reference to their clinical experience. It requires an average of 4 minutes to complete this scale (Schwarzer & Jerusalem, 1995). The results were scored by this author. Permission to use this instrument was granted for all research studies that properly cite the authors (See Appendix B).

Procedures

Following IRB permission from Liberty University, the online survey program, Survey Monkey, was used to input the ten items from the GSE instrument along with a description of the study. Program directors from all participating doctoral nurse anesthesia programs were contacted to grant permission for their students to participate. Clinical coordinators from various hospitals in Michigan were also emailed to request participation. After approval from the program directors and clinical coordinators, an email link was sent from either the program director or clinical coordinator to all eligible students, and responses were returned anonymously. An informed consent form was available on the first page of the electronic survey.

On the survey, participants were asked to indicate their academic year and approximate sessions of neuraxial and peripheral nerve block simulation experience before performing these techniques in clinical. The survey included a description of self-efficacy. The scores from each survey were imported into SPSS for data analysis. The data was then analyzed, and the results were reported. As the survey responses were anonymous, no participant names were attached to the survey results. All information was stored on the researcher's laptop and kept securely.

Data Analysis

To test the independent variables of one or more sessions of neuraxial anesthesia simulation experience before performing a neuraxial anesthetic in clinical, and one or more sessions of peripheral nerve block simulation experience before performing a peripheral nerve block in clinical, two independent *t* tests were conducted using the survey data from the GSE. Results are reported below. Considering the research questions involved two groups:

group 1: one or more sessions of simulation experience, and group 2: no sessions of simulation experience, the independent *t* test was the appropriate measure. Warner (2020) states, "The independent-samples *t*-test is used to evaluate whether the means of a Y-dependent variable differ significantly across two groups" (p. 329).

Two independent samples *t* tests were used to test the difference in means between the independent variable of SRNAs with one or more sessions of simulation experience and the dependent variable of clinical self-efficacy. Descriptive statistics are described below (see table 1). A normal data distribution was first assessed through visual screening of box and whisker plots which revealed no outliers. Independent *t* tests require assumptions of normality, homogeneity of variance, and independence of Y scores between and within groups (Warner, 2020). Assumption of normality was assessed through the Kolmogorov-Smirnov test (Warner, 2020, p. 148). The Komogorov-Smirnov test is more appropriate when the sample size is greater than 50 as in this study (Mishra et al., 2019). The kurtosis and skewness of the data were also assessed. The homogeneity of variance was assessed by Levene's F test (Warner, 2020, p. 332). Data from the computed t-tests were compared to α =.05. Effect sizes for all tests were reported using Cohen's *d*. See table 4 and table 7.

CHAPTER FOUR: FINDINGS

Overview

The purpose of this quantitative causal-comparative study was to explore the effect of simulation training on SRNA self-efficacy. Simulation experience of neuraxial and peripheral nerve block techniques prior to performing these procedures in the clinical setting was considered. This chapter will describe the research findings from the survey of nurse anesthesia programs in the United States using the General Self-Efficacy (GSE) scale. This will include descriptive statistics for each research question and the result of the null hypothesis.

Research Questions

RQ1: Is there a difference for SRNAs in clinical self-efficacy between SRNAs with no neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique in clinical, and SRNAs with one or more sessions of neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique in clinical?

RQ2: Is there a difference for SRNAs in clinical self-efficacy between SRNAs with no peripheral nerve block simulation experience before performing a peripheral nerve block in clinical and SRNAs with one or more sessions of peripheral nerve block simulation experience before performing a peripheral nerve block in clinical?

Null Hypothesis(es)

$H_0$1: There is no difference in clinical self-efficacy for SRNAs with no neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique in clinical and SRNAs with one or more sessions of neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique in clinical.

$H_0$2: There is no difference in clinical self-efficacy for SRNAs with no peripheral nerve block simulation experience before performing a peripheral nerve block in clinical and

SRNAs with one or more sessions of peripheral nerve block simulation experience before performing a peripheral nerve block in clinical.

Descriptive Statistics

Demographics

Participants in this study included 104 student registered nurse anesthetists (SRNAs) from doctoral nurse anesthesia programs across 13 different states. Respondents to the survey were all current students completing clinical rotations. Anonymity was ensured by having students only report their academic year, along with the number of simulation sessions completed for neuraxial and peripheral nerve block anesthetic techniques. Participants were then asked to complete the GSE survey based on their first clinical performance of the indicated procedure (neuraxial or peripheral nerve block anesthetic technique).

The survey was sent to 49 doctoral nurse anesthesia programs across 13 states and respondents included 68 (65.4%) third-year- students, 29 (27.9%) second-year students, and 7 (6.7%) first-year students. Participants were grouped according to no neuraxial simulation experience prior to performing a neuraxial anesthetic technique in clinical, one or more sessions of neuraxial simulation experience prior to performing a neuraxial anesthetic technique in clinical, no peripheral nerve block simulation experience prior to performing a peripheral nerve block anesthetic technique in clinical, and one or more sessions of peripheral nerve block simulation prior to performing a peripheral nerve block technique in clinical. Respondents included 8 SRNAs who had no neuraxial simulation experience prior to performing a neuraxial technique in clinical and 96 SRNAs who had one or more sessions of neuraxial simulation experience prior to performing a neuraxial technique in clinical. Respondents also included 24 SRNAs who had no peripheral nerve block simulation experience before performing a peripheral nerve block technique in clinical and 80 SRNAs who had one or more sessions of peripheral nerve block simulation prior to performing a peripheral nerve block technique in clinical.

Study Variables

The dependent variable of clinical self-efficacy was measured from responses to the Schwarzer and Jerusalem General (1995) Self-Efficacy Scale (GSE). The participants answered 10 questions which were answered on a Likert-type scale with the possible answers being not true at all, hardly true, moderately true, and exactly true. The participants answered the questions to the GSE two times with one time in the context of performing a neuraxial anesthetic technique for the first time in clinical, and the other context being performance of a peripheral nerve block anesthetic technique for the first time in clinical. Each answer was weighted with one point for the answer not true at all, two points for the answer hardly true, three points for the answer moderately true, and four points for the answer exactly true. The highest possible score was 40 and the lowest 10.

For the no neuraxial simulation group, GSE scores ranged from 10 to 38 with a mean of 26 (*SD*= 12.7). For the one or more sessions of neuraxial simulation group, GSE scores ranged from 22 to 40 with a mean of 31.6 (*SD*= 3.5). See Table 1. For the no peripheral nerve block simulation group, GSE scores ranged from 10 to 38 with a mean of 26.9 (*SD*= 9.0). For the one or more sessions of peripheral nerve block simulation, GSE scores ranged from 20 to 40 with a mean of 30.2 (*SD*= 4.5). See Table 2.

Table 1

Neuraxial Descriptive Statistics

NA		*n*	Minimum	Maximum	*M*	*SD*
No Sim	NAGSE	8	10	38	26.00	12.694
	Valid N (listwise)	8				
Sim	NAGSE	96	22	40	31.58	3.496
	Valid N (listwise)	96				

Table 2

Peripheral Nerve Block Descriptive Statistics

PNB		*n*	Minimum	Maximum	*M*	*SD*
No Sim	PNBGSE	24	10.00	38.00	26.9167	9.00684
	Valid N (listwise)	24				
Sim	PNBGSE	80	20.00	40.00	30.2125	4.47127
	Valid N (listwise)	80				

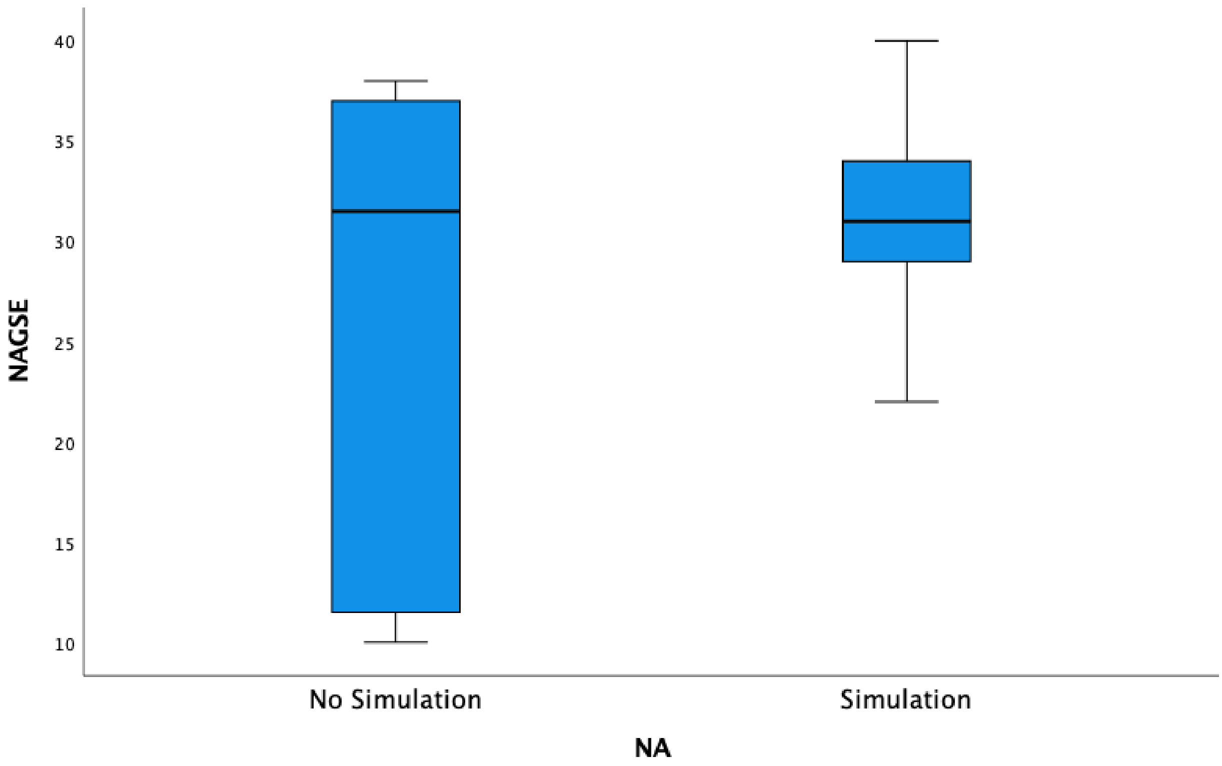
Results

Hypothesis 1

The null hypothesis corresponding to Research Question 1 states that there is no difference in clinical self-efficacy for SRNAs with no neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique in clinical and SRNAs with one or more sessions of neuraxial anesthesia simulation experience before performing a neuraxial anesthetic technique in clinical. Preliminary data screening revealed no extreme outliers. See Figure 1.

Figure 1

Box and Whisker Plot for Neuraxial Clinical Self-Efficacy



An independent *t*-test was conducted considering clinical self-efficacy along with assumption tests for normality and homogeneity of variance. Additional assumptions were met including one dependent variable being measured at the continuous level, one independent variable measured consisting of two categorical, independent groups (no simulation versus one or more sessions of simulation). No participants were members of both the no simulation and one or more simulation session groups.

The assumption of normality was assessed using the Kolmogorov-Smirnov which is appropriate for sample sizes greater than 50 (Mishra et al., 2019). See Table 3.

Table 3

NA Tests of Normality

		Kolmogorov-Smirnov[a]		
	NA	Statistic	*df*	Sig.
NAGSE	No Simulation	.278	8	.069
	Simulation	.098	96	.025

a. Lilliefors Significance Correction

The results showed that the assumption of normality was violated with a significance value of $p = .069$ and $p = .025$ which is less than the alpha level set at $p < 0.05$. The assumption of normality was also tested according to the skewness and kurtosis of the data, which revealed a normal distribution of the data with skewness $z = -0.70$, and kurtosis $z = -1.4$ for the no simulation group, and skewness $z = -.03$ and kurtosis $z = 1.2$ for the one or more simulation sessions group. A Levene's test was then used to examine the homogeneity of variance and assess if the error variance of general self-efficacy scores was equal between the no simulation and one or more simulation sessions groups. The results indicated that this assumption was not met with $p = .000$ at the $p < 0.05$ level. See Table 4.

Table 4

NA Levene's Test

		Levene Statistic	*df*1	*df*2	Sig.
NAGSE	Based on Mean	98.428	1	102	.000
	Based on Median	37.787	1	102	.000
	Based on Median and with adjusted *df*	37.787	1	22.952	.000
	Based on trimmed mean	95.447	1	102	.000

A t-test for Equality of Means was conducted with t (102)= -3.203, p= .25, and Cohen's d= -1.179 for a small effect size. Self-efficacy for SRNAs with no neuraxial simulation experience showed no statistically significant difference from SRNAs with one or more neuraxial simulation experiences. Therefore, the researcher failed to reject the null hypothesis. See Table 5.

Table 5

NA Independent Samples T Test

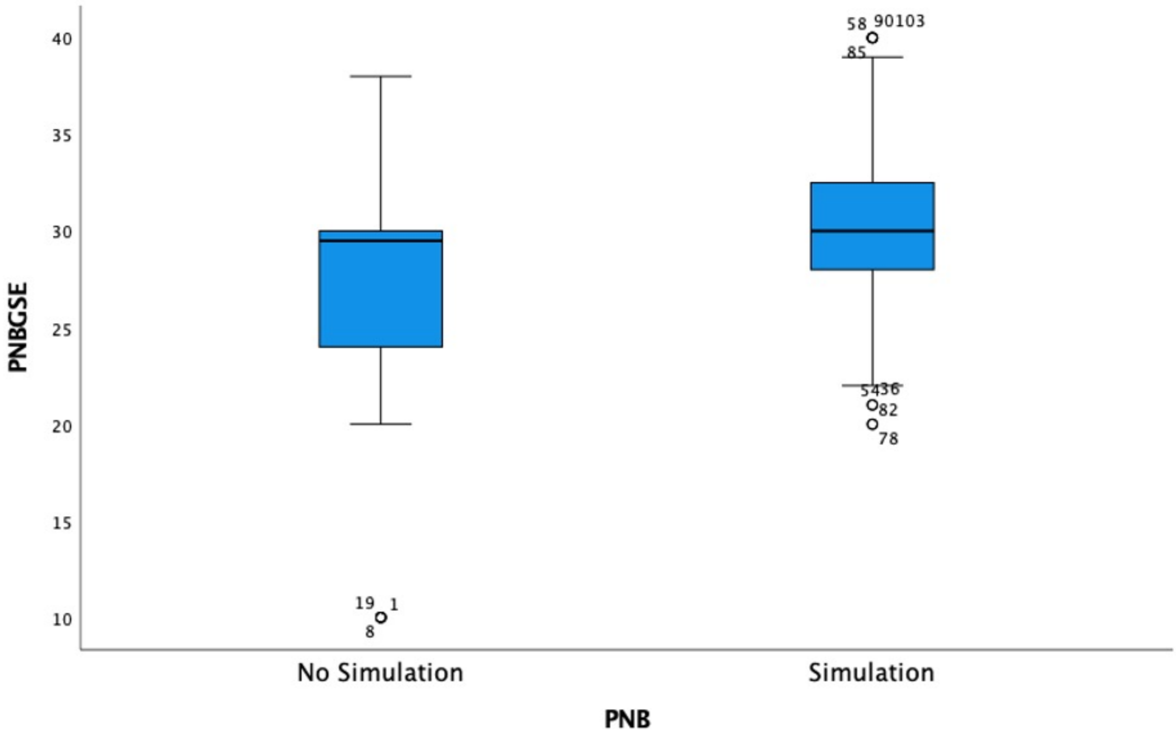
			Neuraxial GSE	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	*F*		98.428	
	Sig.		.000	
t-test for Equality of Means	t		-3.203	-1.240
	df		102	7.089
	Sig. (2-tailed)		.002	.254
	Mean Difference		-5.583	-5.583
	Std. Error Difference		1.743	4.502
	95% Confidence Interval of the Difference	Lower	-9.041	-16.202
		Upper	-2.125	5.036

Hypothesis 2

The null hypothesis corresponding to Research Question 2 states that there is no difference in clinical self-efficacy for SRNAs with no peripheral nerve block simulation experience before performing a peripheral nerve block anesthetic technique in clinical and SRNAs with one or more sessions of peripheral nerve block simulation experience before performing a peripheral nerve block anesthetic technique in clinical. Preliminary data screening revealed no extreme outliers. See Figure 2.

Figure 2

Box and Whisker Plot for Peripheral Nerve Block Clinical Self-Efficacy



An independent *t*-test was conducted considering clinical self-efficacy along with assumption tests for normality and homogeneity of variance. Additional assumptions were met, including one dependent variable being measured at the continuous level, and one independent variable measured consisting of two categorical, independent groups (no simulation versus one or more sessions of simulation). No participants were members of both the no simulation and one or more simulation session groups.

The assumption of normality was assessed using the Kolmogorov-Smirnov which is appropriate for sample sizes greater than 50 (Mishra et al., 2019). See Table 6.

Table 6

Peripheral Nerve Block Test of Normality

		Kolmogorov-Smirnov[a]		
	PNB	Statistic	*df*	Sig.
PNBGSE	No Simulation	.216	24	.005
	Simulation	.131	80	.002

a. Lilliefors Significance Correction

The results showed that the assumption of normality was violated with a significance value of p = .005 and p = .002 which is less than the alpha level set at $p < 0.05$. The assumption of normality was also tested according to the skewness and kurtosis of the data, which revealed a normal distribution of the data with skewness z= -1.84, and kurtosis z = -.035 for the No simulation group, and skewness z = 0.29, and kurtosis z = 0.86 for the one or more simulation sessions group. A Levene's test was then used to examine the homogeneity of variance and assess if the error variance of general self-efficacy scores was equal between the no simulation and one or more simulation sessions groups. The results indicated that this assumption was not met with p=.000 at the p <0.05 level. See Table 7.

Table 7

Peripheral Nerve Block Levene's Test

		Levene Statistic	*df*1	*df*2	Sig.
PNBGSE	Based on Mean	16.749	1	102	.000
	Based on Median	9.502	1	102	.003
	Based on Median and with adjusted df	9.502	1	58.532	.003
	Based on trimmed mean	15.376	1	102	.000

A t-test for Equality of Means was conducted with t (102)= -1.7, p= .095, and Cohen's d= -.57 for a small effect size. Self-efficacy for SRNAs with no peripheral nerve block simulation experience showed no statistically significant difference from SRNAs with one or more peripheral nerve block simulation experiences. Therefore, the researcher failed to reject the null hypothesis. See Table 8.

Table 8

Peripheral Nerve Block Independent Samples T Test

			Peripheral Nerve Block GSE	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	*F*		16.749	
	Sig.		.000	
t-test for Equality of Means	t		-2.437	-1.730
	df		102	26.484
	Sig. (2-tailed)		.017	.095
	Mean Difference		-3.296	-3.296
	Std. Error Difference		1.353	1.905
	95% Confidence Interval of the Difference	Lower	-5.979	-7.209
		Upper	-.613	.617

CHAPTER FIVE: CONCLUSIONS

Overview

This chapter will discuss the results of this causal-comparative study of the effect of neuraxial and peripheral nerve block simulation experience on SRNA clinical self-efficacy. Implications of this study will be described along with limitations. The chapter will conclude with recommendations for future research.

Discussion

The purpose of this quantitative, causal-comparative study was to explore the effect of simulation training on clinical self-efficacy in Student Registered Nurse Anesthetists (SRNAs). Two specific anesthetic techniques were considered, including the performance of spinal or epidural anesthesia (neuraxial technique) and the performance of a peripheral nerve block anesthetic technique. The Schwarzer and Jerusalem (1995) General Self-Efficacy Scale (GSE) was utilized as a part of a survey sent to 49 doctoral nurse anesthesia programs across 13 different states. Participants were asked to indicate their academic year, number of neuraxial simulation sessions completed prior to performing this procedure in clinical, and the number of peripheral nerve block simulation sessions completed prior to performing this procedure in clinical. Participants were then asked to complete the GSE first in reference to performing a neuraxial technique in clinical for the first time, and then in reference to performing a peripheral nerve block in clinical for the first time. If there is a difference between GSE scores between SRNAs with no simulation versus SRNAs with one or more simulation sessions, then this warrants future exploration into bolstering the simulation curriculum of nurse anesthesia programs.

The first research question of this causal-comparative study considered whether a difference in clinical self-efficacy exists between SRNAs with no neuraxial simulation experience and SRNAs with one or more sessions of neuraxial simulation experience before completing this procedure in clinical. The results of this study indicate that there was no statistically significant difference between SRNAs who had no neuraxial simulation prior to completing this technique in clinical and SRNAs who had one or more neuraxial simulation sessions prior to completing this procedure in clinical. Despite these findings, other researchers have found improved self-efficacy related to simulation sessions in other anesthesia-related procedures, including a simulated cannot intubate or oxygenate high-fidelity scenario given to anesthesia trainees (Berwick et al., 2019). Similarly, Staun et al. (2020) found improved self-efficacy scores in SRNAs following a cardiac surgery high-fidelity simulation session.

One notable finding from this causal-comparative study was that while there was not a statistically significant difference in self-efficacy scores when considering neuraxial simulation, the minimum score for those with no neuraxial simulation sessions was much lower in comparison with the one or more neuraxial simulation sessions group. It is possible that low participants in the no neuraxial simulation group may have contributed to the lack of statistical significance. Tujuague (2019) found no statistically significant improvement in SRNA self-efficacy following high-fidelity simulation and proposed that low participant turnout likely generated these results.

Warner (2020) suggests that the robustness of the independent *t* test precludes the need for a Levene test and recommends reporting the equal variances assumed even when this assumption has been violated (p. 333). Statistical significance was found when considering the equal variances assumed for neuraxial self-efficacy ($p = .002$), however, due to the low sample size, this researcher used the values associated with the equal variances not assumed. While the mean self-efficacy score was lower for the no neuraxial simulation group in comparison with one or more sessions of neuraxial simulation, this was not found to be statistically significant. One possible factor in this study may have been the overall self-efficacy of the SRNAs completing the survey. Imus et al. (2017) note that SRNAs with higher self-efficacy are likely to seek out more challenging clinical opportunities that will improve their overall clinical performance. Bandura (1977) noted that self-efficacy is generalizable across fields. If SRNAs were already functioning with high levels of self-efficacy, then the effect of simulation training may not have been as profound in this group. Future research should consider measuring general self-efficacy in other clinically related areas before measuring this in performing a neuraxial anesthetic.

The second research question of this causal-comparative study considered if a difference in clinical self-efficacy exists between SRNAs with no peripheral nerve block simulation and SRNAs with one or more sessions of peripheral nerve block simulation sessions before completing this procedure in clinical. The results of this causal-comparative study found no statistically significant difference in clinical self-efficacy between SRNAs with no peripheral nerve block simulation experience and SRNAs with one or more peripheral nerve block simulation sessions before completing this procedure in clinical. Despite these findings, simulation training has been found to improve self-efficacy in various fields, including nursing (Li et al., 2019), pharmacy (Nebergall et al., 2021), physical therapy (Ivey et al., 2018), and medical students (Kozhevnikov et al., 2018). Moreover, the Anesthesia Patient Safety Foundation (APSF) encourages simulation as a way to improve patient safety (Saddawi-Konefka & Cooper, 2020). As with the neuraxial anesthetic technique, peripheral nerve blocks are invasive procedures that potentially place patients in harm's way when inexperienced practitioners are performing the procedure (Wiederhold et al., 2023). Improved clinical performance has been associated with higher self-efficacy (Opacic, 2023), which could also lead to greater patient safety.

Despite the lack of statistical significance found with this research question, the minimum and maximum self-efficacy scores were lower for SRNAs with no peripheral nerve block simulation experiences compared to SRNAs with one or more peripheral nerve block simulation sessions. Lower participant numbers may have once again contributed to these findings. However, as noted above, with Warner's (2020) recommendation to consider the equal variances assumed data even with violation of this assumption, the results of this study would have been statistically significant (p = .017). However, due to the smaller sample size for the no simulation sessions group, this researcher based the results on equal variances not being assumed.

Although the null was not rejected for either research question, participants did have higher clinical self-efficacy scores when they participated in one or more sessions of either neuraxial or peripheral nerve block simulation prior to completing these procedures in clinical. This supports research by Hulsey and Culpepper (2021) and Sudduth (2019) which found improved SRNA self-efficacy following high-fidelity simulation. Invasive procedures are of particular importance when considering how to train students before completing on a live patient. Higher self-efficacy scores with invasive procedures considered in this study support findings from Johnston (2022), who also found improved self-efficacy in CRNAs following an invasive procedure simulation.

SRNAs will continue to perform neuraxial anesthetic techniques as well as peripheral nerve block techniques as required by the Council on Accreditation of Nurse Anesthesia Educational Programs (COACRNA.org.n.d). Simulation training will continue as a requirement for all nurse anesthesia educational programs (COACRNA.org.n.d). Improving patient safety by improving clinical performance may be achieved through higher self-efficacy (Opacic, 2023). Based on the results of this study, simulation of regional anesthesia may help to build SRNA clinical self-efficacy. Simulation training brings in all of the methods of building self-efficacy proposed by Bandura (1977) and may help to mitigate the disparity found in SRNAs by Imus et al. (2017) between self-efficacy in clinical versus the didactic setting. The results of this study, though not statistically significant, still support the call for simulation as a way to build SRNA self-efficacy.

Implications

The results of this study have numerous implications for SRNA educators to consider. SRNAs with no neuraxial or peripheral nerve block simulation sessions reported lower mean scores of clinical self-efficacy. Self-efficacy has been demonstrated to be an important component of clinical performance (Opacic, 2023). SRNAs who have higher self-efficacy are more likely to take on difficult challenges that will ultimately build their clinical practice (Imus et al., 2017). Anesthesia providers with strong clinical experiences in their training are likely to become stronger practitioners. Simulation training not only builds clinical self-efficacy (Hulsey & Culpepper, 2021), but the benefits are likely to extend beyond graduation as SRNAs with greater self-efficacy are more likely to continue to grow in their clinical competence.

There is risk involved with any medical procedure, but the risk increases as the invasive nature of the procedure increases. Neuraxial and peripheral nerve block techniques are invasive procedures with great potential for harm to the patient. Simulation training has been shown to improve patient safety (Saddawi-Konefka & Cooper, 2020) and should be employed as a way for SRNAs to help improve patient safety. While the Council on Accreditation for Nurse Anesthesia Education Programs (COA) does not specify the type of simulation experience that programs should utilize, the results of this study coupled with the inherent risk involved with invasive procedures highlight the need for regional anesthesia simulation training.

SRNAs with greater self-efficacy are more likely to demonstrate greater clinical success (Ghofranipour et al., 2018) as well as academic success (Wu et al., 2020). The results of this study support the findings that simulation training helps in developing SRNA clinical skills (Erlinger et al., 2019). Additionally, performing an invasive procedure on a live patient is a high-stress situation that may not always facilitate the greatest learning experience. A simulated environment allows the educator to control the stress level to some degree and decrease the physiologic arousal in the learner. This, along with accomplishing a performance task, providing verbal feedback, and demonstrating the technique for all learners involved employs all four of Bandura's (1977) sources of self-efficacy.

SRNAs have the opportunity to improve patient safety by growing into competent practitioners. Clinical competency improves when clinical self-efficacy increases. The findings of this study support the use of regional anesthesia simulation training in SRNA education. To help meet the growing demand and existential need for patient safety-focused practitioners, simulation training should be a major component of every SRNA educational program.

Limitations

Despite surveying 49 doctoral nurse anesthesia programs across 13 different states, SRNA participation was low in the no-simulation groups. While the minimum sample size was met, according to Gall et al. (2007), the implications of this study are limited due to the low participation in the no-simulation groups. One threat to the internal and external validity of this study may have been selection bias. As mentioned above, SRNAs who already demonstrate higher self-efficacy may not have demonstrated a profound increase in self-efficacy following simulation training. Similarly, SRNAs with lower self-efficacy to begin with may also have not demonstrated a more profound increase in self-efficacy. This would make the findings less generalizable to the larger population of SRNAs.

Additionally, participants were taken from all cohorts of each surveyed anesthesia program. This creates a potential for recall bias. Recall bias occurs when participants are less likely to relate true information on a survey depending on their outcome (Everson & Marsit, 2020). 65% of the participants in this study were third-year SRNAs soon to be graduating. If these participants completed their first regional anesthetic earlier in the program, it is possible they may not have been able to recall the necessary information to accurately fill out the GSE.

Attempts were made to mitigate these threats by specifying that participants complete the GSE in reference to the first time they completed a neuraxial or peripheral nerve block anesthetic technique. Additionally, the Schwarzer and Jerusalem (1995) GSE was the instrument used as it has been demonstrated to have both strong construct validity and reliability. Programs from 13 different states were surveyed, representing programs with front-loaded didactic instruction as well as integrated clinical and didactic instruction. As stated above, causal-comparative research does have limitations. No direct inferences may be drawn from the data (Gall et al., 2007, p.314), and true experimental data would be needed to support the findings of this study.

Recommendations for Future Research

There is a gap in the literature regarding the effect of simulation training on SRNA self-efficacy. This study has added to the literature by focusing specifically on the simulation of regional anesthetic techniques and their impact on SRNA self-efficacy. There remain numerous recommendations for further study as outlined below:

1. A larger sample size consisting of SRNAs who have not had regional anesthesia simulation prior to performing a regional anesthetic in clinical.
2. A true experimental study considering the change in self-efficacy before a regional anesthesia simulation session and after a regional anesthesia simulation session.
3. Expansion of comparative analysis to include the number of simulation sessions and their effect on clinical self-efficacy.

4. Expansion of type of clinical technique studied to include invasive line access, crisis management, and advanced airway techniques.
5. Consideration of a different tool to measure self-efficacy.
6. Qualitative analysis of methods to improve SRNA simulation experiences.
7. Expansion of comparative analysis to consider self-efficacy scores based on academic year.
8. Expansion of comparative analysis to consider the timing of simulation experience based on the academic year.

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APPENDIX A: PERMISSION TO USE SCHWARZER AND JERUSALEM GSE

Freie Universität Berlin

Fachbereich Erziehungs-
wissenschaft und Psychologie
- Gesundheitspsychologie -

Freie Universität Berlin, Gesundheitspsychologie (PF 10),
Habelschwerdter Allee 45, 14195 Berlin, Germany

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14195 Berlin, Germany

Fax +49 30 838 55634
health@zedat.fu-berlin.de
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Permission granted

to use the General Self-Efficacy Scale for non-commercial reseach and development purposes. The scale may be shortened and/or modified to meet the particular requirements of the research context.

http://userpage.fu-berlin.de/~health/selfscal.htm

You may print an unlimited number of copies on paper for distribution to research participants. Or the scale may be used in online survey research if the user group is limited to certified users who enter the website with a password.

There is no permission to publish the scale in the Internet, or to print it in publications (except 1 sample item).

The source needs to be cited, the URL mentioned above as well as the book publication:

Schwarzer, R., & Jerusalem, M. (1995). Generalized Self-Efficacy scale. In J. Weinman, S. Wright, & M. Johnston, *Measures in health psychology: A user's portfolio. Causal and control beliefs* (pp.35-37). Windsor, UK: NFER-NELSON.

Professor Dr. Ralf Schwarzer
www.ralfschwarzer.de

APPENDIX B: LIBERTY UNIVERSITY IRB APPROVAL LETTER

June 26, 2023

Dear Joseph Kiesznowski, Treg Hopkins,

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and no further IRB oversight is required.

Your study falls under the following exemption category, which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:104(d):

Category 2.(i). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:
The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects;

Your stamped consent form(s) and final versions of your study documents can be found under the Attachments tab within the Submission Details section of your study on Cayuse IRB. Your stamped consent form(s) should be copied and used to gain the consent of your research participants. If you plan to provide your consent information electronically, the contents of the attached consent document(s) should be made available without alteration.

Please note that this exemption only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued exemption status. You may report these changes by completing a modification submission through your Cayuse IRB account.

If you have any questions about this exemption or need assistance in determining whether possible modifications to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,
G. Michele Baker, PhD, CIP
Administrative Chair
Research Ethics Office

APPENDIX C: LETTER TO PROGRAM DIRECTORS

Dear Program Director,

As a doctoral candidate in the School of Education at Liberty University, I am conducting IRB approved research on the impact of simulation training on SRNA self-efficacy as part of the requirements for a Ph.D. degree. The purpose of my research is to investigate if simulation of regional anesthesia techniques (neuraxial and peripheral nerve blocks) builds clinical self-efficacy in SRNAs, and I am writing to invite your students to participate in this study.

Participants must be SRNAs currently enrolled in your program. Participants will be asked to take an anonymous, online survey. It should take approximately 5 minutes to complete the survey. Participation will be completely anonymous, and no personal, identifying information will be collected.

To request your students to participate, please email the attached recruitment letter to all 3 cohorts of your program.

A consent form is provided as the first page of the survey. The consent document contains additional information about my research.

Additional IRB information is located on the first page of the online survey. Because participation is anonymous, participants do not need to sign and return the consent document unless they would prefer to do so. After participants have read the consent form, they may proceed to complete the survey. Doing so will indicate that they have read the consent information and would like to take part in the study. Thank you for your help in completing this study.

Sincerely,

Joe Kiesznowski, CRNA, Ph.D. Candidate

APPENDIX C: SOCIAL MEDIA RECRUITMENT

SRNAs/Future CRNAs

I am conducting research as part of the requirements for a Ph.D at Liberty University. The purpose of my research is to investigate the impact of simulation on clinical self-efficacy. To participate you must be currently enrolled in a Doctoral Nurse Anesthesia Program. Participants will be asked to take a completely anonymous survey that takes about 3 minutes. If you would like to participate and meet the criteria, please click the link or scan the QR code below.

https://www.surveymonkey.com/r/NJV53NW

A consent form is provided as the first page of the survey. The consent document contains additional information about my research.
After you have read the consent form, please proceed to complete the survey. Doing so will indicate that you have read the consent information and would like to take part in the study. Thank you for your consideration!

Joe Kiesznowski, Ph.D. Candidate, CRNA

APPENDIX D: LETTER TO CLINICAL COORDINATORS

Dear Clinical Coordinator,

Please allow me to introduce myself. I am a CRNA at Detroit Receiving Hospital and an assistant professor at Wayne State University in Detroit, MI. I am also currently a Ph.D. candidate at Liberty University where I am conducting IRB approved research on the impact of simulation training on SRNA self-efficacy as part of the requirements for this degree. The purpose of my research is to investigate if simulation of regional anesthesia techniques builds clinical self-efficacy in SRNAs, and I am writing to invite your students to participate in this study.

Participants must be SRNAs currently enrolled in an accredited program. Participants will be asked to take an anonymous, online survey. It should take approximately 4 minutes to complete the survey. Participation will be completely anonymous, and no personal, identifying information will be collected.

To request your students to participate, please copy the following link and send to all cohorts of your program currently participating in clinical rotations.

Survey Link: https://www.surveymonkey.com/r/NJV53NW

A consent form is provided as the first page of the survey. The consent document contains additional information about my research.

Additional IRB information is located on the first page of the online survey. Because participation is anonymous, participants do not need to sign and return the consent document. After participants have read the consent form, they may proceed to complete the survey. Doing so will indicate that they have read the consent information and would like to take part in the study. Thank you for your help in completing this study.

Sincerely,

Joe Kiesznowski, CRNA, Ph.D. Candidate

APPENDIX E: SURVEY QUESTIONS

Self-efficacy is the belief that you can achieve a desired performance (Bandura, 1977). SRNAs with higher self-efficacy are more likely to seek out challenging clinical opportunities that will improve their overall clinical performance (Imus, 2017). This study will help to determine if simulation improves SRNA self-efficacy in clinical. The survey should take roughly 4 minutes to complete and is graded on a 4 point scale with the final score ranging from 10-40. NO personal information will be collected so you will remain anonymous. Simulation may include any modality (high, low-fidelity, computer program, VR) used as a surrogate for the actual procedure.

Please answer the survey questions based on the first time you performed the indicated procedure in clinical.
1. Academic Year:
2. # of Neuraxial (Spial/Epidural) Simulation Sessions before performing a neuraxial technique in clinical:
3. # of Peripheral Nerve Block Simulation sessions before performing a PNB in clinical:
4. In the context of performing a neuraxial anesthetic (spinal or epidural): Complete GSE (see below)
5. In the context of performing a peripheral nerve block: Complete GSE (see below)

APPENDIX F: GENERAL SELF-EFFICACY SCALE

	Not at all true	Hardly true	Moderately true	Exactly true
1. I can always manage to solve difficult problems if I try hard enough	☐	☐	☐	☐
2. If someone opposes me, I can find the means and ways to get what I want.	☐	☐	☐	☐
3. It is easy for me to stick to my aims and accomplish my goals.	☐	☐	☐	☐
4. I am confident that I could deal efficiently with unexpected events.	☐	☐	☐	☐
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.	☐	☐	☐	☐
6. I can solve most problems if I invest the necessary effort.	☐	☐	☐	☐
7. I can remain calm when facing difficulties because I can rely on my coping abilities.	☐	☐	☐	☐
8. When I am confronted with a problem, I can usually find several solutions.	☐	☐	☐	☐
9. If I am in trouble, I can usually think of a solution	☐	☐	☐	☐
10. I can usually handle whatever comes my way.	☐	☐	☐	☐

APPENDIX G: GENERAL SELF-EFFICACY SCALE SCORING

About: This scale is a self-report measure of self-efficacy.

Items: 10

Reliability:
Internal reliability for GSE = Cronbach's alphas between .76 and .90

Validity:
The General Self-Efficacy Scale is correlated to emotion, optimism, work satisfaction. Negative coefficients were found for depression, stress, health complaints, burnout, and anxiety.

Scoring:

	Not at all true	Hardly true	Moderately true	Exactly true
All questions	1	2	3	4

The total score is calculated by finding the sum of all items. For the GSE, the total score ranges between 10 and 40, with a higher score indicating more self-efficacy.

APPENDIX H: CONSENT FORM

Title of the Project: Simulation and Self-Efficacy in the SRNA: A Quantitative, Causal-Comparative Study
Principal Investigator: Joe Kiesznowski, Doctoral Candidate
School of Education, Liberty University

You are invited to participate in a research study. To participate, you must be currently enrolled in a fully accredited doctoral program of nurse anesthesia in the US. Taking part in this research project is voluntary. Please take time to read this entire form and ask questions before deciding whether to take part in this research.

The purpose of the study is to explore the effect of simulation training on SRNA clinical self-efficacy.

If you agree to be in this study, I will ask you to do the following: Complete an anonymous, online survey, which will ask you to indicate your academic year, indicate the number of simulation sessions performed before clinical in the selected area, and finally, complete the General Self-Efficacy Scale in reference to the specific procedure outlined in the survey. The whole survey should take about 5 minutes.

Participants should not expect to receive a direct benefit from taking part in this study. Benefits to society include helping to understand more about building self-efficacy in SRNAs through simulation training.

The expected risks from participating in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

The records of this study will be kept private. Research records will be stored securely, and only the researcher will have access to the records. Participant responses to the online survey will be anonymous. Data will be stored for three years on a password-locked computer. Following three years, the data will be erased from the password-locked computer.

Participation in this study is voluntary. Your decision on whether to participate will not affect your current or future relations with Liberty University. If you decide to participate, you are free to not answer any question or withdraw at any time prior to submitting the survey without affecting those relationships.

If you choose to withdraw from the study, please exit the survey and close your internet browser. Your responses will not be recorded or included in the study.

The researcher conducting this study is Joe Kiesznowski, CRNA. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact him at du0530@wayne.edu. You may also contact the researcher's faculty sponsor, Dr. Treg Hopkins at thopkins19@liberty.edu

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the IRB. Our physical address is Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA, 24515; our phone number is 434-592-5530, and our email address is irb@liberty.edu.

Disclaimer: The Institutional Review Board (IRB) is tasked with ensuring that human subjects research will be conducted in an ethical manner as defined and required by federal regulations. The topics covered and viewpoints expressed or alluded to by student and faculty researchers are those of the researchers and do not necessarily reflect the official policies or positions of Liberty University.

Before agreeing to be part of the research, please be sure that you understand what the study is about. You can print a copy of the document for your records. If you have any questions about the study later, you can contact the researcher using the information provided above.