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Anesthesia Clinical Core Competencies and High Fidelity Human Simulation

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I am submitting herewith a dissertation written by Jeffrey Colby James entitled "Anesthesia Clinical Core Competencies and High Fidelity Human Simulation." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Education.

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Anesthesia Clinical Core Competencies and High Fidelity Human Simulation

A Dissertation Presented for the
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Jeffrey Colby James
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Dedication

First and foremost, this dissertation is dedicated to my wife Melinda James, for her never ending love and support. I love you more than you could ever know. You are my rock. Also, this dissertation is dedicated to the memory of Dr. Ed Counts who was my inspiration to pursue a doctorate in Education with a concentration in instructional technology.

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Abstract

The purpose of the study was to identify anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing High Fidelity Human Simulation (HFHS). This purpose was achieved by identifying the perceptions of nurse anesthesia educational program administrators and faculty regarding the anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing HFHS. Participants completed a 50-item web-based survey instrument and demographic questionnaire (Anesthesia Core Competency and Simulation Survey). High fidelity human simulation (HFHS) based evaluation of anesthesia clinical core competency proficiency can be a valuable tool for assessing anesthesia trainees, certifying nurse anesthetists, and recertifying nurse anesthetists. Evidence from this study suggests there is a consensus among anesthesia educational program administrators and faculty regarding anesthesia clinical core competencies that are appropriate for proficiency evaluation utilizing HFHS. Anesthesia educational program administrators and faculty in the United States agree that with the exception of Prone Position (appropriateness score = 2.99, with 3 being neutral), the required experiences put forth by the Council on Accreditation of Nurse Anesthesia Educational Programs and the National Board for Certification and Recertification of Nurse Anesthetists are suitable for evaluating proficiency utilizing HFHS. Thus, the agreement among administrators and educators that emerged from this study provides a foundation on which faculty can begin to incorporate HFHS into their curricula.

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Chapter 1

Introduction to the Study

Simulations of actual experiences for the purpose of demonstrating proficiency are used in several healthcare specialties, including nurse anesthesia. The healthcare industry has incorporated simulation into the curriculum of many healthcare-related educational programs, including nurse anesthesia (AANA, 2013; COA 2009). Nurse anesthesia education has used bench models for discussion and practice of procedural techniques. Simulation models in the 1980s were nothing more than plastic, molded examples of body parts or entire human models. They were used in lectures to demonstrate technique and positioning. These models were also used in laboratory courses for students to practice procedural techniques, such as positioning and cardiopulmonary resuscitation. Today, high fidelity human simulation (HFHS) has become highly sophisticated, reaching a level of realistic experience not achieved in the past with human simulation (Harvard, 2008). HFHS can be utilized as part of nurse anesthesia education, and many universities and colleges have very sophisticated anesthesia simulation facilities. Many university healthcare educational programs utilize simulation centers that promote the use of human simulation across education in medical and allied health fields including nurse anesthesia (Harvard, 2008).

Nurse anesthetists are anesthesia providers who are Advanced Practice Nurses (APN), which means they have specialized as Certified Registered Nurse Anesthetists (CRNA). CRNAs are registered nurses who have satisfactorily completed a graduate degree (master's or doctorate), specializing in the practice of nurse anesthesia, and have passed the National Board for Certification and Recertification of Nurse Anesthetists' (NBCRNA) national certification

exam. These registered nurses must be graduates of an accredited bachelor's degree granting college or university and must have completed 1 or more years of practice as a registered nurse in a critical care or intensive care unit at a medical center. Following the critical care experience, they must complete a graduate degree (master's or doctorate) in nurse anesthesia from a Council on Accreditation of Nurse Anesthesia Educational Program (COA) accredited nurse anesthesia program of 28-36 months duration (COA, 2013). Following completion and graduation from a COA-accredited graduate nurse anesthesia program, the registered nurse is eligible to take written board exams given by the NBCRNA (NBCRNA, 2013). The registered nurse who has completed all NBCRNA requirements and has passed the national board exam is then a CRNA and APN (ANA, 2013; NBCRNA, 2013).

The COA (2013) requires that nurse anesthesia programs demonstrate that graduates have acquired the skills and knowledge associated with anesthesia clinical core competencies, including anesthesia care related knowledge, skills in patient safety, perianesthetic management, critical thinking, communication, clinical experiences, and the professional role. However, the COA does not specify the method or methods an individual program must use to demonstrate that the anesthesia core competency requirements have been met.

Nurse anesthesia program administrators and faculty have suggested that anesthesia core competencies can be evaluated effectively in an HFHS lab (Bohan, 2007). The current anesthesia educational research literature does not define the anesthesia core competencies that would be appropriate to evaluate using HFHS. Therefore, defining nurse anesthesia clinical core competencies that are appropriate for evaluation utilizing HFHS would be the next step in incorporating HFHS into anesthesia educational programs.

Statement of the Problem

The COA (2013) identifies anesthesia clinical core competencies in its standards for nurse anesthesia educational programs' clinical experiences required for nurse anesthesia program completion. However, as stated earlier, the COA does not define the method or methods an individual program should use to evaluate student knowledge of anesthesia clinical core competencies. Many nurse anesthesia educational programs have utilized high fidelity human simulation to evaluate anesthesia skills (Lewis, Strachan, & Smith, 2012). The COA (2013) as well as nurse anesthesia literature have not defined which of the anesthesia clinical core competencies would be appropriate for evaluating proficiency using HFHS. Therefore, there is a need to understand which anesthesia clinical core competencies are appropriate. The problem to be addressed in this study is to identify this gap in the knowledge about anesthesia clinical core competencies.

Purpose of the Study

High fidelity human simulation in nurse anesthesia educational programs is relatively new, and appropriate anesthesia clinical core competencies that can be evaluated for proficiency using this method have not been identified. Thus, the purpose of this study is to identify anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing HFHS. This purpose was achieved by identifying the perceptions of nurse anesthesia educational program administrators and faculty regarding the anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing HFHS.

Research Questions

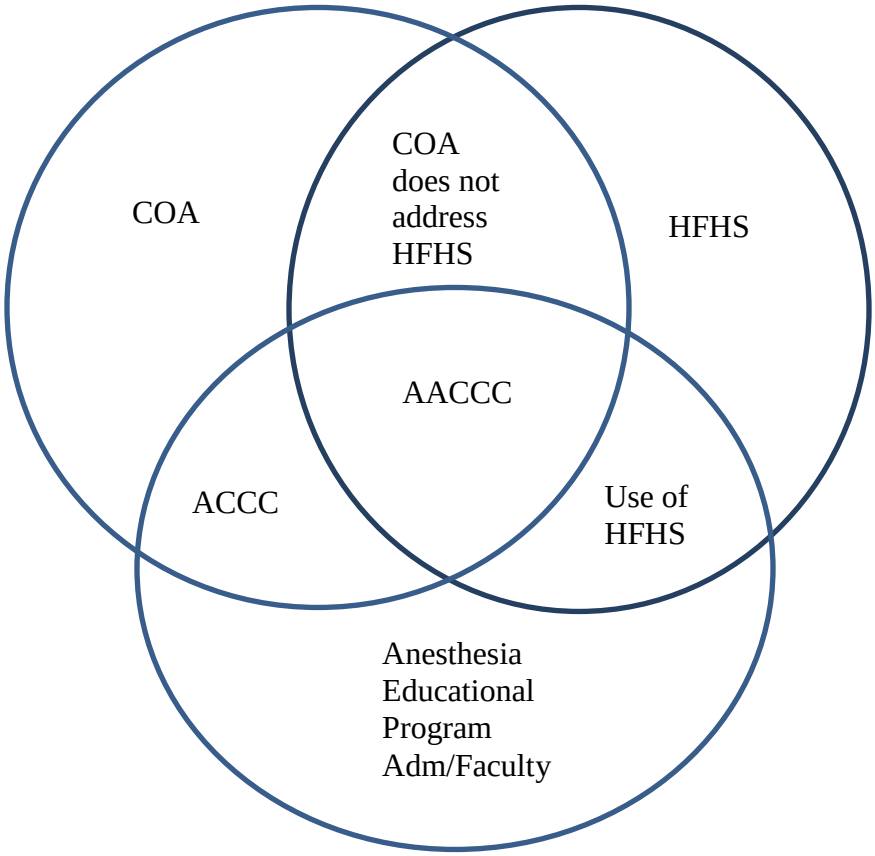
This exploratory research identifies appropriate anesthesia clinical core competencies for evaluating proficiency utilizing high fidelity human simulation (HFHS). This was accomplished by addressing the following questions:

1. What are the anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing high fidelity human simulation in nurse anesthesia educational programs?
2. Are there differences in appropriate anesthesia clinical core competencies identified by program administrators and faculty in nurse anesthesia educational programs?
3. Are there differences in appropriate anesthesia clinical core competencies identified based on years of experience and faculty rank?
4. Are there differences in appropriate anesthesia clinical core competencies identified among program administrators and faculty whose programs utilize high fidelity human simulation in their curriculum and those that do not?

Framework for the Study

The COA Standards for Nurse Anesthesia Educational Programs (COA, 2009) mandates that each accredited graduate nurse anesthesia program provide opportunities to gain 550 minimum cases and design a curriculum that enables graduates to obtain the clinical experiences required for certification by the NBCRNA (2013). The NBCRNA mandates that board eligible graduates of accredited graduate nurse anesthesia educational programs show verified completion from program directors of the minimum required clinical experience listed by the NBCRNA to be eligible to sit for the nurse anesthesia national certification exam.

The COA (2013)/NBCRNA (2013) identify required anesthesia clinical experiences in the Standards for Nurse Anesthesia Educational Programs (2009) and the requirements for taking the NBCRNA national certification examination. The required experiences from the COA are composed of the competencies to be considered for the purpose of this study in identifying anesthesia clinical core competencies appropriate for evaluating proficiency utilizing HFHS. Therefore, this study used the required clinical experiences as the framework for defining the anesthesia clinical core competencies that may be appropriate for evaluating proficiency utilizing HFHS. These clinical experiences form the structure or foundation for development of the Appropriate Anesthesia Clinical Core Competencies (AACCC) Model below (Figure 1.1). It represents the multifactorial relationships involved in the development of those competencies that are appropriate for evaluating proficiency utilizing HFHS.



Appropriate Anesthesia Clinical Core Competencies (AACCC) Model:

COA—Council on Accreditation of Nurse Anesthesia Educational Programs

HFHS—High Fidelity Human Simulation

ACCC—Anesthesia Clinical Core Competencies

AACCC—Appropriate Anesthesia Clinical Core Competencies for Evaluating Proficiency Utilizing HFHS

Significance of the Study

This study is significant because it provides knowledge related to nurse anesthesia educational program utilization of the relatively new technology in a high fidelity human simulation. Furthermore, this research is intended to provide knowledge related to the anesthesia clinical core competencies that are appropriate for evaluating proficiency in a high fidelity human simulation lab in nurse anesthesia educational programs. Information obtained will also assist program administrators and faculty in understanding how high fidelity human simulation can be used to evaluate student nurse anesthetists' mastery of anesthesia clinical core competencies. In addition, this study identifies the differences among program administrator and faculty perceptions of appropriate anesthesia clinical core competencies. Finally, program administrators and faculty who currently use (or plan to use) high fidelity human simulation in their curricula may find this study to be helpful in their student evaluation efforts. A deeper understanding of HFHS and anesthesia clinical core competency proficiency evaluation will broaden the knowledge base of theories and competency development in this area of healthcare education.

Assumptions, Delimitations, Limitations

This study assumes the following:

All nurse anesthesia educational programs in the United States are required to be accredited by the COA (2013).

Graduates from any program not accredited by the COA for the duration of the program will not be eligible to take the national certification exam administered by the NBCRNA.

Respondents to the ACCC-HFHS survey, open-ended questions, and requested demographic information will provide accurate and honest responses and information.

The survey items used in this study accurately reflect the specific COA (2013)/NBCRNA (2013) clinical experiences required for taking the NBCRNA national certification examination.

The following are the delimitations of this study:

The intended study sample represents the study population.

Anesthesia clinical core competencies are clinical experiences that graduates of COA-accredited graduate nurse anesthesia educational programs must master prior to applying to sit for the NBCRNA (2013) national certification examination.

The survey instrument will be administered online.

The survey instrument will be the only method of collecting data.

This study is limited by the following:

The survey items will be subject to the respondents' interpretation.

Because the survey population is limited to graduate nurse anesthesia program administrators and faculty located in the United States, the results may not be generalizable to nurse anesthesia in countries other than those in the United States.

Definition of Acronyms

In this study, the following acronyms will be used, as defined below:

AANA: American Association of Nurse Anesthetists

AACCC: Appropriate Anesthesia Clinical Core Competencies

ACGME: Accrediting Council for Graduate Medical Education

ACCC (Anesthesia Clinical Core Competencies): Clinical core competencies that are mastered by participating in required clinical experiences mandated by the Council on Accreditation of Nurse Anesthesia Educational Programs and the National Board for Certification and Recertification of Nurse Anesthetists.

APN: Advanced Practice Nurse. A registered nurse who has completed a graduate program awarding a Master of Science in Nursing (MSN), Master of Science in Anesthesia (MSA), Master of Science (MS), Doctor of Nursing Practice (DNP), Doctor of Nurse Anesthesia Practice (DNAP), Doctor of Nursing Science (DNS), or Doctor of Philosophy (PhD) degree in a specialty field of advanced practice nursing and has passed an advanced practice nursing specialty national board certification examination.

COA: Council on Accreditation of Nurse Anesthesia Educational Programs

COA Standards for Nurse Anesthesia Educational Programs: The standards set forth by the COA (2009) that each graduate nurse anesthesia educational program must meet or exceed for accreditation purposes.

CRNA: National Board for Certification and Recertification of Nurse Anesthetists Certified Registered Nurse Anesthetist (CRNA)

HFHS (High Fidelity Human Simulation): Simulation that incorporates a computerized full-body mannequin that can be programmed to provide realistic physiological, auditory, and visual responses to actions performed by the simulation participant.

NBCRNA: National Board for Certification and Recertification of Nurse Anesthetists. The certifying body for CRNAs.

Definition of Anesthesia Clinical Core Competencies

Anesthesia Clinical Core Competencies: The nurse anesthesia clinical experiences required by the Council on Accreditation of Nurse Anesthesia Educational Programs (COA) and the National Board for Certification and Recertification of Nurse Anesthetists (NBCRNA) that nurse anesthesia graduate students must master prior to graduate nurse anesthesia educational program completion and prior to being eligible to take the national nurse anesthesia certification exam.

Individual Competencies:

Trauma/Emergency: Providing anesthesia services required for traumatic injury or surgical emergency

General Anesthesia: Anesthesia services rendering a patient unaware and nonreactive to surgical stimulation

IV Induction: Intravenous technique for induction of general anesthesia

Tracheal Intubation: Introduction of a breathing tube into the trachea of a patient

Alternative Airway Techniques: Methods of introducing a breathing tube into the trachea of a patient or providing an effective airway to a patient unable to maintain their own airway other than by direct laryngoscopy

Fiber Optic Intubation: Utilization of a fiber optic scope to introduce a breathing tube into the trachea of a patient

Inhaled Induction: Inducing general anesthesia utilizing inhaled anesthetic agents

Mask Management: management of a patient's airway by utilizing an airway mask

Pediatric 2-12 Years: Providing anesthesia services for patients between the ages of 2-12

OB Patients: Providing anesthesia services for obstetric patients

LMA or Similar Airway: Utilization of laryngeal mask airway or similar device

Pediatric Under 2 Years: Providing anesthesia services for patient under the age of 2

Mechanical Ventilation: Management of a patient's respiration utilizing artificial mechanical ventilation

PA Catheter Monitoring: Monitoring a patients hemodynamics utilizing a pulmonary artery catheter

IV Induction Agents: Utilizing intravenous agents for the purpose of inducing general anesthesia

Emergence from Anesthesia: Managing a patient while awakening from a general anesthetic

Pharmacological Agents: Utilizing medications necessary for providing anesthesia services

Geriatric Patients 65 Years or >: Providing anesthesia services for patients 65 years old or older

CVP Monitoring: Monitoring a patients central venous pressure

Arterial Line Monitoring: Monitoring a patient blood pressure utilizing an arterial catheter

Cesarean Section: Providing anesthesia services for patients undergoing cesarean section

IV Opioid Agents: Providing intravenous opioids to patients

Inhaled Agents: utilizing inhaled anesthetics to patients during general anesthesia

Total IV Anesthesia (TIVA): utilizing only intravenous anesthesia agents to induce and maintain a general anesthetic

IV Muscle Relaxant Agents: Utilizing intravenous muscle relaxants (paralytic agents) during a general anesthetic

IV Agents Other: Utilizing other intravenous medications other than anesthetic, opioid, or muscle relaxants during a general anesthetic

CVP Placement: Placement of a central venous catheter

Intra-Abdominal: Providing anesthesia services for patients undergoing procedures in the abdomen

Lung Procedure: Providing anesthesia services for patients undergoing procedures involving the lungs

Intra-Thoracic: Providing anesthesia services for patients undergoing procedures in the thoracic cavity

Extremities Procedure: Providing anesthesia services for patients undergoing procedures on the upper or lower extremities

Regional Anesthesia Administration: Providing anesthesia services requiring administration of a spinal, epidural, intrathecal, or extremity local anesthetic blocks

Vascular Procedure: Providing anesthesia services for patients undergoing procedures involving the vascular system

Heart Procedure: Providing anesthesia services for patients undergoing procedures to the heart

Extra-Thoracic: Providing anesthesia services for patients undergoing procedures outside of the thoracic cavity

PA Catheter Placement: Placement of a pulmonary artery catheter

Regional Anesthesia Management: monitoring a patient whom has had the administration of a spinal, epidural, intrathecal, or extremity local anesthetic blocks

Extra-Cranial: Providing anesthesia services for patients undergoing procedures outside of the head

Arterial Line Insertion: Placement of an arterial catheter

Labor Analgesia: Providing analgesia (pain relief) for a patient in labor

Neuro-Skeletal Procedure: Providing anesthesia services for patients undergoing procedures involving the nervous system and or spine.

Oro-Pharyngeal Procedure: Providing anesthesia services for patients undergoing procedures of the mouth or throat

MAC Anesthesia: Monitored anesthesia care (sedation)

Neck Procedure: Providing anesthesia services for patients undergoing procedures involving the neck

IV Placement: Placement of an intravenous catheter

Perineal Procedure: Providing anesthesia services for patients undergoing procedures involving the perineal area

Sitting Position: Providing anesthesia services for patients undergoing procedures requiring a sitting position

Lithotomy Position: Providing anesthesia services for patients undergoing procedures requiring a lithotomy position

Lateral Position: Providing anesthesia services for patients undergoing procedures requiring a lateral position

Prone Position: Providing anesthesia services for patients undergoing procedures requiring a prone position

Conclusion

The use of HFHS as a tool for evaluating anesthesia clinical core competencies has not been examined to date. Furthermore, the anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing HFHS have not been determined. The goal of this study is to identify the anesthesia clinical core competencies that are appropriate for evaluation using HFHS and shed light on the differences among the perceptions of anesthesia educational program administrators and faculty pertaining to those competencies.

Chapter 2 continues with a review of the literature on advanced practice healthcare provider competencies and HFHS. Included in this review is research related to clinical competencies and utilization of HFHS for the purpose of evaluating proficiency.

Chapter 2

Literature Review

Chapter 1 introduced the need to identify anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing high fidelity human simulation (HFHS). The problem, purpose, conceptual framework, and significance of this study were presented. Chapter 2 reviews the literature that provides a foundation for the development of anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing HFHS. First, this chapter explores the literature related to healthcare clinical competencies. Research literature related to existing clinical competencies and the development of clinical competencies in healthcare educational programs including nurse anesthesia is reviewed. Next, this chapter explores how the use of HFHS relates to clinical competency. Research literature pertaining to the current utilization of HFHS by nurse anesthesia and other advanced practice healthcare educational programs to evaluate proficiency of clinical core competencies is reviewed. In conclusion, the gap in current practice and the research literature related to anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing HFHS are summarized.

Clinical Competencies

The review of literature on clinical competencies begins with a brief introduction of competencies in healthcare education. This introduction is followed by a review of literature related specifically to anesthesia clinical core competencies. First, regarding competencies in healthcare education, a study that identifies and explores the characteristics of a clinical competency in graduate medical education is presented. Then, several studies regarding the identification and development of clinical competencies in allied healthcare organizations are

reviewed. Finally, several studies with a focus on identifying and developing anesthesia clinical core competencies are examined.

King, Schiavone, Counselman, and Panacek (2002) noted that a clinical core competency is required by the ACGME (2002) to be incorporated into the curriculum of every accredited graduate school of medicine's residency training program. Their study examined the adaptation of an ACGME required clinical competency to the specific specialty of emergency medicine. One of the study's goals was to form an agreed upon definition of and assessment criteria for the "Patient Care" clinical core competency specific to emergency medicine residency training. In order to define this competency, the researchers conducted a survey of the members of the Council of Emergency Medicine Residency Directors (CORD-EM). The resulting definition was built upon the ACGME's (2002) base definition of patient care and included elements unique to emergency medicine. In addition, the ACGME (2002) competency assessment tools were explored and prioritized for use in assessing the competency of emergency medicine trainees in the area of patient care proficiency. The methods of competency assessment that were explored included checklist evaluation, standardized patients, procedural/case logs, record review, global rating/assessment, standardized oral exam, objective structured clinical exam, healthcare provider portfolio, patient survey questionnaires, 360-degree global evaluation, and high fidelity human simulation (HFHS) (King et al., 2002). This study pointed out that HFHS allows for the direct observation and assessment of trainees without concern for patient safety (King et al., 2002). King et al. also stated that feedback from HFHS assessments can be provided immediately, and the required competency can be repeated until proficiency is achieved. The

authors pointed out that the data revealed in this study utilizing HFHS have merit and deserve further investigation. Demographic information on the participants was not reported.

Numerous healthcare educational programs have taken on the task of identifying and defining clinical core competencies specific to their specialty profession (Ferrier et al., 2013). In a survey study conducted by Ferrier et al. (2013), practice-based competencies were developed and validated for the Canadian Association of Genetic Counsellors (CAGC). This study surveyed the CAGC membership, including faculty and administrators of educational programs in the genetic counseling profession. Practice-based competencies were identified from the survey responses with representation from a majority of the regions where members of this profession practice. Interestingly, the competencies identified by this survey were formally adapted by both the CAGC board of directors as well as the national certification board of the CAGC in 2012 (Ferrier et al., 2013). The strengths of this study included a large survey sample, and seven of eight regions of practice were represented in the responses received. The limitations included a lack of demographic information.

Several allied healthcare organizations conducted summits focusing on forming a consensus on clinical core competencies. One such summit was reported by Fishman et al. (2013). This study used a multidisciplinary approach with the objective of developing core competencies in pain assessment and management for pre-licensure health professional education using a modified Delphi methodology. Following an in-depth literature review, an interprofessional competency advisory committee was formed to conduct a 2-day consensus summit. Participants developed healthcare interdisciplinary or collaborative consensus-derived competencies (Fishman et al., 2013). Although among the strengths of this interprofessional

consensus summit was the multiple number of disciplines represented by the participants, no data regarding which healthcare-related disciplines were included in the summit and which were excluded were provided in the report. Those that were included consisted of physicians, veterinarians, and nurse practitioners; however, nurse anesthetists and many other advanced practice healthcare providers were not included. A limitation of this study was that the modified Delphi technique concluded without performing multiple rounds and ended prior to all participants agreeing on the resulting competencies.

Another core competency consensus study was conducted by Wallengren (2011). This study also utilized a modified Delphi technique involving 43 expert panelists consisting of 26 physicians and 10 nurses. The purpose of this study was to identify core clinical competencies for primary care providers who treat allergy patients. Participants included primary care physicians and nurses as well as representatives from specialty practitioners in areas related to the treatment of allergy patients. The Delphi study was conducted in three rounds. In the first round, all participants listed potential competencies related to primary care providers encountering allergy patients. In the second round, participants used a Likert-type scale to rate the potential competencies derived from the first round. The third round included only those items that received a 3.25 score or higher from the second round. The score of 3.25 represented the point at which 75% of participants scored the items as 2-4 on the Likert scale (desirable to necessary). In the third round, only those items on which 75% of the participants agreed were included in the final list of competencies, which was determined to be a consensus (Wallengren, 2011). Among the strengths of this study was the inclusion of representatives both from the primary care providers who care for allergy patients and allergy specialists. One of the

limitations of the study was that the final list of competencies contained items upon which a minimum of 75% of participants agreed. The use of this modified Delphi technique ended without continuing rounds until all participants agreed on the final list of competencies. The researchers reported that they did not continue rounds due to the poor participant response rate in the third round of the study.

Another study by Barrett and Bion (2006) employed online and postal surveys to identify core competencies in adult intensive care medicine. Participants who were all current intensive care practitioners were invited to submit their answers to the single open-ended question, "Tell us which competencies are essential for physicians specializing in intensive care medicine" (Barrett & Bion, 2006). The researchers promoted the study via national coordinators who used partnership websites, national and international conferences, and intensive care publications to spread the word. Participants were also contacted by email. A total of 5,241 responses were received over a 6-month period. The researchers followed up the survey with a modified Delphi technique including two phases to further define the intensive care medicine essential competencies. A panel of 12 experts in the field of intensive care medicine discussed and considered the survey responses during the Delphi phases one and two. The panel of experts identified 102 essential intensive care medicine core competencies. The strengths of this study included the participation of a large number of respondents from 57 countries, which improved the generalizability of the results (Barrett & Bion, 2006). The limitations included a lack of demographic information regarding the panel of experts.

A survey study by Norris (2007) developed competencies for nurse anesthesia student clinical evaluations using an online survey. All COA (2007) accredited nurse anesthesia

educational program administrators in the United States were invited to participate. They were asked to rate essential clinical competencies that were taken from the clinical evaluation instruments of several graduate nurse anesthesia programs. A goal of this study was to determine which essential competencies should be assessed on a daily basis. Another goal was to determine the differences among those essential competencies with respect to first- and second-year graduate nurse anesthesia students. The results demonstrated some significant differences among the essential competencies that were determined to be appropriate for first-year students as compared to those appropriate for second-year students. The reported differences related to the competencies that may be appropriate for evaluating the proficiency level of second-year graduate nurse anesthesia students but not appropriate for first-year students. The study also revealed statistically significant agreement among administrators and assistant or associate administrators about which essential competencies were appropriate for first-year students and those that were appropriate for second-year students (Norris, 2007). One of the limitations of this study was the use of the essential clinical competencies from several arbitrarily chosen nurse anesthesia educational programs instead of those from a randomly chosen sample from the population of nurse anesthesia programs for the survey.

Summary of Clinical Competency Literature Reviewed

In the previous literature review, King et al.'s (2002) study explored a clinical core competency mandated by the ACGME (2002) for specialty residency educational programs of all graduate schools of medicine. The study refined the definition of the core competency of patient care to include elements unique to the practice of emergency medicine. This study is a good example of how an accrediting organization's required core competency can be built upon to

meet the needs of a specific advanced practice healthcare specialty. In the studies presented above by Ferrier et al. (2013), Fishman et al. (2013), Wallengren (2011), and Barrett and Bion (2006), the research demonstrated the development of clinical core competencies utilizing survey or modified Delphi research techniques. Furthermore, these studies developed competencies specific to their specialty advanced practice healthcare profession.

Finally, the last study that was presented (Norris, 2007) is a good example of clinical core competency development in anesthesia advanced practice education. Although the Norris (2007) study did not develop competencies related to the utilization of HFHS, it is a helpful example of the use of the survey method to query anesthesia educational program administrators.

Although all of the studies related to clinical core competencies had limitations, they collectively form a foundation for research to develop clinical core competencies in advanced practice healthcare related to nurse anesthesia.

High Fidelity Human Simulation and Current Utilization Related to Evaluation of Proficiency

The review of high fidelity human simulation (HFHS) literature begins with a brief introduction of healthcare simulation utilization. The introduction is followed by a review of literature providing the precedence for using HFHS to assess anesthesia clinical core competencies. First, two studies that provide a foundation for the use of HFHS in allied healthcare provider education including nurse anesthesia education is presented. Then, several studies that demonstrate various methods of HFHS utilization for the purpose of evaluating clinical skills proficiency in anesthesia educational programs are presented. Finally, research regarding the assessment and validation of anesthesia clinical competencies is reviewed.

High fidelity human simulation is a relatively new technology that is used in nurse anesthesia and other healthcare-related educational programs. In fact, according to the National League for Nursing (NLN) (NLN, 2004), HFHS has been used in nurse anesthesia programs for less than 20 years. The NLN also points out that nurse anesthesia is leading the way in using HFHS in nursing. In a survey conducted by the NLN (2004), 32 of 34 nursing schools responded, with four of those having graduate nurse anesthesia programs. Seventy-five percent of the nurse anesthesia programs responding to the survey used HFHS, whereas only 56% of baccalaureate programs utilized HFHS, and only 25% of other graduate nursing programs used the technology (NLN, 2004).

Regarding using HFHS for evaluating competency in graduate nursing educational programs, 50% of the respondents thought it should be used. They also commented that HFHS was useful in assessing student clinical knowledge and skill levels (NLN, 2004). Furthermore, a majority of respondents stated that HFHS was appropriate for evaluating competency in areas that are important to nurse anesthesia, including technical skills (61%) and critical events (54%), and a substantial number of respondents (46%) felt that the vital skill of airway management in anesthesia was appropriate (NLN, 2004).

In a study by Turcato, Roberson, and Covert (2008) that surveyed nurse anesthesia program directors, 50% of the respondents reported that their programs utilized HFHS in the curriculum. However, only 54.7% of the program directors who were invited to participate responded. Turcato et al. did not report whether the programs whose directors did not respond to the survey utilized HFHS or not. Therefore, it was not possible to determine whether those program directors whose programs utilized HFHS were more likely to respond to the survey. As

a result, it is not possible to verify whether the likelihood that an invited participant responded was influenced by their program utilization of HFHS or not (Turcato et al., 2008).

Few studies were found that related to the use of HFHS to evaluate anesthesia clinical competencies. One exception, however, was a study conducted by Fehr et al. (2011) that investigated the relevance of the use of HFHS to evaluate pediatric anesthesia skills. The study consisted of 10 HFHS scenarios that were designed to reflect perioperative pediatric anesthesia care. Thirty-five anesthesia trainees consented to participate. Participants consisted of anesthesiology residents and pediatric anesthesia fellows. Two similarly trained and board-certified pediatric anesthesiologists scored each scenario using a key action checklist. As speculated by the authors, trainees who were further along in their training program scored higher overall in each scenario (more proficient in pediatric anesthesia skills) than those with less experience. The reliability of rater scores was examined by conducting a generalizability study. The goal of the generalizability study was to be able to generalize individual trainee scores to many other pediatric anesthesia skills. The results showed that the generalizability coefficient was moderate at 0.57, which is adequate for low stakes, formative assessments; however, additional scenarios would need to be added to the assessment if it were to be utilized for high stakes assessments, such as for board certification. One notable finding was that increasing the number of raters only minimally increased the generalizability coefficient (+-0.03).

Fehr et al. (2011) also examined the validity of assessment scores. A significant difference was found when comparing groups of trainees based on months of experience ($p <$ 0.01). However, many of the individual trainees with much less experience had overall scores that may represent a higher performance standard than that of some of the trainees with more

experience who performed at a lower level. This result may support the concept of trainee success (progression) based on competency proficiency rather than experience (Fehr et al., 2011).

Henrichs et al. (2009) conducted a study related to the use of HFHS to evaluate anesthesia clinical skills that examined the performance of CRNAs and anesthesiologists on an HFHS-based skills assessment. The prospective, randomized, single-blinded study enrolled 26 CRNAs and 35 anesthesiologists certified by the American Board of Anesthesiologists (ABA) who chose to participate among 300 CRNAs and 300 anesthesiologists randomly selected from the local area of the study. A list of 12 anesthesia simulation skills scenarios were randomly chosen for assessment in both groups of participants by 10 CRNAs and 10 anesthesiologists. All skill scenarios were taken from lists of experiences required by both the COA/NBCRNA (2009) and the ABA (2012) content outline for residents in specialty training. Each participant managed 8 of the 12 skills assessment scenarios, resulting in 488 rated simulation exercises. Formally trained raters, who were not anesthesia providers, consisted of a research nurse and a physician. Results included the two-way ANOVA yielding a significant group effect ($F1 = 7.8$, $p < 0.01$), where the anesthesiologists (mean 66.6%, +- 11.7; range = 41.7%-86.7%) received slightly higher overall scores than the CRNAs (59.9% +- 10.2; range = 38.3%-80.4%). No significant difference was found between the two groups of participants by individual scenario, suggesting that overall group performance by scenario was consistent.

Finally, a significant effect ($F11 = 60.7$, $p = <0.01$) was attributable to the individual scenario. This finding indicated that the CRNAs' and anesthesiologists' scores varied considerably within the individual scenario. The reported implications for practice of this study

included the potential intraoperative patient care concern revealed by the considerable score variance between both CRNAs and anesthesiologists within individual scenarios. These implications suggest that some individual anesthesia providers failed to diagnose and treat simulated emergencies within the scenario. Reported limitations of the study included the method of participant selection between the two groups being compared (Henrichs et al., 2009). Also, the participants' demographic information was not reported. It may have included general information as well as the rank of individual participants' board examination scores, practice type (team or solo practice), years of practice, or practice facility type (private practice or university-based). Another limitation noted was that the level of education or research experience of the research nurse rater was not mentioned nor was the physician rater's level of research experience or the third rater's (alternative rater in the event of disagreement amongst raters) education and research experience (Henrichs et al., 2009). Although this study has limitations, it does provide an example of how HFHS is used for anesthesia-related skills assessment.

Murray, Boulet, Kras, McAllister, and Cox (2005) conducted an HFHS-based anesthesia skills performance assessment for anesthesia training. The participants comprised a convenience sample of resident anesthesiologists consisting of 12 clinical anesthesia year-1, postgraduate year-2 residents and 16 clinical year-2 or 3 postgraduate year-3 or 4 residents. All of the anesthesia resident participants had completed a general intern year as well as their respective anesthesia training consisting of 1 to 3 years, for a minimum of 2 and a maximum of 3 years postgraduate training. Participants also included student nurse anesthetists who comprised a convenience sample recruited from two graduate nurse anesthesia educational programs. All

student nurse anesthetists had completed their clinical anesthesia training and were near program completion, and all participants had previous HFHS experiences. Six scenarios developed by the investigators were presented to the participants during individual simulation sessions. The participants' performances of related anesthesia clinical skills were rated by five faculty anesthesiologists and one nurse clinician. Rating methods included a detailed checklist, an abbreviated key action checklist, and a single global rating scale (a visual analog scale). The detailed checklists and key action checklists for each scenario were developed by the investigators. The single global rating scale was a 10 cm visual analog scale with 0 cm representing unsatisfactory anesthesia skills performance and 10 cm representing outstanding anesthesia skills performance. Three raters (two anesthesiologists and the nurse clinician) rated the participants using the detailed checklist. The remaining three raters (anesthesiologists) rated the participants using the abbreviated checklist and the single global rating scale.

The results emerged from a comparison of the three groups of participants. ANOVA was used to test for specific differences in performance among the three groups. No significant difference was found within groups in individual scenarios. However, a significant difference was found that was attributable to between groups ($F = 11.2$; $p < 0.01$). This result indicated a significant difference in mean scores among the three groups. In the post hoc analysis (Scheffe test for multiple comparisons), the clinical anesthesia year 2-3, postgraduate year 3-4 resident group had a statistically significant higher mean score than the student nurse anesthetist group ($F = 11.2$; $p < 0.05$). No significant difference was found between the two groups of residents ($F = 5.0$; $p > 0.05$) or the student nurse anesthetists and the clinical anesthesia year-1, postgraduate

year-2 residents ($F = 6.2$; $p > 0.05$). A reported significant main effect attributable to individual scenario ($F = 17.5$; $p < 0.01$) was also found (Murray et al., 2005).

The study's limitations included bias related to the individual training of the raters. There was no mention of the anesthesiologists' level of training, fellowship training, level of experience, ABA board certification, or research experience or training. Nor was there mention of the nurse clinician's level of education, research training, or research experience. No CRNA clinicians or educators were included as raters. The bias assumed by the mere professional competition among CRNAs and anesthesiologists in the job market is not addressed nor assessed due to the absence of CRNA raters in the study.

Ahn et al. (2013) conducted a study assessing clinical core competency pertaining to the Accreditation Council for Graduate Medical Education's (ACGME, 2013) requirement for temporary cardiac pacing. This study used HFHS to assess procedural competency through simulation. The ACGME (2013) clinical experience guidelines recommend that emergency medicine residents perform six cardiac pacing attempts while making no distinction between transcutaneous pacing (TCP) or transvenous pacing (TVP) during residency training. The purpose of the research was to validate this ACGME requirement by assessing the minimum number of experiences required to demonstrate clinical competency in performing cardiac pacing by using HFHS. The study was conducted with a convenience sample of 36 emergency medicine residents from the University of Chicago Emergency Medicine Residency Program. IRB approval and informed consent was obtained prior to conducting the research. Participants required a mean of 3.14 attempts and a median of 3 attempts to demonstrate proficiency in performing TCP and a mean of 5.25 and a median of 6 attempts to demonstrate proficiency in

performing TVP. A one-way analysis of variance did not reveal any difference among the participants based on postgraduate years of experience or training (TCP, $p = 0.254$; TVP, $p = 0.672$). Overall, participants required a mean total number of experiences (including TCP and TVP) of 8.39 and a median total number of experiences (including TCP and TVP) of 9 to achieve clinical competency at cardiac pacing. Accounting for both TCP and TVP, the results of this study revealed that the number of attempts required by participants is greater than those required by ACGME guidelines. Self-reported limitations to the study included the lack of measurement of skill retention and failure to determine interrater reliability and validity assessment of the test instrument. Also, the study was limited to a single residency 3-year training program; whereas many programs across the United States are 4-year training programs (Ahn et al., 2013). Although this study has limitations, it is also a good example of how HFHS can be used to assess an accrediting organization's required clinical competencies.

Mudumbai, Gaba, Boulet, Howard, and Davies (2012) conducted a clinical competency simulation assessment validation study. This research provided evidence to support the validity of HFHS performance scores related to anesthesia clinical skills. All 12 participants were third-year anesthesiology residents currently enrolled in the same anesthesiology graduate medical training program. All participants had not been on duty during the previous 24 hours, received the same standardized simulation instructions, and were subjected to the same standardized simulation scenarios. The two raters were staff anesthesiologists who had no prior experience with the study participants. The average interrater reliability was 0.86. A total of 82 simulation assessments were completed over a 2-year period. Assessment scores were based on a percentage of key actions completed as well as a 1-4 Likert scale (1 = poor, 2 = marginal, 3 =

acceptable, 4 = good). Uniquely, this research linked and compared simulation assessment scores with participants' other performance evaluations. Simulation assessment scores were linked and compared to participant aggregate ratings by dozens of supervising attending anesthesiologist preceptors. American Board of Anesthesiology (ABA) in-training examination scores were also linked and compared with participants' simulation assessment scores. A positive correlation ($r = 0.19$) was found between the preceptor aggregate rating of participants and performance in the simulation assessments.

A positive correlation was also reported between the participant ABA in-training examination scores and simulation assessment scores, but the overall Pearson Correlation Coefficient was not reported. The strengths of this study included the concordance in scoring between raters and that an NIH Certificate of Confidentiality was obtained, which protects the participants from results disclosure to internal or external sources, such as the residency director or department chairperson. The reported limitations of this study included the small number of study participants, and all participants were from a single anesthesiology training program (Mudumbai et al., 2012). Again, although this study has limitations, it provides an initial validation for using HFHS as a tool for evaluating anesthesia-related clinical competencies.

Summary of HFHS and Current Utilization Literature Reviewed

The NLN (2004) survey above pointed out that nurse anesthesia educational programs are leading the way in using HFHS in graduate nursing programs. Also, the NLN (2004) survey demonstrated that 50% or higher of the graduate nursing educator respondents felt that HFHS should be used in graduate nursing programs, including nurse anesthesia. Furthermore, HFHS is a useful tool in assessing competency in skills that are important to nurse anesthesia (NLN,

2004). Fehr et al. (2011) conducted a study of anesthesiology residents' skills assessment. This study utilized HFHS as a tool for assessing anesthesia skills as well as support for competency-based training program progression. Henrichs et al. (2009) also presented HFHS as a tool for assessing anesthesia clinical skills among CRNAs and anesthesiologists. Although this study had serious limitations, it provided data consistent with valid assessment results using HFHS. Murray et al. (2005) also conducted research using HFHS-based anesthesia skills assessment. This study had serious limitations as well; however, it also provided another example of using HFHS for assessing anesthesia clinical skills.

Ahn et al. (2013) presented a study comparing ACGME (accrediting organization) resident requirements to simulated clinical skill competency. This study's goal was to determine if the ACGME requirement for emergency medicine residents of six cardiac pacing experiences was appropriate for determining proficiency. Although a limited study, the results demonstrated that more than the six ACGME required pacing experiences were needed to demonstrate clinical skill proficiency. Another study by Mudumbai et al. (2012) provided evidence to support the validity of results when HFHS is used as a tool for clinical competency assessment. Regardless of these studies' limitations, they demonstrate a desire by anesthesia educators to use HFHS for the purpose of assessment and the ability of HFHS to be an effective tool in assessing anesthesia clinical core competency proficiency.

Conclusion

The purpose of this literature review was to explore advanced practice healthcare provider clinical core competencies and the use of HFHS to evaluate proficiency. Because of the consistency of findings using survey research in the literature presented above, the same data collection method was used for this study. However, there was not an appropriate survey instrument available that could be used to determine the answers to the research questions, so the researcher created an instrument following a pilot study.

There is an abundance of literature concerning HFHS; however, there is very little literature focusing on competency development or evaluation related to HFHS. Despite the lack of research, the studies in this literature review provide a foundation on which to create a survey instrument which fulfills the purpose of this study focusing on identifying appropriate anesthesia clinical core competencies for evaluation using HFHS. Chapter 3 presents the method, population, sample, instrument, procedure, and data analysis that were used in this study.

Chapter 3

Method

An online survey was used to identify demographic information and the perceptions of program administrators and faculty regarding anesthesia clinical core competencies that are appropriate for evaluating proficiency in a high fidelity human simulation lab.

Population and Sample

All graduate nurse anesthesia CRNA program administrators and faculty in COA (2013) accredited programs comprised the population of this study. The sample of this study includes the program administrators and faculty who responded to the internet-based survey. Program administrators included both directors and assistant or associate directors. Faculty included instructors, assistant professors, associate professors, and professors who are full-time faculty in a COA-accredited graduate nurse anesthesia educational program. All program administrators and faculty are CRNAs.

The study sample included respondents from the population of program administrators and faculty from all 112 COA (2013) accredited graduate nurse anesthesia educational programs in the United States. COA (2013) accredited graduated nurse anesthesia educational programs were identified by the list of accredited nurse anesthesia educational programs provided by the AANA (2013) on their website: http://www.aana.com/aanaaffiliates/accreditation/pages/accredited-programs.aspx. The list of potential respondents included approximately 318 CRNA nurse anesthesia educational program administrators, assistant administrators, and faculty. They were invited via email (appendix E) to participate in the survey.

Program administrators and faculty were identified initially by reviewing all 112 COA (2013) accredited graduate nurse anesthesia educational program websites. Participants located in the resident state of the researcher were not included in the survey to eliminate any conflict of interest due to local politics among programs. Participants' mailing addresses and email addresses were identified and recorded from the programs' websites. In order to obtain program administrators' and faculty's contact mail and email addresses of those programs that do not identify program administrators and faculty on their website were contacted by email and/or telephone calls to the anesthesia program. After establishing a complete list of program administrators and faculty, invitations to participate in the study were emailed and a follow-up email was sent to each potential participant. All anesthesia administrators, assistant administrators, and faculty (other than 18 from the researcher's home state) were invited via email (appendix E) to participate in the survey (318 potential respondents).

Instrumentation

No suitable instrument was available for conducting this study; therefore, a 50-item web-based survey instrument consisting of the established COA/NBCRNA (2013) required clinical experiences (anesthesia clinical core competencies) and demographic questionnaire was created. A pilot study of the instrument was conducted with the participation of CRNA nurse anesthesia educational program administrators, assistant administrators, and faculty of two programs that were not included in this study and were not from the resident state of the researcher. The web-based survey was administered via the Qualtrics web-based survey instrument service.

Survey items included demographic information about participants and programs, the use of high fidelity human simulation, as well as perceptions of participants related to anesthesia

clinical core competencies and high fidelity human simulation. Demographic information included both individual participants and program specifics. Items related to individual participants included participants' role as an administrator or faculty member; years of experience, both clinically as an anesthesia provider and as an administrator and/or faculty member; and faculty rank. Program specifics included accreditation status; degree awarded upon completion of the program; and individual school or college in which the program is conducted (graduate school of nursing, allied health, healthcare administration, or freestanding nurse anesthesia program). Items related to the use of HFHS included program and individual participant use of HFHS. Items related to the perceptions of participants pertaining to anesthesia clinical core competencies and HFHS included a list of anesthesia clinical core competencies based on the COA (2013) required clinical experiences found in the COA Standards for Accreditation of Nurse Anesthesia Educational Programs (2009). Participants were asked to rate individual anesthesia clinical core competencies on a scale from low to high appropriateness for evaluating proficiency using HFHS.

Institutional Review Board approval of this study and instrument was obtained prior to inviting participants to complete the survey. An Informed Consent was included at the beginning of the survey instrument, and each participant was required to read it and accept it prior to beginning the survey. The anonymity of individual respondents was preserved, and the identity of respondents was not recorded with individual survey responses. The only information about respondents that was collected related to whether a potential survey respondent had completed the survey or not. The potential respondents who had not completed the survey during the initial period allowed for completion (one week) received a weekly reminder email.

The program administrators with potential respondents who had not completed the survey during the first two weeks allowed for completion received follow-up emails and/or phone calls. Reminder emails and/or phone calls continued for four weeks or until a minimum of 20 program administrator respondents, 20 assistant administrator respondents, and 20 faculty respondents had completed the survey. Upon the closure of the web-based survey, the identities of the respondents were destroyed. Thus, demographic data does not include individual respondent identity or institutional identity.

Procedure

Invitations to participate in the study were sent via email to each potential program administrator, assistant administrator, and faculty participant. Invitations included information related to the study's informed consent and internet-based survey. Follow-up email invitations to each potential participant were sent approximately one week after the initial invitations were emailed. They contained a link to the web-based survey as well as information related to the purpose of the study, informed consent, and the researcher's contact information. Follow-up email invitations to participants who had not responded were sent approximately every week for a period of three weeks after the initial email invitation was sent. The web-based survey was closed after three weeks, at which time a significant number of participants had responded.

Data Analysis

Data describing demographic and perceptual findings that support answers to the four research questions were analyzed. The research questions are as follows:

1. What are the anesthesia clinical core competencies that are appropriate for evaluating proficiency in a high fidelity human simulation lab in nurse anesthesia educational programs?
2. Are there differences in anesthesia clinical core competencies identified by program administrators and faculty in nurse anesthesia educational programs?
3. Are there differences in anesthesia clinical core competencies identified based on years of experience and faculty rank?
4. Are there differences in anesthesia clinical core competencies identified between those program administrators and faculty whose programs utilize high fidelity human simulation in their curriculum and those that do not?

The raw data were collected and downloaded into an SPSS statistical analysis spreadsheet program for statistical analysis. Descriptive statistics were calculated for each survey item. Frequency distributions revealed answers to the research questions. An Analysis of Variance (ANOVA) was also performed to determine if there was a difference in responses among anesthesia educational program administrators, assistant administrators, and faculty. Finally, Pearson and Spearman correlation tests were conducted to determine if there was any statistical significance among the responses to each item and the respondents' years of anesthesia clinical experience and faculty rank, respectively.

Conclusion

This chapter described the procedure used to conduct this study. A sample (N=94) of nurse anesthesia educational program administrators, assistant administrators, and faculty completed a survey regarding the anesthesia clinical core competencies that would be

appropriate for evaluating proficiency using high fidelity human simulation. A survey instrument was developed for this study following a pilot study to validate the items used. Demographic information along with the corresponding item rankings were analyzed using descriptive and parametric statistics. A table of the COA (2013)/NBCRNA (2013) required clinical experiences, the survey instrument, and the online survey informed consent can be found in the Appendix A.

Chapter 4

Results

The purpose of this study was to identify anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing high fidelity human simulation (HFHS). To achieve this purpose, the researcher identified the perceptions of nurse anesthesia educational program administrators and faculty regarding anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing HFHS. A sample of Certified Registered Nurse Anesthetist (CRNA) nurse anesthesia educational program administrators and faculty was obtained through a web-based survey created by using Qualtrics survey software. All CRNA nurse anesthesia educational program administrators, assistant administrators, and faculty in all of the 112 nurse anesthesia graduate educational programs located in the United States (with the exception of the six programs in the researchers home state) and accredited in 2014 by the Council on Accreditation of Nurse Anesthesia Educational Programs (COA) were invited to participate in the study survey and comprised the sample.

An email was sent to potential respondents inviting them to participate in the web-based survey. From more than 300 initial email invitations and two rounds of reminder emails, 94 respondents completed the survey. Following the closure of the survey period, data were cleaned using the process described in the "12 Steps of Data Cleaning" by Morrow et al. (2013). While some responses to survey items were missing, an assessment of the missing data (utilizing the "Missing Data Analysis" test in the data analysis software SPSS used for this study) revealed that missing responses were random and comprised less than 5% for any variable. However, it was still possible to calculate the perceptions of respondents regarding the appropriateness of

each anesthesia clinical core competency. No responses were eliminated from the study. Of the 318 potential respondents in the population of United States nurse anesthesia educational program administrators, assistant administrators, and faculty, 94 completed the survey for a response rate of 29.6%.

This chapter presents an analysis of the survey results beginning with a report of respondents' demographic data. The remainder of this chapter analyzes the results of the study as they relate to the research questions. This analysis is accomplished by an examination of the Anesthesia Competency and Simulation web-based survey item results pertaining to the individual anesthesia clinical core competency appropriateness scores as well as those scores related to demographic information.

Analysis of Anesthesia Competency and Simulation Survey Results

In order to fulfill the objectives of the study, the researcher developed and pilot-tested a new survey instrument because no suitable instrument was available. The 50-item web-based survey instrument, titled Anesthesia Competencies and Simulation, was created using Qualtrics web-based survey software. A pilot study of the instrument was conducted with the participation of seven nurse anesthesia education experts who were CRNA nurse anesthesia educational program administrators, assistant administrators, and faculty from two programs not included in this study. The pilot study was conducted to validate the survey items and rating scale. No major changes were made to the survey as a result of the pilot study. Reliability of the results was calculated by the split-half reliability test. Psychometric reliability of the survey items was found to be high with one half of items (N=25) and the second half of items (N=25) having a

Cronbach's Alpha of .959 and .932 respectfully. The survey results have a split-half Spearman-Brown Coefficient of .812 indicating a high reliability of the survey items.

Demographic Profile

Multiple demographic characteristics were examined, including the following: the state in which the respondent's nurse anesthesia educational program was located, gender, age, clinical practice, highest academic degree, utilization of HFHS, funding for HFHS, usefulness of HFHS, length of time as faculty in a nurse anesthesia educational program, faculty rank, and anesthesia educational position. Demographic data are presented in Table 4.1 below. Respondents were associated with nurse anesthesia educational programs located in 30 different states from all regions of the continental United States. Male anesthesia educators represented 30 of the respondents, and 64 were female. The age of respondents ranged from 31 to 68 years old. The mean age of respondents was 48.8 years old, with a standard deviation of 11 years. One of the respondents reported having only a bachelor's degree, 33 reported having a master's degree, 31 had a practice doctoral degree (Doctor of Nursing Practice, Doctor of Nurse Anesthesia Practice, other), and 30 had a research doctoral degree (Doctor of Philosophy, Doctor of Education, Doctor of Nursing Science, other). For faculty rank, 28 of the respondents were instructors, 36 were assistant professors, 24 were associate professors, and six were full professors. Thirty six respondents reported that they were CRNA anesthesia educational program faculty, 21 were CRNA assistant or associate program administrators (assistant director), and 37 were CRNA program administrators (director).

The number of years respondents reported having been a faculty member of a nurse anesthesia educational program were a minimum of one year and a maximum of 37 years, with a

mean of 10 years and a standard deviation of nine years. Regarding anesthesia clinical practice, 12 of the respondents did not practice clinical anesthesia at the time of participation in the survey, 59 practiced less than 20 hours per week, nine practiced more than 20 hours per week and less than 40 hours per week, and 14 practiced 40 hours or more per week. Utilization of HFHS was reported by 84 of respondents, whereas 10 stated they had not used HFHS in their educational practices. Respondents reported that 39 of their respective anesthesia educational programs had received funding for HFHS, whereas 55 stated their programs had not received funding for HFHS. Ninety-eight percent of the respondents reported that HFHS was somewhat to very useful in their anesthesia educational practices, whereas only 2% reported that HFHS was somewhat not to not useful in their anesthesia educational practices. The open ended question for additional comments was not utilized by any respondents for comments related to the survey.

Table 4.1 Respondent Demographic Data (N=94)

Demographic Data	
	Number of Respondents
State of Anesthesia Educational Program	
Alabama	1
Arizona	2
Arkansas	1
California	5
Connecticut	2
Florida	8
Illinois	2
Iowa	1
Kansas	2
Louisiana	2
Maryland	1
Michigan	3
Minnesota	4
Mississippi	1
Missouri	3
Nebraska	3
New Jersey	1
New York	1
North Carolina	3
North Dakota	1
Ohio	5

Table 4.1 (continued)

Demographic Data	
	Number of Respondents
State of Anesthesia Educational Program	
Pennsylvania	12
South Carolina	2
South Dakota	3
Texas	14
Virginia	1
Washington	4
West Virginia	4
Wisconsin	1
Gender	
Male	30
Female	64
Clinical Practice	
Do Not Practice	12
Part Time (20 hours/week or less)	59
Part Time (>20 but <40 hours/week)	9
Full Time (40 hours or >/week)	14
Highest Academic Degree	
Masters	33
Practice Doctorate	31
Research Doctorate	30
Utilize HFHS	
Yes	84
No	10

Table 4.1 (continued)

Demographic Data	
	Number of Respondents
State of Anesthesia Educational Program	
Funding for HFHS	
Yes	39
No	55
HFHS Usefulness	
Very Useful	70
Somewhat Useful	22
Somewhat Not Useful	1
Not Useful	1
Time as Faculty	
0-5 years	41
6-10 years	22
11-15 years	4
16-20 years	14
21-25 years	7
26 or > years	6
Faculty Rank	
Professor	6
Associate Professor	24
Assistant Professor	36
Instructor	28
Anesthesia Educational Position	
Administrator (Program Director)	37
Assistant Administrator (Assistant Program Director)	21
Faculty	36

In order to address the research questions in the next section, data related to individual survey items regarding the anesthesia clinical core competencies and the various anesthesia educational program administrative and faculty groups are presented. Further, research questions are addressed by examining the differences between respondents' reported demographic groups as reflected in the competency appropriateness scores.

Research Questions

This section presents an analysis of data related to the four research questions in order to reveal (1) which of the anesthesia clinical core competencies would be appropriate for evaluating proficiency utilizing HFHS and (2) if there are differences among competency appropriateness score responses by various groups of CRNA nurse anesthesia educational program administrators and faculty. The research questions are restated below, and data analysis results related to each question are presented.

Research question 1.

What are the anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing high fidelity human simulation in nurse anesthesia educational programs?

Overall mean scores and standard deviations are presented below in Table 4.2 (complete calculated results can be found in the Appendix). The calculated appropriateness mean scores represent the overall mean score for evaluating proficiency utilizing HFHS for each required COA (2013) and NBCRNA (2013) anesthesia clinical core competency (clinical experience). Scores are listed in descending order. Competency appropriateness score data were analyzed by calculating the overall appropriateness mean score and standard deviation for each competency. The overall appropriateness mean scores ranged from (1) not appropriate, (2) somewhat not

appropriate, (3) neutral, (4) somewhat appropriate, and (5) very appropriate. Individual competencies with an appropriateness score of greater than 3 were perceived by nurse anesthesia educational program administrators and faculty to be somewhat to very appropriate for evaluating proficiency utilizing HFHS.

Forty-nine of the 50 anesthesia clinical core competencies were found to have an appropriateness mean score of greater than 3, indicating that nurse anesthesia educational program administrators and faculty perceived those competencies to be appropriate for evaluating proficiency utilizing HFHS. It is interesting to note that no competencies received an overall mean appropriateness score of 3 (neutral). Only one of the competencies ("Prone Position" with mean score of 2.99) received an overall appropriateness mean score of less than 3, indicating that nurse anesthesia educational program administrators and faculty perceived that competency to be inappropriate for evaluating proficiency utilizing HFHS.

Table 4.2 Anesthesia Clinical Core Competencies Appropriateness for Evaluation of Proficiency Utilizing HFHS Mean Scores (N = 94)

Anesthesia Clinical Core Competency	Mean Appropriateness Score	Std. Deviation	Min.	Max.
Trauma/Emergency)	4.62	.739	1	5
General Anesthesia	4.58	.774	1	5
IV Induction	4.57	.815	1	5
Tracheal Intubation	4.46	.925	1	5
Alternative Airway Techniques	4.44	.831	2	5
Fiber Optic Intubation	4.42	.913	1	5
Inhaled Induction	4.34	1.009	1	5
Mask Management	4.27	.997	1	5
Pediatric 2-12 Years	4.23	1.022	1	5

Table 4.2 (continued)

Anesthesia Clinical Core Competency	Mean Appropriateness Score	Std. Deviation	Minimum	Maximum
OB Patients	4.21	1.059	1	5
LMA or Similar Airway	4.19	.978	1	5
Pediatric Under 2 Years	4.16	1.111	1	5
Mechanical Ventilation	4.08	1.013	1	5
PA Catheter Monitoring	4.08	.981	1	5
IV Induction Agents	4.06	1.054	1	5
Emergence from Anesthesia	4.05	1.034	1	5
Pharmacological Agents	4.04	1.030	1	5
Geriatric Patients 65 Years or >	4.03	1.015	1	5
CVP Monitoring	4.00	1.090	1	5
Arterial Line Monitoring	4.00	1.109	1	5
Cesarean Section	4.00	1.173	1	5
IV Opioid Agents	3.97	1.065	1	5
Inhaled Agents	3.94	1.103	1	5
Total IV Anesthesia (TIVA)	3.93	1.039	1	5
IV Muscle Relaxant Agents	3.90	1.061	1	5
IV Agents Other	3.89	1.084	1	5
CVP Placement	3.88	1.282	1	5
Intra-Abdominal	3.83	1.043	1	5
Lung Procedure	3.80	1.153	1	5
Intra-Thoracic)	3.77	1.134	1	5
Extremities Procedure	3.76	1.155	1	5
Regional Anesthesia Administration	3.75	1.285	1	5
Vascular Procedure	3.73	1.088	1	5
Heart Procedure	3.72	1.145	1	5
Extra-Thoracic	3.68	1.123	1	5
PA Catheter Placement	3.65	1.395	1	5
Regional Anesthesia Management	3.63	1.131	1	5
Extra-Cranial	3.57	1.144	1	5
Arterial Line Insertion	3.57	1.438	1	5
Labor Analgesia	3.57	1.261	1	5
Neuro-Skeletal Procedure	3.56	1.099	1	5

Table 4.2 (continued)

Anesthesia Clinical Core Competency	Mean Appropriateness Score	Std. Deviation	Minimum	Maximum
Oro-Pharyngeal Procedure	3.52	1.198	1	5
MAC Anesthesia	3.48	1.157	1	5
Neck Procedure	3.43	1.151	1	5
IV Placement	3.34	1.371	1	5
Perineal Procedure	3.34	1.126	1	5
Sitting Position	3.20	1.337	1	5
Lithotomy Position	3.12	1.337	1	5
Lateral Position	3.08	1.379	1	5
Prone Position	2.99	1.425	1	5

Research question 2.

Are there differences in appropriate anesthesia clinical core competencies identified by program administrators and faculty in nurse anesthesia educational programs?

The disparity among anesthesia educational program administrators and faculty regarding the appropriateness of anesthesia clinical core competencies for evaluating proficiency utilizing HFHS can be analyzed by investigating the differences among each of the anesthesia clinical core competency appropriateness mean scores (dependent variable) and the three anesthesia education positions reported in the demographic information (independent variable). Respondents reported their anesthesia education positions as falling into one of three groups, specifically, the Administrator (program director) group, the Assistant Administrator (assistant program director) group, and the Faculty group. The data were analyzed by calculating one-way ANOVA and post hoc Tukey tests. The appropriateness mean scores revealing statistically

significant differences among the groups that were reported in the demographic data are listed in Tables 4.3 through 4.7 below.

Overall, only four differences across educational position groups emerged from the analysis of the appropriateness mean scores. Four anesthesia clinical core competencies received appropriateness mean scores with statistically significant differences among administration/faculty groups. These are presented in the following sections.

Cesarean Section. One of the competencies demonstrating a significant appropriateness score mean difference among groups was "Cesarean Section" (Table 4.3), with an overall significance of .019. For this competency, the appropriateness mean score representing the difference between Administrators (4.36) and Assistant Administrators (3.45) was .911 with a significance of .015. There was no significant "Cesarean Section" competency appropriateness score mean difference between the Administrators (directors) and Faculty or Assistant Administrators (assistant directors) and Faculty. The competency received a somewhat to very appropriate score from the three groups of Administrators (directors), Assistant Administrators (assistant directors), and Faculty, with overall group score means of 4.36, 3.45, and 3.92, respectively. The overall score mean for the competency was 4.00 (somewhat appropriate) with a standard deviation of 1.065.

Table 4.3 Competency Appropriateness by Educational Position Group Descriptives, ANOVA, and Post Hoc Tukey for Cesarean Section Anesthesia Clinical Core Competency Appropriateness Score

Descriptives					
		N	Group Overall Mean	Std. Deviation	Std. Error
Cesarean Section Anesthesia Clinical Core Competency (Dependent Variable)	Director	36	4.36	.990	.165
	Assistant Director	20	3.45	1.234	.276
	Faculty	38	3.92	1.239	.201
	Total	94	3.99	1.187	.122

ANOVA (p < or = .05)						
		Sum of Squares	df	Mean Square	F	Sig.
Cesarean Section Anesthesia Clinical Core Competency (Dependent Variable)	Between Groups	10.971	2	5.485	4.159	.019
	Within Groups	120.019	91	1.319		
	Total	130.989	93			

Post Hoc Tukey (p < or = .05)					
	Education Position	Education Position	Mean Difference	Std. Error	Sig.
Cesarean Section Anesthesia Clinical Core Competency (Dependent Variable)	Director	Assistant Director	.911	.320	.015
		Faculty	.440	.267	.231
	Assistant Director	Faculty	.471	.317	.303

Extremities Procedure. The second competency demonstrating a significant appropriateness score mean difference among groups was "Extremities Procedure" (Table 4.4), with an overall significance of .015. For this competency, the appropriateness score mean representing the difference between Assistant Administrators (3.23) and Faculty (4.13) was .899 with a significance of .013. There was no significant "Extremity Procedure" competency score mean difference between Administrators (directors) and Faculty or Administrators (directors) and Assistant Administrators (assistant directors). The competency received a somewhat to very appropriate score from the three groups of Administrators (directors), Assistant Administrators (assistant directors), and Faculty, with overall group score means of 3.65, 3.23, and 4.13, respectively. The overall score mean for the competency was 3.76 (somewhat appropriate) with a standard deviation of 1.153.

Table 4.4 Competency Appropriateness by Educational Position Group Descriptive, ANOVA, and Post Hoc Tukey Calculated Statistics for Extremities Procedure Anesthesia Clinical Core Competency Appropriateness Scores

Descriptive					
		N	*Mean*	Std. Deviation	Std. Error
Extremities Procedure Anesthesia Clinical Core Competency (Dependent Variable)	Director	36	3.65	1.238	.206
	Assistant Director	20	3.23	1.280	.286
	Faculty	38	4.13	.907	.147
	Total	94	3.75	1.166	.120

Table 4.4 (continued)

ANOVA (p < or = .05)						
		Sum of Squares	*df*	Mean Square	*F*	Sig.
Extremities Procedure Anesthesia Clinical Core Competency (Dependent Variable)	Between Groups	11.219	2	5.610	4.428	.015
	Within Groups	115.282	92	1.267		
	Total	126.501	94			

Post Hoc Tukey (p < or = .05)					
	Education Position	Education Position	Mean Difference	Std. Error	Sig.
Extremities Procedure Anesthesia Clinical Core Competency (Dependent Variable)	Director	Assistant Director	.421	.314	.377
		Faculty	-.478	.262	.166
	Assistant Director	Faculty	-.899*	.311	.013

Extra-Cranial. The third competency demonstrating a significant appropriateness score mean difference among groups was "Extra-Cranial" (Table 4.5), with an overall significance of .033. For this competency, the appropriateness score mean representing the difference between Assistant Administrators (3.06) and Faculty (3.87) was .815 with a significance of .027. There was no significant "Extra-Cranial" competency mean score difference between Administrators (directors) and Faculty or Administrators (directors) and Assistant Administrators (assistant directors). The competency received a somewhat to very appropriate score from the three groups of Administrators (directors), Assistant Administrators (assistant directors), and Faculty, with

overall group score means 3.49, 3.06, and 3.87, respectively. The overall score mean for the competency was 3.57 (somewhat appropriate) with a standard deviation of 1.144.

Table 4.5 Competency Appropriateness by Educational Position Group Descriptive, ANOVA, and Post Hoc Tukey Calculated Statistics for "Extra-Cranial" Anesthesia Clinical Core Competency Appropriateness Scores

Descriptives					
		N	Mean	Std. Deviation	Std. Error
Extra-Cranial Anesthesia Clinical Core Competency (Dependent Variable)	Director	36	3.49	1.174	.196
	Assistant Director	20	3.06	1.310	.293
	Faculty	38	3.87	.955	.155
	Total	94	3.55	1.152	.119

ANOVA (p < or = .05)						
		Sum of Squares	*df*	Mean Square	*F*	Sig.
Extra-Cranial Anesthesia Clinical Core Competency (Dependent Variable)	Between Groups	8.926	2	4.463	3.544	.033
	Within Groups	114.593	92	1.259		
	Total	123.519	94			

Post Hoc Tukey (p < or = .05)					
	Ed. Position	Ed. Position	Mean Diff.	Std. Error	Sig.
Extra-Cranial Anesthesia Clinical Core Competency (Dependent Variable)	Director	Assistant Director	.435	.313	.350
		Faculty	-.380	.261	.317
	Assist.Dir.	Faculty	-.815*	.310	.027

IV Induction Agents. The fourth and last competency demonstrating a significant appropriateness score mean difference among groups was "IV Induction Agents" (Table 4.7), with an overall significance of .046. For this competency, the appropriateness score mean representing the difference between Administrators (3.78) and Faculty (4.37) was .589 with a significance of .045. There was no significant "IV Induction Agents" competency score mean difference between Assistant Administrators (assistant directors) and Faculty or Administrators (directors) and Assistant Administrators (assistant directors). The competency received a somewhat to very appropriate score from Administrators (directors), Assistant Administrators (assistant directors), and Faculty, with overall group score means of 3.78, 3.90, and 4.37, respectively. The overall score mean for the competency was 4.06 (somewhat appropriate) with a standard deviation of 1.054.

Table 4.6 Competency Appropriateness by Educational Position Group Descriptive, ANOVA, and Post Hoc Tukey Calculated Statistics for "IV Induction Agents" Anesthesia Clinical Core Competency Appropriateness Scores

Descriptives					
		N	Mean	Std. Deviation	Std. Error
IV Induction Agents Anesthesia Clinical Core Competency (Dependent Variable)	Director	36	3.78	1.268	.211
	Assistant Director	20	3.90	.968	.217
	Faculty	38	4.37	.818	.133
	Total	94	4.05	1.067	.110

ANOVA (p < or = .05)						
		Sum of Squares	*df*	Mean Square	*F*	Sig.
IV Induction Agents Anesthesia Clinical Core Competency (Dependent Variable)	Between Groups	6.933	2	3.467	3.190	.046
	Within Groups	98.885	92	1.087		
	Total	105.819	94			

Post Hoc Tukey (p < or = .05)					
	Education Position	Education Position	Mean Difference	Std. Error	Sig.
IV Induction Agents Anesthesia Clinical Core Competency (Dependent Variable)	Director	Assistant Director	.120	.291	.910
		Faculty	.589	.242	.045
	Assistant Director	Faculty	.469	.288	.240

Research question 3.

Are there differences in appropriate anesthesia clinical core competencies identified based on years of experience and faculty rank?

The relationship among anesthesia educational program administrators and faculty with respect to appropriateness of competencies for evaluating proficiency utilizing HFHS can also be analyzed by investigating the differences between reported demographic information pertaining to years of educational experience (time as faculty) and faculty rank as they relate to the anesthesia clinical core competency appropriateness scores. First, differences related to the reported demographic information of length of time as faculty (independent variable) and appropriateness score (dependent variable) were evaluated. Time as Faculty groups were identified as respondents with 1-5 years (N=41), 6-10 years (N=22), 11-15 years (N=4), 16-20 years (N=14), 21-25 years (N=7), and 26 or more years (N=6) of experience. Faculty rank groups were identified as Professors, Associate Professors, Assistant Professors, and Instructors.

Time as Faculty. The disparity among anesthesia educational program administrators and faculty pertaining to competency appropriateness was also analyzed by investigating the differences among each of the competency appropriateness mean scores (dependent variable) and the six time as faculty groups (independent variable) reported in the demographic information. The data were analyzed by calculating one-way ANOVA and post hoc Tukey tests. Overall, there was no significant difference among appropriateness score means for time as faculty groups emerged.

Faculty Rank. Faculty rank was also analyzed by investigating the differences among each of the competency appropriateness mean scores (dependent variable) and the four faculty

rank groups (independent variable) reported in the demographic information. The data were analyzed by calculating one-way ANOVA and post hoc Tukey tests. The appropriateness score means demonstrating statistically significant differences among faculty rank groups reported in the demographic data are listed in Tables 4.9-4.13 below.

Overall, only five differences emerged from the appropriateness mean scores for faculty rank groups.

Intra-Thoracic. One of the competencies demonstrating a significant appropriateness score mean difference among groups was "Intra-Thoracic" (Table 4.9), with an overall significance of .028. For this competency, the appropriateness score mean representing the difference among the faculty rank groups of Professor and Assistant Professor was 1.359 with a significance of .033. There was no significant "Intra-Thoracic" appropriateness score mean difference among any of the other faculty rank groups. This competency received a somewhat to very appropriate score from the four faculty rank groups, with overall group score means of 4.83, 3.65, 3.47, and 4.00, respectively. The overall appropriateness score mean for the competency was 3.76 (somewhat appropriate) with a standard deviation of 1.145.

Table 4.7 Competency Appropriateness by Faculty Rank Group Descriptive, ANOVA, and Post Hoc Tukey Calculated Statistics for "Intra-Thoracic" Anesthesia Clinical Core Competency Appropriateness Scores(N = 94)

Descriptives					
		N	Mean	Std. Deviation	Std. Error
Intra-Thoracic Anesthesia Clinical Core Competency (Dependent Variable)	Professor	6	4.83	.408	.167
	Associate Professor	25	3.65	1.210	.242
	Assistant Professor	36	3.47	1.174	.196
	Instructor	27	4.00	1.000	.192
	Total	94	3.76	1.145	.118

ANOVA (p < or + .05)						
		Sum of Squares	*df*	Mean Square	*F*	Sig.
Intra-Thoracic Anesthesia Clinical Core Competency (Dependent Variable)	Between Groups	11.684	3	3.895	3.179	.028
	Within Groups	110.248	91	1.225		
	Total	121.932	94			

Post Hoc Tukey (p < or = .05)					
Dependent Variable	Faculty Rank	Faculty Rank	Mean Difference	Std. Error	Sig.
Intra-Thoracic Anesthesia Clinical Core Competency (Dependent Variable)	Professor	Associate Professor	1.181	.503	.095
		Assistant Professor	1.359*	.488	.033
		Instructor	.833	.500	.346
	Associate Professor				
		Assistant Professor	.178	.288	.926
		Instructor	-.347	.307	.672
	Assistant Professor				
		Instructor	-.525	.282	.251

Heart Procedure. The second competency demonstrating a significant appropriateness score mean difference among groups was "Heart Procedure" (Table 4.10), with an overall significance of .029. For this competency, the appropriateness score mean representing the difference among the Professor and Assistant Professor groups was 1.365 with a significance of .034. There was no significant "Heart Procedure" competency score mean difference among any of the other faculty rank groups. This competency received a somewhat to very appropriate score from the four faculty rank groups, with overall group score means of 4.83, 3.53, 3.47, and 3.93, respectively. The overall appropriateness score mean for the competency was 3.70 (somewhat appropriate) with a standard deviation of 1.156.

Table 4.8 Competency Appropriateness by Faculty Rank Group Descriptive, ANOVA, and Post Hoc Tukey Calculated Statistics for "Heart Procedure" Appropriateness Scores (N = 94)

Descriptives					
		N	Mean	Std. Deviation	Std. Error
Heart Procedure Anesthesia Clinical Core Competency (Dependent Variable)	Professor	6	4.83	.408	.167
	Associate Professor	25	3.53	1.184	.237
	Assistant Professor	36	3.47	1.197	.200
	Instructor	27	3.93	1.035	.199
	Total	94	3.70	1.156	.119

ANOVA ($p <$ or + .05)						
		Sum of Squares	*df*	Mean Square	*F*	Sig.
Heart Procedure Anesthesia Clinical Core Competency (Dependent Variable)	Between Groups	11.772	3	3.924	3.140	.029
	Within Groups	112.459	91	1.250		
	Total	124.231	94			

Table 4.8 (continued)

Post Hoc Tukey (p < or = .05)					
Dependent Variable	Faculty Rank	Faculty Rank	Mean Difference	Std. Error	Sig.
Heart Procedure Anesthesia Clinical Core Competency (Dependent Variable)	Professor	Associate Professor	1.307	.508	.056
		Assistant Professor	1.365	.493	.034
		Instructor	.907	.505	.281
	Associate Professor				
		Assistant Professor	.057	.291	.997
		Instructor	.400	.310	.572
	Assistant Professor				
		Instructor	.457	.285	.380

Lung Procedure. The third competency demonstrating a significant appropriateness score mean difference among groups was "Lung Procedure" (Table 4.11), with an overall significance of .036. For this competency, the appropriateness score mean representing the difference among the groups of Professor and Associate Professor was 1.377 with a significance of .043. There was no significant "Lung Procedure" competency score mean difference among any of the other faculty rank groups. This competency received a somewhat to very appropriate score from the four faculty rank groups, with overall group score means of 4.83, 3.46, 3.67, and 4.03, respectively. The overall appropriateness score mean for the competency was 3.79 (somewhat appropriate) with a standard deviation of 1.156.

Table 4.9 Competency Appropriateness by Faculty Rank Group Descriptive, ANOVA, and Post Hoc Tukey Calculated Statistics for "Lung Procedure" Anesthesia Clinical Core Competency Appropriateness Scores (N = 94)

Descriptives					
		N	Mean	Std. Deviation	Std. Error
Lung Procedure Anesthesia Clinical Core Competency (Dependent Variable)	Professor	6	4.83	.408	.167
	Associate Professor	25	3.46	1.220	.244
	Assistant Professor	36	3.67	1.211	.202
	Instructor	27	4.03	1.019	.196
	Total	94	3.79	1.165	.120

ANOVA (p < or + .05)						
		Sum of Squares	*df*	Mean Square	*F*	Sig.
Lung Procedure Anesthesia Clinical Core Competency (Dependent Variable)	Between Groups	11.358	3	3.786	2.966	.036
	Within Groups	114.876	91	1.276		
	Total	126.234	94			

Post Hoc Tukey (p < or = .05)					
Dependent Variable	Faculty Rank	Faculty Rank	Mean Difference	Std. Error	Sig.
Lung Procedure Anesthesia Clinical Core Competency (Dependent Variable)	Professor	Associate Professor	1.377	.514	.043
		Assistant Professor	1.161	.498	.099
		Instructor	.804	.510	.398
	Associate Professor	Assistant Professor	.216	.294	.883
		Instructor	.573	.314	.267
	Assistant Professor	Instructor	-.357	.288	.602

Neuro-Skeletal. The fourth competency demonstrating a significant appropriateness score mean difference among groups was "Neuro-Skeletal" (Table 4.12), with an overall significance of .036. For this competency, the appropriateness score mean representing the difference among the groups of Professor and Associate Professor was 1.377 (Table 4.12), with a significance of .043. There was no significant "Neuro-Skeletal" competency score mean difference among any of the other faculty rank groups. This competency received a somewhat to very appropriate score from the four faculty rank groups, with overall group score means of 4.83, 3.46, 3.67, and 4.03, respectively. The overall appropriateness score mean for the competency was 3.79 (somewhat appropriate) with a standard deviation of 1.156.

Table 4.10 Competency Appropriateness by Faculty Rank Group Descriptive, ANOVA, and Post Hoc Tukey Calculated Statistics for "Neuro-Skeletal" Appropriateness Scores (N = 94)

Descriptives					
		N	Mean	Std. Deviation	Std. Error
Neuro-Skeletal Anesthesia Clinical Core Competency (Dependent Variable)	Professor	6	4.50	.548	.224
	Associate Professor	25	3.46	1.080	.216
	Assistant Professor	36	3.26	1.194	.199
	Instructor	27	3.80	.963	.185
	Total	94	3.55	1.106	.114

ANOVA ($p <$ or + .05)						
		Sum of Squares	*df*	Mean Square	*F*	Sig.
Neuro-Skeletal Anesthesia Clinical Core Competency (Dependent Variable)	Between Groups	10.367	3	3.456	3.006	.034
	Within Groups	103.452	91	1.149		
	Total	113.820	94			

Table 4.10 (continued)

Post Hoc Tukey (p < or = .05)					
Dependent Variable	Faculty Rank	Faculty Rank	Mean Difference	Std. Error	Sig.
Neuro-Skeletal Anesthesia Clinical Core Competency (Dependent Variable)	Professor	Associate Professor	1.038	.487	.152
		Assistant Professor	1.243	.473	.049
		Instructor	.701	.484	.472
	Associate Professor				
		Assistant Professor	.206	.279	.882
		Instructor	.336	.298	.672
	Assistant Professor				
		Instructor	.542	.273	.201

Regional Anesthesia Administration. The fifth and last competency demonstrating a significant appropriateness score mean difference among groups was "Regional Anesthesia Administration" (Table 4.13), with an overall significance of .034. For this competency, the appropriateness score mean representing the difference among the groups of Professor and Assistant Professor was 1.243 with a significance of .049. There was no significant "Regional Anesthesia Administration" competency score mean difference among any of the other faculty rank groups. This competency received a somewhat to very appropriate score from the four faculty rank groups, with overall group score means of 4.50, 3.46, 3.26, and 3.80, respectively. The overall appropriateness score mean for the competency was 3.55 (somewhat appropriate) with a standard deviation of 1.106.

Table 4.11 Competency Appropriateness by Faculty Rank Group Descriptive, ANOVA, and Post Hoc Tukey Calculated Statistics for "Regional Anesthesia Administration" Anesthesia Clinical Core Competency Appropriateness Scores

Descriptives					
		N	Mean	Std. Deviation	Std. Error
Regional Anesthesia Administration Anesthesia Clinical Core Competency (Dependent Variable)	Professor	6	4.50	.548	.224
	Associate Professor	25	3.46	1.080	.216
	Assistant Professor	36	3.26	1.194	.199
	Instructor	27	3.80	.963	.185
	Total	94	3.55	1.106	.114

ANOVA (p < or + .05)						
		Sum of Squares	*df*	Mean Square	*F*	Sig.
Regional Anesthesia Administration Anesthesia Clinical Core Competency (Dependent Variable)	Between Groups	10.367	3	3.456	3.006	.034
	Within Groups	103.452	91	1.149		
	Total	113.820	94			

Post Hoc Tukey (p < or = .05)					
Dependent Variable	Faculty Rank	Faculty Rank	Mean Difference	Std. Error	Sig.
Regional Anesthesia Administration Anesthesia Clinical Core Competency (Dependent Variable)	Professor	Associate Professor	1.038	.487	.152
		Assistant Professor	1.243	.473	.049
		Instructor	.701	.484	.472
	Associate Professor				
		Assistant Professor	.206	.279	.882
		Instructor	.336	.298	.672
	Assistant Professor				
		Instructor	.542	.273	.201

Research question 4.

Are there differences in appropriate anesthesia clinical core competencies identified among those program administrators and faculty whose programs utilize high fidelity human simulation in their curriculum and those that do not?

The relationship of anesthesia educational program administrators and faculty with respect to appropriateness of competencies for evaluating proficiency utilizing HFHS can also be analyzed by investigating the differences between reported demographic information related to faculty whose anesthesia educational programs utilized HFHS at the time of this survey and those that did not (independent variable) and anesthesia clinical core competency appropriateness mean scores (dependent variable). Utilization groups were identified as respondents whose anesthesia educational programs utilized HFHS and those that did not.

The disparity among anesthesia educational program administrators and faculty was analyzed by investigating the differences among each of the anesthesia clinical core competency appropriateness score means and the utilization groups reported in the demographic information. Data were analyzed by calculating one-way ANOVA and post hoc Tukey tests. The appropriateness mean scores demonstrating statistically significant differences among groups reported in the demographic data are listed in Tables 4.14-4.15 below. Overall, only two differences emerged from the analysis.

Pediatrics Under 2 Years Old. The first of the competencies demonstrating a significant appropriateness score mean difference among utilization groups was "Pediatrics Under 2 Years Old" (Table 4.14). For this competency, the appropriateness score mean representing the difference among the groups of those administrators and faculty whose anesthesia educational

programs utilized HFHS and those that did not was .803 with a 2-tailed significance of .042. This competency received a somewhat to very appropriate score from the two utilization groups of Utilized and Did Not Utilize, with overall group score means of 4.09 and 4.89, respectively. The overall appropriateness score mean for the competency was 4.23 (somewhat to very appropriate) with a standard deviation of 1.022.

Table 4.12 Competency Appropriateness by Utilization Group Descriptive, t-test Calculated Statistics for "Pediatrics Under 2 Years Old" Anesthesia Clinical Core Competency Appropriateness Scores (N = 94)

Descriptive Statistics					
	Utilized HFHS	*N*	Mean	Std. Deviation	Std. Error Mean
Pediatrics Under 2 Years Old Anesthesia Clinical Core Competency (Dependent Variable)	Yes	85	4.09	1.157	.125
	No	9	4.89	.333	.111

Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	*t*	*df*	Sig. 2-tailed	Mean Difference	Std. Error Difference
Pediatrics Under 2 Years Old Anesthesia Clinical Core Competency (Dependent Variable)	Equal variances assumed	10.058	.002	-2.063	92	.042	.803	.389
	Equal variances not assumed			-4.790	35.863	.000	.803	.168

Sitting Position. The other competency demonstrating a significant appropriateness score mean difference among groups was "Sitting Position" (Table 4.15). For this competency, the appropriateness score mean representing the difference among administrators and faculty whose anesthesia educational programs utilized HFHS and those that did not was 1.005 with a 2-tailed significance of .034. The "Sitting Position" competency received a somewhat to very appropriate score from the two utilization groups of Utilized and Did Not Utilize, with overall group scores mean of 3.11 and 4.11, respectively. The overall appropriateness score mean for the competency was 3.20 (somewhat to very appropriate) with a standard deviation of 1.337.

Table 4.13 Competency Appropriateness by Utilization Group Descriptive, t-test Calculated Statistics for "Sitting Position" Anesthesia Clinical Core Competency Appropriateness Scores

Descriptive Statistics					
	Utilized HFHS	*N*	Mean	Std. Deviation	Std. Error Mean
Sitting Position Anesthesia Clinical Core Competency (Dependent Variable)	Yes	85	3.11	1.347	.146
	No	9	4.11	1.167	.389

Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	*t*	*df*	Sig. 2-tailed	Mean Difference	Std. Error Difference
Sitting Position Anesthesia Clinical Core Competency (Dependent Variable)	Equal variances assumed	.059	.809	-2.152	92	.034	1.005	.467
	Equal variances not assumed			-2.419	10.399	.035	1.005	.415

Conclusion

This study has identified appropriate anesthesia clinical core competencies for evaluating proficiency utilizing HFHS. The results were achieved by identifying the perceptions of nurse anesthesia educational program administrators and faculty pertaining to anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing HFHS. The data from this study's web-based survey, of which a sample of CRNA nurse anesthesia educational program administrators and faculty participated, were examined with respect to the demographic information and research questions. The differences among various groups of anesthesia educational program administrators and faculty that emerged from the data analysis were presented. Chapter 5 includes a discussion of the results as they relate to the demographic information, instrument, and research questions. Furthermore, implications for educational practice and recommendations for further study are presented.

Chapter 5

Discussion and Recommendations

The Council on Accreditation of Nurse Anesthesia Educational Programs (COA 2013) and the National Board for Certification and Recertification of Nurse Anesthetists (NBCRNA 2013) require that nurse anesthesia educational programs incorporate the entire anesthesia clinical core competencies (required experiences) included in this study into their curricula and to document that each required competency has been completed. Neither the COA nor the NBCRNA specify the method or methods by which each program should evaluate proficiency regarding the required anesthesia clinical core competencies (required experiences). The purpose of this study was to identify anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing high fidelity human simulation (HFHS). This study identified those appropriate anesthesia clinical core competencies for evaluating proficiency utilizing HFHS. This was achieved by identifying the perceptions of nurse anesthesia educational program administrators and faculty pertaining to anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing HFHS.

An examination of the data revealed anesthesia educational program, administrator, and faculty demographic characteristics as well as, the anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing HFHS scores. Demographic data included the state in which the respondents' nurse anesthesia educational program was located, gender, age, clinical practice, highest academic degree, utilization of HFHS, funding for HFHS, usefulness of HFHS, length of time as faculty in a nurse anesthesia educational program, faculty rank, and anesthesia educational position. Anesthesia clinical core competency appropriateness scores

included rating scores for each of the COA (2013) and NBCRNA (2013) required anesthesia clinical core clinical competencies (required experiences) for evaluating proficiency utilizing HFHS. This chapter presents a discussion of the results as they relate to the demographic information, instrument, and research questions. The chapter ends with implications for educational practice and recommendations for further study.

Because no suitable instrument was available for use in the study, the Anesthesia Core Competency and Simulation Survey was created by the researcher. The web-based demographic questionnaire and a 50-item survey instrument were developed to meet the study objectives. A pilot study of the instrument was conducted to validate the survey items. No major changes were made to the final survey instrument, and the survey was deployed utilizing the web-based survey instrument service Qualtrics. The study instrument included a demographic questionnaire requesting information about participants and programs, use of high fidelity human simulation, and perceptions of participants related to anesthesia clinical core competencies and high fidelity human simulation.

The survey items (anesthesia clinical core competencies) were based on the Council on Accreditation of Nurse Anesthesia Educational Programs (COA, 2013) required clinical experiences found in the COA Standards for Accreditation of Nurse Anesthesia Educational Programs (2009) and required by the National Board for Certification and Recertification of Nurse Anesthetists (NBCRNA, 2013). Respondents rated each anesthesia clinical core competency on its appropriateness for evaluating proficiency utilizing HFHS.

Discussion of Study Findings

The data regarding demographic characteristics were revealed in Chapter 4, including: the state in which the respondents' nurse anesthesia educational program was located, gender, age, clinical practice, highest academic degree, use of HFHS, funding for HFHS, usefulness of HFHS, length of time as faculty in a nurse anesthesia educational program, faculty rank, and anesthesia educational position. Respondents were associated with nurse anesthesia educational programs from all regions of the continental United States. A majority of anesthesia educator respondents were female (64), with only 30 of respondents being male. The mean age of respondents was 48.85 years old. Also, respondents had earned graduate degrees, with 35% having a minimum of a master's degree and 65% having a doctoral degree (32% research doctorate). Faculty rank included 28 instructors, 36 assistant professors, 24 associate professors, and 6 full professors. Respondents reported that their positions in anesthesia education were 36 CRNA anesthesia educational program faculty, 21 CRNA assistant program administrator (assistant director), and 37 CRNA program administrator (director). The number of years respondents reported having been a faculty member of a nurse anesthesia educational program were a minimum of zero to one year and a maximum of 37 years, with a mean of 10 years and a standard deviation of nine years.

Regarding anesthesia clinical practice, only 12 of the respondents did not practice clinical anesthesia, and only 14 practiced full-time; the majority (68) of respondents practiced part-time. Only 10 of respondents did not use HFHS, whereas a majority (84) reported utilizing HFHS in their anesthesia educational practices. While a minority of the respondents' anesthesia educational programs had received funding to support HFHS (42%), it is interesting to note that

the majority (98%) of respondents reported that it was their perception that HFHS was somewhat to very useful in their anesthesia educational practices, whereas only 2% of respondents reported that HFHS was only somewhat not to not useful in their anesthesia educational practices.

The sections to follow present a discussion of the implications of the data with respect to (1) which of the anesthesia clinical core competencies would be appropriate for evaluating proficiency utilizing HFHS and (2) if there are differences among competency appropriateness score responses by various groups of CRNA nurse anesthesia educational program administrators and faculty. The research questions are restated below, and discussion related to the statistically significant results for each question are presented.

Research Question 1

What are the anesthesia clinical core competencies appropriate for evaluating proficiency utilizing high fidelity human simulation in nurse anesthesia educational programs?

The first research question examined existing Council on Accreditation of Nurse Anesthesia Educational Programs' (COA, 2013) and National Board for Certification and Recertification of Nurse Anesthetists' (NBCRNA, 2013) mandated anesthesia clinical core competencies (required clinical experiences) and how they relate to evaluating proficiency utilizing High Fidelity Human Simulation (HFHS). The data for Research Question 1 was presented in Chapter 4 (Table 4.2). To address the first research question, the researcher identified the anesthesia clinical core competencies that are appropriate for evaluating proficiency utilizing HFHS. Respondents rated each anesthesia clinical core competency (required experience) on their appropriateness for evaluation utilizing HFHS. No respondents

gave an item a score of N/A. Survey items (competencies) each had a calculated mean, which represents the overall appropriateness mean score for evaluating proficiency utilizing HFHS.

The overall appropriateness mean scores ranged from (1) not appropriate to (5) very appropriate; a mean greater than 3 was considered to be more appropriate than neutral for evaluating proficiency utilizing HFHS (appendix B). Forty-nine of the 50 anesthesia clinical core competencies had an appropriateness mean score greater than 3 (neutral), indicating that nurse anesthesia educational program administrators and faculty perceived those competencies to be appropriate for evaluating proficiency utilizing HFHS. Only one of the competencies ("Prone Position") received an overall appropriateness mean score of less than 3 (2.99), indicating that nurse anesthesia educational program administrators and faculty perceived that competency to be less than appropriate for evaluation utilizing HFHS.

"Trauma/Emergency", "General Anesthesia", and "IV Induction" stood out with appropriateness scores greater than 4.5 (4.62, 4.58, and 4.57, respectively). It is not surprising that these three competencies received high scores because they are essential or universal anesthesia clinical core competencies that encompass the majority of the clinical skills required of anesthesia providers. Likewise, 15 competencies had appropriateness scores greater than 4 but less than 4.5, indicating that respondents perceived those competencies to be very important in evaluating proficiency. These competencies included "Tracheal Intubation", "Alternative Airway Techniques", "Fiber Optic Intubation", "Inhaled Induction", "Mask Management", "Pediatric 2-12 Years", "OB Patients", "LMA or Similar Airway", "Pediatric Under 2 Years", "Mechanical Ventilation", "PA Catheter Monitoring", "IV Induction Agents", "Emergence from Anesthesia", "Pharmacological Agents", and "Geriatric Patients 65 Years or Greater". Again,

these competencies include basic clinical skills that are required by anesthesia providers. They include various airway techniques, induction of anesthesia, and emergence from anesthesia. Furthermore, these 15 competencies include techniques related to providing anesthesia care to patients spanning their lifetime, including pediatric patients, those experiencing pregnancy, and geriatric patients.

The four competencies with the lowest appropriateness mean scores were those related to positioning during anesthesia, including "Sitting Position", "Lithotomy Position", "Lateral Position", and "Prone Position" (3.20, 3.12, 3.08, and 2.99, respectively). Interestingly, individual anesthesia providers caring for patients undergoing procedures requiring anesthesia services may be held liable for patient injury as a result of positioning. Also of interest, the standard deviation for each item increased as the mean score decreased which may indicate less agreement among administrators and faculty with regard to those competencies having lower means. Furthermore, anesthesia educational program administrators and faculty may perceive that evaluating proficiency for positioning competencies can be accomplished using less expensive simple medical models, such as non-high fidelity mannequins rather than HFHS. The appropriateness score results indicate that the majority of existing anesthesia clinical core competencies with the possible exception of one ("Prone Position") are all appropriate for evaluation utilizing HFHS. Furthermore, the data show that there is consensus among anesthesia educational program administrators and faculty about which competencies are appropriate for evaluation utilizing HFHS. Anesthesia educators agreed, as did King et al. (2002) who found agreement among leaders in the field of emergency medicine, that HFHS has merit in evaluating competency. The findings reveal that anesthesia educational program administrators and faculty

agree that all of the anesthesia clinical core competencies are important for consideration in evaluating proficiency using HFHS.

Research Question 2

Are there differences in appropriate anesthesia clinical core competencies identified by program administrators and faculty in nurse anesthesia educational programs?

The second research question examined the differences in the perceptions of anesthesia educational program administrators and faculty. The anesthesia clinical core competency (required experiences) appropriateness scores from the survey of anesthesia educational program administrators (program director), assistant administrators (assistant program director), and faculty respondents were examined for disparity among groups. Data related to educational position and competency appropriateness revealed only five (out of a possible 150) significant differences among educational position groups. The competencies found to have significant differences in appropriateness scores means were "Cesarean Section", "Extremity Procedure", "Extra-Cranial", "Neck Procedure", and "IV Induction Agents".

Administrators and assistant administrators with regard to the competency of "Cesarean Section" demonstrated a difference significance of .015 with score means of 4.36 and 3.45 respectively. Assistant administrators and faculty with regard to the competency of "Extremity Procedures" demonstrated a difference significance of .013 with score means of 3.23 and 4.13 respectively. Assistant administrators and faculty with regard to the competency of "Extra-Cranial" demonstrated a difference significance of .027 with score means of 3.06 and 3.87 respectively. Administrators and faculty with regard to the competency of "IV Induction Agents" demonstrated a difference significance of .045 with score means of 3.78 and 4.37 respectively.

The result differences with regard to administrators, assistant administrators, and faculty may indicate that those with more experience or knowledge related to HFHS had higher overall scores. Administrators may have more experience with funding issues related to HFHS and faculty may be using this technology more frequently than assistant administrators.

While there were five differences revealed by the data, all of the competencies demonstrating differences between educational position groups received overall score means of somewhat to very appropriate for evaluating proficiency utilizing HFHS. As Norris (2007) also found, educational administrators, assistant administrators, and faculty agree with one another on the appropriateness of competencies for evaluating proficiency. Because the data revealed very few differences among the anesthesia educational position groups, one can conclude that there is evidence of an agreed upon set of appropriate competencies.

Research Question 3

Are there differences in appropriate anesthesia clinical core competencies identified based on years of experience and faculty rank?

The third research question examined differences between anesthesia educational program administrators and faculty based on their years of anesthesia educational experience and faculty rank. The data were divided into groups based on years of experience and were examined for disparity among the groups. Time as faculty groups were identified as respondents having 1-5 years, 6-10 years, 11-15 years, 16-20 years, 21-25 years, and 26 or more years of experience. Data related to educational experience and competency appropriateness revealed one significant difference among the groups' appropriateness mean scores, which was Laryngeal Mask Airway or Other. It received an overall appropriateness mean score of somewhat to very

appropriate for evaluating proficiency utilizing HFHS. While the data showed an overall significant difference among groups (p = .022), no significant difference between any two groups based on years of educational experience was found.

Also examined were data related to rank among anesthesia educational program administrators and faculty. The data were divided into groups based on faculty rank and were examined for disparity among groups. The faculty ranks included Professor, Associate Professor, Assistant Professor, or Instructor. The data revealed five significant differences among the groups' appropriateness score means. Those competencies that received appropriateness score means with significant differences among faculty rank groups included "Intra-Thoracic", "Heart Procedure", "Lung Procedure", "Neuro-Skeletal", and "Regional Anesthesia Administration". While there were five differences revealed by the data, all of the competencies demonstrating differences among faculty rank groups received overall mean scores of somewhat to very appropriate for evaluating proficiency utilizing HFHS. Furthermore, overall mean scores were within the somewhat to very appropriate range of scores higher faculty ranking professors (N=6) consistently had higher mean scores than the associate (N=25) or assistant (N=36) professors and no significant difference when compared with instructors. Again, this may indicate that those with more experience related to funding and utilization of HFHS (professors and instructors) score higher than those with potentially less experience (associate and assistant professors).

Again, the findings show that anesthesia administrators and faculty agree, regardless of experience or faculty rank, on which competencies are appropriate for evaluating proficiency utilizing HFHS. Furthermore, with very little difference found among the years of experience

and faculty rank groups there is further evidence of a consensus regarding appropriateness scores.

Research Question 4

Are there differences in appropriate anesthesia clinical core competencies identified among those program administrators and faculty whose programs utilize high fidelity human simulation in their curricula and those that do not?

The fourth research question examined differences among anesthesia educational program administrators' and faculty's utilization of HFHS. The data were examined for disparity among the groups and revealed two significant differences. The competencies identified were "Pediatrics Under 2 Years Old" and "Sitting Position".

The "did not utilize HFHS" group had a significantly higher mean score than the "did utilize HFHS" for both of the competencies with significant differences in mean scores both. While there were two differences revealed by the data, both of the competencies demonstrating differences among HFHS utilization groups received overall score means of somewhat to very appropriate for evaluating proficiency utilizing HFHS. Thus, the small amount of difference found in the data serves as further evidence of agreement among groups. However, the results demonstrated that a majority of respondents were from programs that utilize HFHS in their curricula, even though only 51% of anesthesia programs utilize HFHS (Turcato et al., 2008). Therefore, because there were very few administrators and faculty from programs that did not utilize HFHS, the results may be influenced by the possibility that only those administrators and faculty from programs that utilized HFHS responded to the survey.

Implications for Educational Practice

This study presents evidence of a consensus among anesthesia educational program administrators and faculty regarding existing anesthesia clinical core competencies and their appropriateness for evaluating proficiency utilizing HFHS. While 49 of the 50 competencies were reported to be appropriate for evaluation, no competencies were found to be inappropriate among the infrequent differences revealed among the various groups of anesthesia administrators and faculty. Although HFHS has been utilized in the past for demonstration and learning, the results of this study provide evidence that supports utilizing HFHS for evaluating proficiency. The implications for educational practice include issues related to teaching, learning, and evaluation, as well as the expense of using HFHS.

Prior to using HFHS to evaluate proficiency, anesthesia educators need to consider how the anesthesia clinical core competencies will be incorporated into the curricula of their educational programs. The evidence from this study suggests that the anesthesia clinical core competencies developed for teaching, learning, and evaluation can be grouped into various common skills groups, including universal competencies, basic clinical skills, and those competencies that may be appropriate for evaluating proficiency with technology that is less expensive than HFHS.

First, the universal competencies with the highest appropriateness score means (greater than 4.5 out of 5) are essential anesthesia clinical core competencies that encompass the majority of clinical skills required of anesthesia providers. These top-scoring competencies were "Trauma/Emergency", "General Anesthesia", and "IV Induction". Second, the results showed that basic clinical skills were represented in the 15 competencies that had appropriateness mean

scores of greater than 4 and less than 4.5. Those competencies include "Tracheal Intubation", "Alternative Airway Techniques", "Fiber Optic Intubation", "Inhaled Induction", "Mask Management", "Pediatric 2-12 Years", "OB Patients", "LMA or Similar Airway", "Pediatric Under 2 Years", Mechanical Ventilation", "PA Catheter Monitoring", "IV Induction Agents", "Emergence from Anesthesia", "Pharmacological Agents", and "Geriatric Patients 65 Years or Greater". These competencies signify basic anesthesia skills spanning the lifetime of patients, including various airway techniques, induction of anesthesia, and emergence from anesthesia. Third, four competencies may be appropriate for evaluating proficiency using less expensive medical models, such as non-high fidelity mannequins. They are "Sitting Position", "Lithotomy Position", "Lateral Position", and "Prone Position", with mean scores of 3.20, 3.12, 3.08, and 2.99, respectively.

Although the study findings support utilizing HFHS as a means of evaluating proficiency, this technology presents obstacles for anesthesia educational programs. Issues related to the use of HFHS include the high cost of technology, logistics regarding scheduling and location of equipment, and lack of training related to educators' use of HFHS.

High fidelity human simulation is very expensive, and many programs may not be able to afford to purchase the equipment. Administrators and faculty may not view the benefits of utilizing HFHS in their programs' curricula as worth the expense. One way of dealing with the expense of HFHS would be to share this technology among anesthesia educational programs and/or other healthcare-related educational programs, such as nursing and medicine. Regional HFHS centers could share with or rent the technology to other programs. This would spread the cost of HFHS to multiple programs and decrease the expense to any one program.

Sharing HFHS technology however, may create an issue with scheduling and the physical location of the equipment. Anesthesia educational program clinical schedules and clinical site location may prohibit the use of HFHS by all trainees because of distance and travel time to and from the physical location of the equipment.

While access to the use of HFHS is one problem faced by anesthesia educators, training and lack of experience related to the utilization of HFHS in educational practice is another barrier. Incorporating HFHS into anesthesia education curricula would require programs to dedicate time and resources to faculty and staff training. Manufacturers of HFHS provide product training for programs that purchase HFHS equipment. However, training and experience are not provided to programs using or renting equipment purchased by other programs.

Recommendations for Further Study

Future research regarding anesthesia clinical core competencies and HFHS is needed to determine which competencies should be required for provider certification and whether the method of proficiency evaluation using HFHS is beneficial. Repeating this study may contribute to the reliability of the study survey instrument however, the researcher's recommendations for further study include research pertaining to clinical core competency development, evaluation methods using HFHS, and access to and cost of utilizing HFHS. Further discussion of these recommendations follows.

Future research needed to examine anesthesia educators' perceptions of which essential clinical core competencies should be required for provider certification. If anesthesia educators were asked to report their perceptions of the essential anesthesia clinical core competencies, how would they compare with the current COA (2013) and NBCRNA (2013) competencies (required

experiences)? Differences may exist between the current competencies and what educators believe should be considered important competencies. Some of the current competencies may no longer be essential, and new competencies may be introduced due to changes in anesthesia techniques, pharmacology, and medical technology.

Future research needed to investigate the development of standard proficiency criteria for individual anesthesia clinical core competencies. With the increasing use of HFHS in anesthesia education, more studies are needed to draw in-depth conclusions about anesthesia clinical core competencies and those that are appropriate for evaluating proficiency utilizing HFHS. Repeated studies will broaden the data generated from and strengthen the reliability of the Anesthesia Competencies and Simulation instrument developed for this study.

Anesthesia clinical core competencies currently put forth by the COA (2013) and the NBCRNA (2013) are required clinical experiences that must be mastered prior to anesthesia educational program completion. Neither the COA (2013) nor the NBCRNA (2013) mandate the method for determining competency proficiency. Studies regarding clinical skills proficiency that is essential for the safe practice of anesthesia are needed to determine if new anesthesia providers and recertifying providers are competent. Furthermore, anesthesia educational programs do not have a common standard for evaluating proficiency in the COA (2013) and NBCRNA (2013) required competencies. An investigation into the development of criteria for evaluating proficiency in individual competencies utilizing HFHS may provide a common method for evaluation.

Further examination of anesthesia educational program access to and cost of HFHS needed. Research related to the number of programs using HFHS and the cost of acquiring and

maintaining HFHS equipment is needed. An examination of the number of programs that do not use HFHS in their curricula may reveal barriers associated with access and cost.

Conclusion

High fidelity human simulation (HFHS) based evaluation of anesthesia clinical core competency proficiency can be a valuable tool for assessing anesthesia trainees, certifying nurse anesthetists, and recertifying nurse anesthetists. Evidence from this study suggests there is a consensus among anesthesia educational program administrators and faculty regarding anesthesia clinical core competencies that are appropriate for proficiency evaluation utilizing HFHS. Anesthesia educational program administrators and faculty in the United States agree that with the exception of Prone Position (appropriateness score = 2.99, with 3 being neutral), the required experiences put forth by the COA and NBCRNA are suitable for evaluating proficiency utilizing HFHS. Thus, the agreement among administrators and educators that emerged from this study provides a foundation on which faculty can begin to incorporate HFHS into their curricula.

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Appendices

Appendix A

Nurse Anesthesia Educational Program Required Clinical Experiences

Required Clinical Experience	**Minimum Number of Experiences**
ASA Class III & IV	**100**
Total ASA Class I - V	**550**
Specific Anesthetics	
Geriatric 65 + years	50
Pediatric 2 – 12 years	25
Pediatric less than 2 years	10
Trauma/Emergency	30
Ambulatory/Outpatient	100
Obstetrical	30
Cesarean	10
Labor Analgesia	10
Prone	20
Lithotomy	25
Lateral	5
Sitting	5
Intra-abdominal	75
Extrathoracic	15
Extremities	50
Perineal	15
Extracranial	15
Oropharyngeal	20
Intrathoracic	15
Heart	5
Lung	5
Neck	5
Neuroskeletal	20

Required Clinical Experience	Minimum Number of Experiences
Vascular	10
Anesthesia Method	
General anesthesia	350
Intravenous induction	200
Inhalational induction	10
Mask management	25
Laryngeal Mask Airway (or similar devices)	25
Tracheal Intubation	200
Total intravenous anesthesia	10
Emergence from anesthesia	200
Regional anesthesia management	30
Regional anesthesia administration	25
Monitored anesthesia care	25
Pharmacological Agents	
Inhalational agents	200
Intravenous induction agents	200
Intravenous agents muscle relaxants	200
Intravenous agents opioids	200
Intravenous agents other	50
Arterial Technique	
Arterial puncture/catheter insertion	25
Intra-arterial blood pressure monitoring	25
CVP Catheter	

Required Clinical Experience	Minimum Number of Experiences
Placement	5
Monitoring	15
Pulmonary artery Catheter	
Placement	
Monitoring	
Other	
Intravenous catheter placement	100
Mechanical ventilation	200
Alternative airway management techniques	
Fiberoptic techniques	5
Other techniques	5

Source: COA/NBCRNA (2013)

Appendix B

Anesthesia Clinical Core Competencies and

High Fidelity Human Simulation Survey Instrument Pilot Study

Please take respond to each demographic item and add any comments you may.

I acknowledge that I have read and agree with the informed consent form for this online survey.

Agree

Disagree

What state is your anesthesia educational program located?

Pull down menu for state

What is your highest academic degree?

Associate Degree

Bachelor's Degree

Master's Degree

Practice Doctorate (DNP, DNAP, other)

Research Doctorate (PhD, EdD, DNS, other)

What is your anesthesia education position?

CRNA Program Administrator

CRNA Assistant or Associate Program Administrator

CRNA Program Faculty

What is your faculty rank?

Professor

Associate Professor

Assistant Professor

Instructor

How long have you been a faculty member of a nurse anesthesia educational program?

Less than 1 year

1-5 years

6-10 years

11-20 years

21-30 years

31-40 years

41 years or greater

What is your gender?

Male

Female

What is your age?

21-30 years old

31-40 years old

41-50 years old

51-60 years old

61-70 years old

71 years old or older

How often do you practice nurse anesthesia?

Do not currently practice

Practice part time (20 hours per week or less)

Practice part time (greater than 20 but less than 40 hours per week)

Practice full time (40 hours per week or more)

Have you utilized high fidelity human simulation in your anesthesia educational practice?

Yes

No

Has your anesthesia educational program received funding for high fidelity human simulation and/or training?

Yes

No

Do you consider high fidelity human simulation useful in your anesthesia educational practice

Yes

No

Somewhat useful

Please add additional comments related to demographic items below:

Please respond to each survey item and add any comments you may have related to the validity of each item as related to the appropriateness of the item with regard to evaluation of proficiency utilizing high fidelity human simulation.

Survey Items:

Please indicate your rating of items as related to their appropriateness for evaluation utilizing High Fidelity Human Simulation. Please use the rating scale of 1-5 with 1 being not appropriate, 2 somewhat not appropriate, 3 neutral, 4 somewhat appropriate, and 5 being very appropriate (N/A=not applicable)for evaluation of proficiency utilizing High Fidelity Human Simulation.

Comments related to survey items:

Geriatric 65 + years	N/A 1 2 3 4 5
Pediatric 2 – 12 years	N/A 1 2 3 4 5
Pediatric less than 2 years	N/A 1 2 3 4 5
Trauma/Emergency	N/A 1 2 3 4 5
Obstetrical	N/A 1 2 3 4 5
Cesarean	N/A 1 2 3 4 5
Labor Analgesia	N/A 1 2 3 4 5
Prone	N/A 1 2 3 4 5
Lithotomy	N/A 1 2 3 4 5
Lateral	N/A 1 2 3 4 5
Sitting	N/A 1 2 3 4 5
Intra-abdominal	N/A 1 2 3 4 5
Extrathoracic	N/A 1 2 3 4 5
Extremities	N/A 1 2 3 4 5
Perineal	N/A 1 2 3 4 5

Extracranial	N/A 1 2 3 4 5
Oropharyngeal	N/A 1 2 3 4 5
Intrathoracic	N/A 1 2 3 4 5
Heart	N/A 1 2 3 4 5
Lung	N/A 1 2 3 4 5
Neck	N/A 1 2 3 4 5
Neuroskeletal	N/A 1 2 3 4 5
Vascular	N/A 1 2 3 4 5
General Anesthesia	N/A 1 2 3 4 5
Intravenous Induction	N/A 1 2 3 4 5
Inhalational Induction	N/A 1 2 3 4 5
Mask Management	N/A 1 2 3 4 5
Laryngeal Mask Airway	N/A 1 2 3 4 5
(or similar devices)	
Tracheal Intubation	N/A 1 2 3 4 5
Total Intravenous Anesthesia	N/A 1 2 3 4 5
Emergence from Anesthesia	N/A 1 2 3 4 5
Regional Anesthesia Management	N/A 1 2 3 4 5
Regional Anesthesia Administration	N/A 1 2 3 4 5
Monitored Anesthesia Care	N/A 1 2 3 4 5
Pharmacological Agents	N/A 1 2 3 4 5
Inhalational Agents	N/A 1 2 3 4 5

Intravenous Induction Agents	N/A 1 2 3 4 5
Intravenous Agents Muscle Relaxants	N/A 1 2 3 4 5
Intravenous Agents Opioids	N/A 1 2 3 4 5
Intravenous agents other	N/A 1 2 3 4 5
Arterial Puncture/Catheter Insertion	N/A 1 2 3 4 5
Intra-arterial Blood Pressure Monitoring	N/A 1 2 3 4 5
CVP Catheter Placement	N/A 1 2 3 4 5
CVP Catheter Monitoring	N/A 1 2 3 4 5
Pulmonary Artery Catheter Placement	N/A 1 2 3 4 5
Pulmonary Artery Catheter Monitoring	N/A 1 2 3 4 5
Intravenous Catheter Placement	N/A 1 2 3 4 5
Mechanical Ventilation	N/A 1 2 3 4 5
Alternative Airway Management Techniques	N/A 1 2 3 4 5
Fiber-optic Techniques	N/A 1 2 3 4 5

Please add additional comments related to this survey instrument below:

Appendix C

Informed Consent Form Online Survey

Appropriate Anesthesia Clinical Core Competencies for Evaluation of Proficiency Utilizing High Fidelity Human Simulation

Purpose of the Study:
Utilization of high fidelity human simulation in nurse anesthesia educational programs is relatively new and appropriate anesthesia clinical core competencies that can be evaluated for proficiency utilizing HFHS have not been identified. The purpose of the study is to identify anesthesia clinical core competencies appropriate for evaluation of proficiency in a high fidelity human simulation lab. This will be achieved by identifying perceptions of nurse anesthesia educational program administrators and faculty with regard to anesthesia clinical core competencies appropriate for evaluation in a high fidelity human simulation lab.

What will be done:
You will complete a survey, which will take 5-10 minutes to complete. The survey includes questions about your demographic information. Other survey questions will address your perceptions of which of the COA/NBCRNA required clinical experiences (clinical core competencies) are appropriate for evaluation of proficiency utilizing high fidelity human simulation. Finally, there is an open ended question where you may comment on the items or give feedback related to clinical core competencies and/or high fidelity human simulation.

Benefits of this Study:
You will be contributing to knowledge related to nurse anesthesia educational program utilization of the relatively new technology in a high fidelity human simulation. Furthermore, your participation will provide knowledge related to the anesthesia clinical core competencies appropriate for evaluating proficiency in a high fidelity human simulation lab in nurse anesthesia educational programs. Information obtained will also assist program administrators and faculty to understand the utilization of high fidelity human simulation as a tool for evaluating student nurse anesthetists' proficiency with regard to anesthesia clinical core competencies. Furthermore, your participation will provide knowledge related to differences among program administrators and faculty perceptions related to the appropriate anesthesia clinical core competencies. Finally, those program administrators and faculty currently utilizing (or plan to utilize) high fidelity human simulation in their curriculum may find that information related to proficiency evaluation of appropriate anesthesia core competencies in a high fidelity human simulation lab helpful.

Risks or discomforts:
No risks or discomforts are anticipated from taking part in this study. If you feel uncomfortable with a question, you can skip that question or withdraw from the study altogether. If you decide to quit at any time before you have finished the questionnaire, your answers will NOT be recorded.

Confidentiality:
Your responses will be kept completely confidential**.** We will NOT know your IP address when you respond to the online survey. Upon completion of the survey you will be entered in a drawing for a Kindle Fire HD. Your name and email address will not be stored with data from your survey. Instead, you will be assigned a participant number, and only the participant number will appear with your survey responses. Only the researchers will see your individual survey responses. The list of e-mail addresses of our participants will be stored electronically in a password protected folder; a hard copy will be stored in a locked filing cabinet.
After we have finished data collection and have sent you a copy of the results of the study, we will destroy the list of participants' e-mail addresses. At the end of the survey, we will ask your permission to use quotations from your responses to the open ended question for professional presentations and publications. If you agree to let us use quotations, we will NOT include any names or nicknames you use.

Decision to quit at any time:
Your participation is voluntary; you are free to withdraw your participation from this study at any time. If you do not want to continue, you can simply leave this website. If you do not click on the "submit" button at the end of the survey, your answers and participation will not be recorded. You also may choose to skip any questions that you do not wish to answer. If you click on the "submit" button at the end of the survey, you will be entered in the drawing. The number of questions you answer will not affect your chances of winning the gift certificate.

How the findings will be used:
The results of the study will be used for scholarly purposes only. The results from the study will be presented in educational settings and at professional conferences, and the results might be published in a professional journal in the field of anesthesia or education.

Contact information:
If you have concerns or questions about this study, please contact Jeffrey James PhD(c), MSN, APN, CRNA at jjames6@utk.edu. By beginning the survey, you acknowledge that you have read this information and agree to participate in this research, with the knowledge that you are free to withdraw your participation at any time without penalty.

Appendix D

IRB Approval

Hi Jeffrey,

I have looked over your proposed Form A human subjects' research protocol entitled "Anesthesia Clinical Core Competencies and High Fidelity Human Simulation", and I will certify it to be exempt from IRB review under 45 CFR 46 Exempt Category # 2. You may proceed with your research.

Best wishes,
Brenda

Brenda Lawson
Compliance Officer and IRB Administrator
Office of Research and Engagement
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Appendix E

Survey Email Invitation

Subject: Anesthesia Clinical Core Competencies/Simulation

Please forward this invitation to participate in Nurse Anesthesia research to your nurse anesthesia program director, assistant director and CRNA faculty.

INTRODUCTION: You are invited to participate in a research study conducted at The University of Tennessee in the college of Education, Educational Psychology department, Instructional Technology concentration. The main investigator of the study is Jeff James CRNA, UTK PhD candidate. You were chosen to participate in this study because you are an anesthesia educational program administrator and/or faculty and are considered an expert in the field of nurse anesthesia education. All nurse anesthesia program directors, assistant program directors and CRNA faculty are invited to participate in this study. Please forward this email to your program assistant director and CRNA faculty. Participation should require no more than 5 minutes of your time. Participation is entirely voluntary; you may withdraw from the study at any time without consequences. Responses will be completely anonymous; your identity will not be linked to this survey in any way. Those participants who wish to participate in the drawing for a Kindle Fire tablet will have the opportunity to enter their name and email address following completion of the survey. Drawing names and email addresses will be kept separate from response data, will not be shared and will be deleted following the drawing.

PURPOSE: The purpose of the study is to identify anesthesia clinical core competencies appropriate for evaluation of proficiency utilizing high fidelity human simulation.

Please find attached the informed consent form for this study.

Click the link below to begin the online Anesthesia Clinical Core Competencies and High Fidelity Human Simulation Survey:

https://utk.co1.qualtrics.com/SE/?SID=SV_b1a5CFQfmjCW8V7

Thank you for your participation,

Jeff James CRNA, MSN, APN
UTK PhD candidate
jcjames1@me.com

Vita

Jeffrey James was born in Parma Ohio, lived in Metropolis, Illinois and Buffalo, New York prior to moving to East Tennessee at the age of 12. Jeff attended the University of Tennessee prior to meeting and marrying his wife Melinda in 1988. He and his wife enjoy having the majority of their family members including living parents, siblings, nephews and niece close by. Jeff worked as a pharmacy technician for six years prior to graduating from Walter State Community College, Morristown, Tennessee with an associate of science in nursing in 1992. He practiced as a pulmonary registered nurse for one year and specialized as a certified critical care nurse for five years. In 1997 Jeff was the top graduating senior at the University of Tennessee, Knoxville, College of Nursing where he graduated with a bachelor of science in nursing. In 2000 he graduated with a master of science degree in nursing, nurse anesthesia concentration. He has practiced as a staff certified registered nurse anesthetist (CRNA) at the University of Tennessee Medical Center, Knoxville since 2000. He was the chief CRNA at the University of Tennessee Medical Center from 2002 until 2007. In 2007 he became assistant professor and founding director of the graduate program in nurse anesthesia at Lincoln Memorial University in Harrogate, Tennessee. In 2011, Jeff returned to full time nurse anesthesia practice to facilitate completing his research and his doctor of philosophy degree in education at the University of Tennessee. Jeff will graduate with the degree of doctor of philosophy in education in December, 2014.