Spring 2019

Simulation as Replacement for Traditional Clinical in Pre-Licensure Nursing Education: Outcomes of Different Ratios of Replacement Time for Traditional Clinical with Simulation

Tiffany Zyniewicz
University of Southern Mississippi

SIMULATION AS REPLACEMENT FOR TRADITIONAL CLINICAL IN PRE-LICENSURE NURSING EDUCATION: OUTCOMES OF DIFFERENT RATIOS OF REPLACEMENT TIME FOR TRADITIONAL CLINICAL WITH SIMULATION

by

Tiffany Leanne Zyniewicz

A Dissertation
Submitted to the Graduate School,
the College of Nursing and Health Professions
and the School of Leadership and Advanced Nursing Practice
at The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

Approved by:

Dr. Kathleen Masters, Committee Chair
Dr. Tonya Breymier
Dr. Janie Butts
Dr. Rebecca Newton
Dr. Kyna Shelley
Dr. Lachel Story

Dr. Kathleen Masters	Dr. Lachel Story	Dr. Karen S. Coats
Committee Chair	Director of School	Dean of the Graduate School

May 2019

ABSTRACT

The use of simulation in nursing education has grown over the last 30 years. The National Council of State Boards of Nursing National Simulation Study indicated that up to 50% of traditional clinical hours can be replaced with simulation at a 1:1 replacement ratio and produce the same outcomes. A review of the literature indicated that there is no standard replacement ratio for simulation time to traditional clinical time being used in pre-licensure nursing education in the United States. The purpose of this study was to explore the outcomes of utilizing a 1:1 simulation-to-traditional clinical time replacement ratio and a 1:2 simulation-to-traditional clinical time replacement ratio in an advanced-level adult medical-surgical nursing course. The ATI Adult Medical Surgical Proctored Assessment Scores and NCLEX scores were used to measure outcomes.

A total of 878 pre-licensure nursing students participated in this study from 6 different nursing programs across the United States. The 1:1 study group had 680 participants and the 1:2 study group had 198 participants, which reflects the prevalent use of 1:1 simulation-to-traditional clinical replacement ratios in pre-licensure nursing programs. Analysis of the data indicated that students in the 1:1 replacement ratio study group had a statistically significant higher mean score on the ATI Adult Medical Surgical Proctored Assessment, but the difference did not have applied meaning. Both study groups had mean scores that fell within the proficiency level in adult medical-surgical nursing knowledge that exceeded minimum expectations. Additionally, data analysis indicated that there was no correlation between simulation-to-traditional clinical replacement ratio (1:1 or 1:2) and NCLEX pass scores. Finally, no significant or meaningful interactions existed between program type (BSN or RN) and mean scores on

the ATI Adult Medical Surgical Proctored Assessment or on NCLEX pass rates. This study provides strong evidence that pre-licensure nursing programs can utilize a 1:1 or 1:2 simulation-to-traditional clinical replacement ratio in an advanced-level Adult Medical Surgical clinical course without having significant differences in ATI Adult Medical Surgical Proctored Assessment scores or NCLEX pass rates.

ACKNOWLEDGMENTS

Special thanks go to my committee chair, Dr. Kathleen Masters for her continued support in the successful completion of this study and her expertise in simulation. I would also like to extend a special thank you to Dr. Lachel Story who was instrumental in providing me with the stamina to keep forward progress on this study. Her assurance to me that she knew I would complete this study was invaluable. As a nurse educator and nurse scholar I will always remember her advice that as long as I continued to move forward, I would make progress and complete the task at hand, however daunting it might seem. This study would also never have been possible without the statistical expertise of Dr. Kyna Shelley. I would like to thank Dr. Shelley for assisting me in designing such a rigorous and valid study. In addition, I would like to thank Dr. Rebecca Newton for her contributions to the applied meaning of my study and to Dr. Janie Butts for her late-night responses to emails. It was comforting to find a colleague that shares the same late-night dedication to writing. Finally, I would like to thank Dr. Tonya Breymier for graciously agreeing to serve on my dissertation committee and for her landmark work in describing simulation-to-traditional clinical ratio replacement use in the United States that provided a foundation for this study.

DEDICATION

I enjoy challenges in life. I love to do the impossible. People told me that it would be impossible to complete a Ph.D. and have a child. Alone it may have been impossible, but with the support I can do anything. I dedicate this dissertation to my wonderfully supportive husband and the encouragement he gave me all through this process; my son Micah for the laughter and fun LEGO breaks he gave me; my son Jordan for his smiles, snuggles, high-fives, and his naps; and my parents, grandparents, and in-laws for their constant praise and support. I would also like to thank my mentors Linda Tieman and Janice Ellis for their encouragement of me through my masters and doctoral education. Additionally, I would like to express my deepest gratitude to Dr. Azita Emami for giving me the advice and courage to make the sacrifices and brave decisions that had to be made to help me successfully complete my doctoral program. I would also like to recognize my colleague Dr. Anne Hirsch for her support of me in beginning this journey, her grace and understanding when I ran into challenges, and for providing me with a role model for being a nurse scholar and mother. I also want to express deepest thanks to Dr. Joan Hendrix for her unending support of me as a colleague and friend as I pursued my doctoral education and completed this study. Finally, I will ever be indebted to Lana Conrad and Mark Squire for their assistance in getting SPSS version 25 to work successfully on my MacBook Pro.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

LIST OF ABBREVIATIONS

AACN	American Association of Colleges of Nursing
ADN	Associate Degree Nurse or in Nursing
ATI	Assessment Technologies Institute
BSN	Baccalaureate of Science in Nursing
CCNE	Commission on Collegiate Nursing Education
CPR	Cardiopulmonary Resuscitation
INACSL	International Nursing Association for Clinical Simulation and Learning
IOM	Institute of Medicine
IPEC	Interprofessional Collaborative Expert Panel
NCLEX	National Council Licensure Examination
NLN	National League for Nursing
NCSBN	National Council of State Boards of Nursing
QSEN	Quality and Safety Education for Nurses
RN	Registered Nurse
SP	Standardized Patient
US	United States

CHAPTER I - INTRODUCTION

Simulation in undergraduate nursing education is an instructional method that allows a single nursing student or a group of students to provide "care for a patient who is represented by a manikin, an actor, or an SP [standardized patient] depending on the clinical situation" (Cato, 2012, p. 3). The continuum of simulation in nursing has seven components: partial and complex task trainers, role-play, games, computer-assisted instruction, standardized patients, virtual reality and haptic systems, and integrated low to high fidelity simulators (Nehring, 2010).

The standard process of simulation in nursing education is similar to traditional clinical in that it can be broken down into three time-segments. A traditional clinical day is made up of preclinical, clinical, and post clinical and typically takes place in a patient care setting under the supervision of a faculty member or experienced registered nurse (RN). A simulation experience consists of pre-briefing, the simulation, and debriefing and typically takes place in a simulation center, learning laboratory, or skills laboratory that replicates a traditional patient care setting. During simulation pre-briefing, students get the opportunity to discuss the simulated patient they will care for and ask any questions of a facilitator or educator. During the simulation period, students provide nursing care for a manikin, an actor, an SP, a task trainer, or any combination of these to experience a realistic patient care scenario. In the debriefing, students typically go through a guided reflection of their simulation experience. During debriefing, students get the opportunity to give and receive feedback related to their performance in caring for the simulated patient.

Educators try to create simulation experiences that are realistic to reflect real traditional patient care experiences. Three levels fidelity or "realism" are used in simulation to match the needs of the educational outcomes: high-fidelity, medium-fidelity, and low-fidelity. Hayden (2010) described high fidelity simulations as those using “a standardized patient or a full-body patient simulator that can be programmed to respond to effective and psychomotor changes, such as breathing chest action” (p. 53). Medium-fidelity simulations are characterized by the use of a “patient care scenario that uses a full-body simulator with installed human qualities such as breath sounds without chest rise” (Hayden, 2010, p. 52). Low-fidelity simulation is the use of “task trainers,” or “part of a manikin designed for a specific psychomotor skill” such as the use of an arm for the practice of establishing intravenous access (Hayden, 2010, p. 52).

Definitions of Simulation

Many definitions of simulation exist in health care. Simulation can mean “a pedagogy using one or more typologies to promote, improve, or validate a participant’s progression from novice to expert” (International Nursing Association for Clinical Simulation and Learning [INACSL], 2013, p. 9). Simulation has also been defined as an activity or event replicating clinical practice using scenarios, high-fidelity manikins, medium-fidelity manikins, standardized patients, role-playing, skills stations, and computer-based critical thinking simulations (Hayden, Jeffries, Kardong-Edgren, & Spector, 2009). Another popular definition of simulation in medicine is Dr. David Gaba’s (2004) “Simulation is a technique, not a technology, to replace or amplify real experiences with guided experiences, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion” (p. 2).

Simulation is also used in fields other than nursing such as business and education, so it is valuable to also take look at how other professions define simulation. According to McCormick (1964) "simulation consists of reproduction or representation of an actual or conceptual physical object, system, process, or situation or of a theoretical construct" (p. 612). Simulation in the field of education can mean a device or technique for setting up the device. According to Twelker (1968) "simulation may be thought of in general terms as: (1) a technique of modeling (physically, iconically, verbally, or mathematically) some aspects of a real or proposed system, process, or environment, or (2) the model (physical, iconic, verbal, or mathematical) of some aspects of a real or proposed system, process, or environment (p. 3).

Bland, Topping, and Wood (2011) derived a definition of simulation that is best utilized for research purposes in the nursing profession by performing a conceptual analysis of the word simulation using the eight-step method of conceptual analysis proposed by Walker and Avant (2005). The Walker and Avant (2005) method of conceptual analysis provides the researcher with empirical referents that can be used to study the concept. The Bland et al. (2011) definition of simulation is being used in this paper. According to Bland et al. (2011) simulation is "a dynamic process involving the creation of a hypothetical opportunity that incorporates an authentic representation of reality, facilitates active student engagement and integrates the complexities of practical and theoretical learning with opportunity for repetition, feedback, evaluation, and reflection" (p. 668). The empirical referents are "(a) creating a hypothetical opportunity; (b) authentic representation; (c) active participation; (d) integration; and (e) repetition, evaluation, and reflection" (Bland et al., 2011, p. 667).

Origins of Simulation

Simulation has been used for thousands of years as part of military warfare training for the purpose of planning, tactics, troop maneuvering, and other military operations. The earliest evidence of the use of simulation for the training of soldiers dates back 5000 years ago in China with the use of models to simulate warfare (Perla, 1990; Weiner, 1959). Strategy games such as GO from Japan, CHATURANGA from India, and chess from the Middle East and Europe allowed ancient military leaders to plan warfare with the use of models or figurines representing soldiers or troops and sand tables or board games representing the battlefield (Smith, 2010). Historically, military leaders have also utilized full-body simulators to train soldiers in hand-to-hand combat. For example, jousts were used in feudal times to train soldiers for combat on horseback (Kimball, 1984). Full-body jousting simulators called quintains were used to simulate opponents. The quintain would quickly rotate and deliver a blow to the training soldier if the simulator was not struck appropriately and, thus, providing instant feedback to the trainee on his combat technique (Tunis 1954).

Simulation has also been used for thousands of years as part of surgical instruction and medical training in the form of physical models of anatomy, disease, or physiological processes such as birth or blood circulation (Kunkler, 2006; Owen, 2012; Rosen, 2014). For example, Chinese physician Wang Wei-Yi (987-1067) had two life-sized bronze statues made in 1027 for the purpose of teaching other physicians surface anatomy and acupuncture points. The simulators had 354 holes where acupuncture needles could be inserted. Historians theorize the statues were filled with fluid and then covered in wax so that trainees would see a drop of fluid if the needle was inserted

correctly (Maciocia, 1982; Schnorrenberger, 2008). Another example of a historical interactive simulator is the obstetrical simulator created by Bologna surgeon Giovanni Antonio Galli, which consisted of a glass uterus in a pelvic model and a flexible mock fetus (Markoviç & Markoviç-Živkoviç, 2010). Galli developed this simulator for the purpose of training surgeons and midwives how to assist with childbirth. Galli evaluated the student's competency by having the student deliver the model fetus while blindfolded.

Simulation in Aviation and Medicine

The modern use of simulation in nursing education has some roots in medical simulation; therefore, it is important to cover how medical simulation developed. However, in many ways simulation in nursing developed independently and in parallel to modern medical simulation. High-fidelity simulators were initially developed and used for medical training but became popular in nursing once the cost of the high-fidelity simulators came down and more grant funding came available for nursing schools to purchase high-fidelity simulators (Leighton, 2014).

The widespread use of simulation in medical training is a direct result of the use of simulation by the aviation industry for pilot training to increase safety. According to Rosen (2014), the evolutions that led to the widespread use of simulation in medicine were:

- the technological revolution of the 1800s which involved power, communication, and transportation;
- the technological revolution of the 1900s which included the development of flight simulators and computers; and

- the educational revolution of the 2000s, which included the incorporation of simulation into medical schools and competency-based assessments.

Essentially, Rosen (2014) proposes that in order for the high-fidelity simulation to be used widely in healthcare education, it was critical for:

- airplanes and flight simulators to be developed;
- communication to be recognized as a major training need in both aviation and medicine to promote safety;
- computer technology to advance to the point where realistic human robotics could be created; and
- medicine to use aviation training and theory-based education methods like simulation as models for medical education.

The first known mechanical flight simulators were developed in 1910 (Allerton, 2009). In the case of the Antoinette Learning Barrel, the flight instructors rocked the barrel to simulate flight; whereas the Sanders trainer used wind to simulate flight (Greeneyer, 2008). Flight simulators were in high demand after surveys in 1912 revealed that pilot error was the source of 90% of all airplane crashes (Greeneyer, 2008). The beginning of World War I in 1914 also created a demand for flight simulators to train military pilots to fly, react to stressful situations, and use newly installed fixed machine guns on military planes (Greeneyer, 2008).

After World War I, flight simulators like the “Link Blue Box Trainer” developed by Edwin Link in 1929 (U.S. Patent 1,825,462, 1931) became largely used as amusement park rides until the onset of World War II in which the Link Blue Box Trainer was used to train mail delivery pilots in the United States Army Air Corps. Edwin Link formed the

Link Aviation Company and became involved in space flight simulation in 1962 (Rosen, 2014). In 1968, the Singer Company acquired Link Aviation and CAE Inc. acquired the flight simulation division in 1988. CAE Inc. later acquired both Immersion Medical and Medical Education Technologies Inc., which were both major healthcare-related simulation-manufacturing companies. CAE Inc. then started the production of high-fidelity human patient simulators for healthcare simulation training in the 1990s (Ledbetter, 1995). Thus, aviation simulation and medical simulation are directly linked since medical simulation evolved out of aviation and because the first company to commercially produce flight simulators eventually grew to produce and manufacture human patient simulators for the healthcare industry.

The first high-fidelity human patient simulator, or “computerized patient” as it was known at the time, was conceived in 1964 by Dr. J. Samuel Denson and Dr. Stephen J. Abrahamson of the University of Southern California. The computerized patient was unveiled in 1967 as “Sim One,” and patented as the Anesthesiological Training Simulator in 1970 (Hoggett, 2013, U.S. Patent 3,520,071, 1970). Sim One was created to simulate an adult male patient in the operating room. The simulator was mounted to a table and open in the back to accommodate pneumatic and electronic hardware. Interestingly, portability was not valued in early high-fidelity human patient simulators. Sim One had many realistic human features, some of which have not even been replicated in modern high-fidelity human patient simulators. Some of Sim One’s features were: palpable temporal and carotid artery pulses; vomiting; bucking; laryngospasm; fasciculation; pupils that reacted to light; blinking eyes at variable closing tension; audible heart sounds; visible cyanosis on the face, torso, and mouth; the ability to produce a manual

blood pressure; and the ability to react physiologically to 10 programmed drugs (Abrahamson, Denson, & Wolf, 1969). Although Sim One was a major breakthrough in using high-fidelity simulation in medical training, it ceased to be used after it was retired in 1975 when parts wore out and could no longer be replaced (Guilbert, 2003). Developing other high-fidelity simulators that could replicate most of Sim One's human features took another one to two decades.

The use of SPs in medical education is another form of high-fidelity simulation since real people are used to simulate realistic patients and illnesses. Dr. Howard Barrows is credited as starting the use of SPs in medical education in 1963 with his first SP case "Patty Duggar." Barrows (1993) defined a SPs as "a person who has been carefully coached to present their own illnesses [or accurately portray a specific patient when given the history and physical examination] in a standardized, unvarying way" so accurately that the simulation cannot be detected by a skilled clinician (p. 444). In performing the simulated patient case, the SP presents a holistic version of the patient. The SP will go beyond the patient history and present realistic body language, physical findings, and the emotional and personality characteristics of the patient (Association of Standardized Patient Educators, 2016).

The 1960s was also the decade when the Resusci® Anne by the Laerdal company was developed for the purpose of airway and resuscitation training under the advice of Dr. Bjorn Lind and Dr. Peter Safar (Grenvik & Schaefer, 2004). Laerdal made the use of task trainers wide-spread for the purpose of training healthcare professionals, healthcare students, and laypersons in cardiopulmonary resuscitation (CPR). CPR was a new and innovative lifesaving procedure at the time of its development (Cooper & Taqueti, 2004).

The Resusci® Anne mannequin was fitted with simulated lungs and a spring in the chest to represent a realistic feel of giving rescue breaths and chest compressions to a human patient. The use of Resusci® Anne for CPR training is one of the first examples of widespread standardized use of simulation in healthcare education.

Another well-known medium-fidelity medical simulator developed in the 1970s that is still in use today by medical programs is "Harvey" (U.S. Patent 3,662,076, 1970). Dr. Michael Gordon at the University of Miami developed Harvey in order to increase standardization in cardiac training for medical students and has the capability of producing normal and abnormal heart sounds, respiration, and blood pressure readings. Gordon was concerned that most early cardiac training for medical students was reliant on the pure chance that they would encounter patients with abnormal heart sounds and rhythms.

Over the course of the 1980s and 1990s, simulation became an area for research and curriculum integration in medical education, especially in anesthesiology (Gaba & DeAnda, 1988; Gravenstein, 1988; Pierce, 1996). The Anesthesia Patient Safety Foundation also held its first simulation meeting in 1988 and its first simulation curriculum meeting in 1989 (Cheney, 2010). The first medical education simulation center was opened in 1993 after the Anesthesia Crisis Resource Management curriculum was launched in Boston and is now known as the Center for Medical Simulation (Rosen, 2014).

Currently, simulation is a major component in the medical education curriculum and is even part of required licensure and recertification exams. The Accreditation Council for Graduate Medical Education (ACGME) has mandated that simulation is used

in medical education programs (2015). The national licensure exam for medical doctors includes Objective Structured Clinical Examinations (OSCEs) with and without the use of SPs (Tetzlaff, 2007; Zayyan, 2011). In 2007, the American Board of Anesthesiologists began including simulation as a component of recertification, known as Maintenance of Certification in Anesthesiology (MOCA), for graduates from anesthesiology programs from within or after 2007 (Gaba & Raemer, 2007).

Simulation Use in Undergraduate Nursing Education

Modern simulation use in nursing education has its roots in military, aviation, and medical simulation training and education; however, simulation has always been used in the education of undergraduate nurses in its most basic form. Four main factors led to the modern intentional and informed use of simulation in undergraduate nursing education:

- the evolution of nursing educational methods and the emphasis on the development of clinical judgment and critical thinking in nursing students;
- the influence from organizations, national reports, and nursing education guidelines such as the Institute of Medicine (IOM) and the Robert Wood Johnson Foundation Quality and Safety Education for Nurses (QSEN);
- the advancement of teaching technology including more affordable high-fidelity simulators; and
- the progression of the skills laboratory into a high-tech clinical learning laboratory or simulation center.

Evolution of Nursing Educational Methods

The methods of educating undergraduate nurses have evolved over the years from the inception of formal nursing education to suit the changing needs of patients and the

transformation of the healthcare environment. Nurse educators have a history of being innovative and responding to societal needs to alter nursing education with the goal of promoting safe and quality patient care. This section provides a brief history of nursing education and how the use of simulation developed out of the changing methods of educating undergraduate nurses.

Florence Nightingale is credited with opening the first formalized nursing training program in 1860. Nightingale opened the Nightingale Training School for Nurses in England in part as a response to the need to care for soldiers wounded in the Crimean War (Faison, 2012). Prior to the foundation of the first nursing school, no formalized training programs for nurses existed and many nurses were women of ill-repute who chose nursing service over serving jail time. Nightingale responded to the need to improve the quality and safety of patient care during the Crimean War by creating the formalized training program for nurses.

Similarly, the need to provide more formal training to nurses in the US arose out of the mass casualties of the Civil War, which spanned from 1861-1865 (Faison, 2012). Formal nursing education began using an apprenticeship model within hospitals. Student nurses staffed the hospitals and provided much of the care despite not having completed their training. In early nursing training programs, physicians taught much of the curriculum. Student nurses would staff hospitals during the day and then take their training classes at night. These first nurse training programs developed into diploma schools in which nurses would be given a certificate at the end of their apprenticeship at the hospital that provided them their training.

In the 1940s, another war helped to reshape nursing education. After World War II, a critical nursing shortage resulted after women who had served as nurses left the workforce, married, had children, or returned to staying home (Haase, 1990). In 1948, Dr. Lucille Brown was commissioned by the Carnegie Foundation to study nursing education. In her report, *Nursing for the Future*, Brown (1948) stated nurses should be educated in colleges and universities and criticized diploma programs for using nursing students as employees during the day and then sending them tired to classes at night. Brown stated this method of nurse training and hospital staffing did not provide a safe environment for the patients or an effective environment to train nurses. Brown expressed that nurses needed to be educated to have a basic foundation of scientific knowledge, apply scientific knowledge to nursing care, stay current on scientific advancement, and be able to discern nursing care activities from activities that should be performed by other professionals, technicians, or unlicensed assistive personnel.

According to Brown (1948), nurses should be trained in leadership and nursing work should not be bogged down with tasks that could be completed by unlicensed assistive personnel (e.g., janitors and housekeepers). Brown distinguished professional nurses as different from technical nurses. Professional nurses were defined as nurses educated in accredited nursing programs. Brown (1948) wrote that nurses could become partners with physicians and dentists if hospitals were willing to staff their hospitals with professional nurses and assistive personnel. The assistive personnel would take on the activities that did not require professional nursing training. Nurses began to be conceptualized as less of a handmaiden to the physician and promoted as more of a team

member and needed training in the knowledge and behavior that would help them become an effective healthcare team member.

Subsequently to Brown's (1948) report, the Committee on the Function of Nursing, chaired by Eli Ginzberg (1948) published the report, *A Program for the Nursing Profession by the Committee on the Function of Nursing* otherwise known as the Ginzberg report. The Committee on the Function of Nursing was formed to study the problems associated with the nursing shortage. The committee recommended revising the method of educating nurses into two levels the professional nurse who would be educated in 4-year college or university programs and practical nurses who were to be educated in 12-month programs situated in hospitals or vocational schools.

The publications by Brown (1948) and the Committee on the Function of Nursing (1948) opened the door for associate degree nursing (ADN) programs to form and thrive. Montag & Gotkin (1959) proposed that a 2-year technical nursing curriculum could be moved into community or junior colleges and the graduates of the community college nursing programs would be able to successfully pass the licensing exam and prove competent to employers. Most nursing students could still complete the ADN curriculum in 2 years up until the 1970s (Brown, 1972).

Despite the fact that ADN programs were created to develop more technical nurses and bachelor of science in nursing (BSN) programs were designed to create nursing leaders, hospitals began hiring BSN and ADN graduates interchangeably for clinical staff or leadership positions in the 1960s (Forest, 1972; Hart, 1983). Nurse educators responded to the unexpected changes in ADN hiring practices by adding management and leadership to the curriculum (Orsolini-Hain & Waters, 2009). The trend

of adding more content to the ADN curriculum continued through the decades, and it currently takes students 3 to 4 years to complete an ADN program.

By the 1970s, prospective nurses had the choice to attend a 4-year Baccalaureate program, a 3-year diploma program, or a 2-year associate degree program, all of which allowed them to take the national board examinations and obtain a registered nursing (RN) license. By the 1990s, many colleges and universities were even adding immersion programs in response to the nursing shortage in which a student could receive their BSN or MSN in as little as 2 years if they had a prior terminal degree.

The nursing shortages over the decades and the creation of multiple pathways to obtain an RN license have created some difficult challenges in nursing education. In addition, nursing education has had to keep current with the changing healthcare environment. Modern patients are sicker, and more treatments and medications are available to patients today than when formal nursing education began in the 1860s. Simulation has become a widely used teaching method as nurse educators have again responded innovatively to the need to prepare safe and competent nurses despite the many challenges in modern-day nursing education.

Nurse educators of today face the challenge to fit increasingly more content into a static amount of college credit hours, as both ADN and BSN graduates must be able to pass the national nurse competency exam at the same level of proficiency. ADN and BSN graduates must also be trained to function at the same skill level despite the difference in the length of their respective programs. Nursing students must be prepared to synthesize and apply knowledge on demand in the healthcare environment and even lead healthcare teams. Undergraduate nursing educators have widely integrated simulation into nursing

curricula to help nursing students make the most of their class time. Simulation provides nursing students with a relatively short and intense applied learning period with a simulated patient care scenario and helps students situate their theoretical learning in a realistic clinical setting (Gore & Thomson, 2016).

Nurse educators are also currently facing decreased access to clinical sites as there is a finite amount of care facilities but an increased demand for nurse graduates due to the current nursing shortage (Leighton, 2014). Students often drive long distances to clinical sites or attend clinical on evening or night shift. In addition, current nursing students are often not allowed to perform certain nursing procedures such as administering medications, performing a finger stick and blood glucose test, administration of blood products, or cardiopulmonary resuscitation in the traditional clinical setting due to the high acuity of patients and the shortage of nursing staff and faculty (Cato, 2012; Leighton, 2014). Nursing students may not be allowed to document in traditional clinical due to the addition of electronic health records to the healthcare environment. In fact, a nursing student may go through an entire nursing program never having completed certain patient care skills in traditional clinical after having demonstrated competency in the skills laboratory (Leighton, 2014).

A gap is growing between the preparation of undergraduate nursing students and the expectations of graduate nurses by employers (Ellis & Hartley, 2004). Nurses not only need to confidently and competently perform nursing skills in the clinical setting, but they also need to be able to quickly recognize deterioration in high-risk, low volume patients. The use of simulation has allowed nurse educators to provide nursing students

with opportunities to practice skills in realistic patient care settings without jeopardizing patient safety (Nehring, Ellis, & Lashley, 2001).

Influence of Organizations, National Reports, and Nursing Guidelines

Another factor affecting the use of simulation in undergraduate nursing education has been the influence of reports and guidelines published by national and international healthcare organizations and accrediting bodies. The following reports, guidelines, and organizations have had the most influence on promoting the widespread use of simulation in nursing education:

- the Institute of Medicine (IOM) reports *To Err is Human* (IOM, 1999) and *The Future of Nursing: Leading Change, Advancing Health* (IOM, 2008);
- the Quality and Safety Education for Nurses (QSEN) competencies for pre-licensure nursing education (Cronenwett et al., 2007);
- the American Association of Colleges of Nursing (AACN) (2008) *Essentials of Baccalaureate Education for Professional Nursing Practice*;
- the Interprofessional Education Collaborative (IPEC) Expert Panel (2011) *Core Competencies for Interprofessional Collaborative Practice*;
- the International Nursing Association for Clinical Simulation and Learning *INACSL Standards of Best Practice: Simulation*[SM] (Decker et al., 2015; INACSL, 2011, 2013; Lioce et al., 2015); and
- the National Council of State Boards of Nursing (NCSBN) National Simulation Study (Hayden, Smiley, Alexander, Kardong-Edgren, & Jeffries, 2014).

The Institute of Medicine (IOM) (1999) reported in *To Err is Human* that as little as 44,000 and as many as 98,000 people die from preventable medical errors in the US every year. The findings and recommendations in this IOM report led to a national movement to improve patient safety through new and improved methods of education for pre-licensure healthcare students and annual training for practicing healthcare workers. The 1999 IOM report also led to awareness by those in the medical community that further assessment of the healthcare system and education of healthcare workers was necessary. The 1999 IOM report led to a cascade of revisions in healthcare education curricula across the U.S. that included pre-licensure nursing curricula.

Makary and Daniel (2016), affiliated with John's Hopkins School of Medicine, published a more recent analysis of medical death rate data over an 8-year period in the U.S. Makary and Daniel calculated that more than 250,000 deaths per year in the U.S. are due to medical error. This number of deaths surpasses the U.S. Centers for Disease Control and Prevention's third leading cause of death, which is a respiratory disease that causes death in close to 150,000 deaths per year. This article put a further spotlight on the problem of medical error in U.S. hospitals and has creating increased pressure on healthcare facilities and pre-licensure health profession programs to improve the way healthcare professionals and students are trained in order to provide quality and safe patient care.

In addition, the IOM and the Robert Wood Johnson Foundation (RWJF) collaborated on a 2-year project to assess and provide recommendations on the transformation of the nursing profession, the largest population of workers in the healthcare field (IOM, 2010). Based on their assessment of the nursing profession, the

IOM recommended in their report *The Future of Nursing: Leading Change, Advancing Health* that "nurses should achieve higher levels of education and training through an improved education system that promotes seamless academic progression" (p. 163). As part of improving nursing education, the IOM recommends utilizing simulation to maximize faculty time and to train higher numbers of nurses to meet the needs of an aging patient population.

The publication of the QSEN Competencies in 2007 was the next major occurrence in professional nursing that promoted simulation use as part of pre-licensure nursing education. The QSEN project began in 2005 and was funded by the Robert Wood Johnson Foundation (RWJF). The project began in response to the IOM (2003) report *Health Professionals Education: A Bridge to Quality.* In the report, the IOM urged healthcare educators to redesign and restructure curriculum based on these five competencies: patient-centered care, interdisciplinary teams, evidence-based practice, quality improvement, and informatics. QSEN adopted the five IOM competencies and added a sixth – safety (Cronenwett et al., 2007). The overall goal of QSEN was to address the challenge of preparing future nurses with the knowledge, skills, and attitudes (KSA) necessary to continuously improve the quality and safety of the healthcare systems in which they work (QSEN, 2013). Several researchers and expert nurse educators recommend using simulation as a method of successfully integrating QSEN competencies throughout undergraduate nursing curriculum (Barton, Armstrong, Preheim, Gelmon, & Andrus, 2009; Brady, 2011; Forneris et al., 2012; Jarzemsky, McCarthy, & Ellis, 2010; Pauly-O'Neill, Prion, & Nguyen, 2013; Tschetter, Lubeck, & Fahrenwald, 2013).

In 2008, the AACN published *The Essentials of Baccalaureate Education for Professional Nursing Practice*. The AACN is a national accrediting body for nursing programs. *The Essentials of Baccalaureate Education for Professional Nursing Practice,* also simply known as the "BSN Essentials," provides nursing programs with a comprehensive set of core standards that are essential for inclusion in baccalaureate curriculum and also provides suggested teaching strategies to obtain the baccalaureate core competencies and knowledge. The nine BSN Essentials are:

- Essential I: Liberal Education for Baccalaureate Generalist Nursing Practice;
- Essential II: Basic Organizational and Systems Leadership for Quality Care and Patient Safety;
- Essential III: Scholarship for Evidence-Based Practice;
- Essential IV: Information Management and Application of Patient Care Technology;
- Essential V: Healthcare Policy, Finance, and Regulatory Environments;
- Essential VI: Interprofessional Communication and Collaboration for Improving Patient Health Outcomes;
- Essential VII: Clinical Prevention and Population Health;
- Essential VIII: Professionalism and Professional Values; and
- Essential IX: Baccalaureate Generalist Nursing Practice.

The AACN (2008) recommended that simulation is utilized as a teaching method to help meet four of the nine BSN essentials. Thus, BSN programs had a major motivator to include simulation in their curriculum to help show the AACN that they met accreditation standards. The AACN suggested that BSN programs immerse nursing

students in simulations with students in other disciplines like history, religion, or engineering to help meet Essential I: Liberal Education for Baccalaureate Generalist Nursing Practice. Simulation is also recommended to help meet Essential IV: Information Management and Application of Patient Care Technology by having students access and analyze data relevant to patient care. The AACN suggested that having students participate in interprofessional simulation experiences can be used to meet Essential VI: Interprofessional Communication and Collaboration for Improving Patient Health Outcomes. To meet the core BSN Essential IX: Baccalaureate Generalist Nursing Practice, the AACN recommended using simulation to help students learn to organize, prioritize, and delegate patient care appropriately.

As mentioned previously, the use of high-fidelity simulation in medicine and nursing first began to intersect in the late 1990s. Interdisciplinary healthcare education began to be promoted with the educational revolution of the 2000s. Simulation began to be considered as an ideal way for nursing students and other health professional students to practice clinically within their role in the healthcare team.

In 2011, the Interprofessional Education Collaborative (IPEC) Expert Panel published the *Core Competencies for Interprofessional Collaborative Practice.* The expert panel was made up of members of six healthcare leadership organizations: the AACN, the American Association of Colleges of Osteopathic Medicine, the American Association of Colleges of Pharmacy, the American Dental Education Association, the Association of American Medical Colleges, and the Association of Schools of Public Health. The IPEC expert panel concluded that although interprofessional collaborative education was being promoted by several national and international healthcare governing

bodies and expert groups, no guidelines, competencies, or best practices were published on interprofessional education in healthcare.

The goal of the IPEC expert panel was to build on each discipline's individual competencies to create core interdisciplinary competencies that would guide interdisciplinary education and promote safe, quality, accessible, patient-centered care. The four core competencies for interprofessional collaborative practice are values/ethics for interprofessional practice, roles/responsibilities, interprofessional communication, and teams and teamwork. Simulation is specifically listed as a method of instruction to help students meet all four of the core interprofessional competencies.

The International Association for Clinical Simulation and Learning (INACSL) has also been instrumental in promoting the use of simulation in undergraduate nursing education. INACSL was formed in 2002 with 41 paid members and the initial mission "to promote and provide the development and advancement of clinical simulation and learning resource centers" (INACSL, 2015). Over the first decade, the membership grew to 1500. INACSL published its first version of the seven Standards of Best Practice for Simulation in 2011, updated the standards in 2013, and added two additional standards in 2015. The standards "were designed to advance the science of simulation, share best practices, and provide evidence-based guidelines for implementation and training standards" (INACSL, 2015). The INACSL Standards for Best Practice: Simulation^{SM} includes:

- Standard I: Terminology,
- Standard II: Professional Integrity of Participant(s),
- Standard III: Participant Objectives,

- Standard IV: Facilitation,
- Standard V: Facilitator,
- Standard VI: Debriefing Process,
- Standard VII: Participant Assessment and Evaluation,
- Standard VIII: Simulation Enhanced Interprofessional Education (Sim-IPE) (Decker et al., 2015), and
- Standard IX: Simulation Design (Lioce et al., 2015)

The most recent publication that promoted the use of simulation in undergraduate nursing education is the NCSBN National Simulation Study (Hayden et al., 2014). This landmark study once and for all established simulation as a credible and valuable pedagogical method for undergraduate nursing students. The study aimed to determine: (a) whether simulation could be substituted for traditional clinical hours, (b) the educational outcomes of undergraduate nursing students in the core clinical courses when simulation was integrated throughout the core nursing curriculum, and (c) whether varying levels of simulation in the undergraduate curriculum impacted the practice of new graduate nurses in their first clinical positions. The NCSBN National Simulation Study will be discussed further in the review of related literature. Hayden et al. (2014) followed pre-licensure nursing students for the two years during their nursing coursework and then six months into their experience as working new graduate nurses. The participants were split into a control group that participated in no more than 10% of their traditional clinical being replaced by simulation, a group that had 25% of traditional clinical replaced with simulation, and a group that had 50% of their traditional clinical replaced with simulation. Hayden et al. (2014) determined that up to 50% of traditional

clinical could be replaced with simulation and produce the same outcomes for nursing students in the areas of knowledge, the ability to pass NCLEX, clinical competency, critical thinking, new graduate nurse clinical performance, and readiness for practice.

Following the publication of the NCSBN National Simulation Study, many state-based regulation agencies have created or are in the process of revising state guidelines regarding how many simulations can be used to replace traditional simulation in undergraduate nursing programs (Rutherford-Hemming, Lioce, Kardong-Edgren, Jeffries, & Sittner, 2016). In the U.S. pre-licensure nursing curriculum is not standard across the nation. Each state board of nursing or institute of higher learning (IHL) regulates nursing programs within their state (Leighton, 2014).

The publication of the NCSBN National Simulation Study has also stimulated valuable conversation amongst undergraduate nurse educators about simulation-to-traditional clinical replacement percentages, simulation-to-traditional clinical replacement ratios, faculty development on simulation, debriefing practices, and the future of simulation (Rutherford-Hemming et al., 2016). Hayden et al. (2014), used a 1:1 ratio in replacing traditional clinical hours with simulation hours for the simulation study, but many programs are utilizing different clinical replacement ratios for simulation. The general consensus amongst nurse educators is that most faculty are not yet prepared to use simulation to replace 50% of traditional clinical and will require more faculty development (Rutherford-Hemming et al., 2016). Debriefing is considered the most valuable part of the simulation experience for nursing students, and faculty are in need of training on best practices and evidenced-based debriefing methods. Furthermore, many nursing programs may not have the infrastructure or essential resources to replace 50% of

traditional clinical with simulation such as equipment, supplies, funding, and dedicated staff (Hayden et al., 2014).

In the beginning of high-fidelity simulation use in nursing education, many educators and administrators were skeptical of simulation as a long-term pedagogical method in the undergraduate nursing curriculum. However, many national and international organizations promote simulation use, guidelines and best practices for simulation in nursing now exist, and empirical evidence supports simulation as a pedagogical method in undergraduate nursing education, so simulation use in nursing programs continues to grow and develop.

Advancement of Teaching Technology in Nursing Education.

Modern nursing practice is complex, multi-focused, ever-changing, and filled with technology unknown and unimaginable to nurses in the late 19th century. However, the goal of the nursing profession has remained roughly the same since the time of Nightingale, which has been to "provide a safe and caring environment that promotes patient health and well-being" (Selanders & Crane, 2012). Evidence suggests that nurse educators have always utilized substitutions in the forms of models or mannequins to replace real patients while training nurses to ensure that nursing students provided safe patient care.

The first documented use of simulation in nursing education was in London, England in 1847 in the *Handbook for Hospital Sisters,* which stated that every nursing school should have "a mechanical dummy, models of legs and arms to learn to bandage, a jointed skeleton, a black drawing board, and drawings, books, and models" (Lees, 1874, p. 34). The first documented nursing simulator or "mechanical dummy" in the U.S. was

called “Mrs. Chase” and was used at Hartford Hospital Training School in Hartford, Connecticut in 1911 (Hermann, 1981). “Mrs. Chase” was conceived by Lauder Sutherland, the principal of Hartford Hospital Training School from 1905 to 1918 and was produced by the doll manufacturer M.J. Chase Company of Pawtucket, Road Island. Sutherland believed that “Mrs. Chase” would assist faculty with demonstrators and allow nursing students to practice skills without creating discomfort to patients (Nehring, 2010). Mrs. Chase was described as having working joints such as hips, elbows, shoulders, and knees.

In 1913, “Baby Chase” dolls in infant and children’s sizes of up to 4 years of age were released for the development of pediatric nursing clinical skills and to teach new mothers the essentials of infant and child care. The Baby Chase dolls had a realistic body mass index and nasal and aural openings. The use of “Mrs. Chase” in the nursing profession was widely adopted after the 1914 release of a new improved life-size manikin by the M.J. Chase Company at the St. Louis nurses’ convention that had an injection site in the arm and an internal reservoir that allowed for urethral, vaginal, and rectal treatments (Hermann, 2008).

Similarly, Monsieur Rouilly and Miss Bedford created the Bedford Nursing Doll, another early nursing simulator, in 1931 (Adam Rouilly, 2013). Monsieur Rouilly was the founder of Adam Rouilly that manufactured and distributed human skeletons and anatomical models. Miss Bedford was a nursing instructor in London. Similar to the “Mrs. Chase” mannequin, the Bedford Nursing Doll was a fabric mannequin and had jointed limbs, a paper mâché head, real human hair, and glass eyes. Over the decades, both the M.J. Chase Company and Adam Rouilly manufacturers improved their

mannequins' realism by updating their mannequins' hairstyles, streamlining the body shapes, adding or remodeling body orifices, creating a more lifelike skin, and by using more durable plastic or metal material in the mannequins' construction as it became available in the 1930s to 1950s (Adam Rouilly, 2013; Hermann, 2008; Nickerson & Pollard, 2010).

As early as the 1980s, nursing educators saw the value of using simulation as an evaluation of clinical competency on a national scale. In 1988, the NCSBN received funding from the Kellogg Foundation to develop an interactive computerized clinical-decision-making assessment using clinical simulations. This exam would be considered for inclusion as a second component of the NCLEX-RN exam in order to test the competency of those seeking licensure as an RN (Bersky et al., 1998). Since the NCLEX-RN was a written test at the time, the test-takers would write the answers to the interactive clinical simulations. The NCSBN Delegate Assembly of 1999 voted against the incorporation of the computerized clinical simulations into the NCLEX-RN; thus, clinical simulations did not become part of the national exam to become an RN (Bremner & Brannan, 2000).

Although high-fidelity simulation was commonly used in medicine in the early 1990s, the use of high-fidelity simulation was not yet widely used in nursing education due to the prohibitive cost of over $200,000 per simulator. By the late 1990s and early 2000s, high-fidelity simulation use began to become more widespread in undergraduate nursing programs as the cost of simulators dropped. In essence, the use of high-fidelity simulation in nursing education became popular and intersected with simulation use in medical education by the late 1990s.

Nehring and Lashley (2004) published the first known large-scale international survey on the use of simulation in undergraduate nursing education. Nehring and Lashley targeted 66 nursing programs and 150 simulation centers, hospitals, armed services bases, and other institutions of higher learning that had purchased the METI Human Patient Simulator™ (HPS™) prior to 2002. Nehring and Lashley (2004) examined the use of high-fidelity simulation in regard to the percentage of use, courses in which the HPS™ was used, training of faculty and staff, HPS™ use for evaluation of competencies, and student opinion. Thirty-four nursing programs and six simulation centers responded to the survey. The HPS was used most often in associate degree nursing programs (44%) followed by baccalaureate programs (26%). Overall, simulation was most often used in medical-surgical courses (63.6% of respondents) and most often used to replace clinical time. The majority of participants (75.8%) reported that one person, usually a nursing faculty member, was primarily responsible for running the simulator; however, typically no extra compensation was offered by colleges or universities to nursing faculty for taking on simulation work (94%). In the community college nursing programs, faculty most often used the HPS™ to evaluate students' competency in the area of technical skills (30.8%) and management of complex patients (30.8%). In the university-based nursing programs, the HPS™ was most often used to evaluate the competency of nursing students' abilities to synthesize knowledge (76.9%) and ability to perform technical skills (61.5%).

Progression of the Skills Laboratory to the Simulation Laboratory in Nursing Education

In nursing education, simulators are often used in simulation laboratories, simulation centers, clinical learning laboratories, or skills laboratories. The first evidence

of an early form of a nursing simulation laboratory was documented in 1916. Bloomfield (1916) described the use of a "demonstration room" in the education of nurses in Syracuse, New York. Later, Davis (1932) gave a detailed description of the nursing skill laboratory at the Indiana University Training School for Nurses. According to Davis, the nurses used the skills laboratory to practice patient care skills on each other and by giving injections to the mannequin. In the early years of nursing education, nurse educators also developed and used task trainers in the forms of simulated human limbs, torsos, or full-body mannequins. These task trainers were used to help teach nursing students how to perform tasks such as injections, urinary catheter insertion, and wound care (Cato, 2012).

Nursing skill laboratories remained static for many decades after the 1930s. Nursing skills laboratories were historically filled with task trainers and supplies to train students on essential nursing skills. In 1976, a group of educators from across the U.S. got together with the goal to change and improve the traditional nursing skills laboratory. The group of innovative people were Charlene Clark (Coordinator of the Practice and Audiovisual Lab at the Intercollegiate College of Nursing, Spokane, Washington), Kathleen Mikan (Coordinator of the Practice and Audiovisual Lab at the University of Alabama at Birmingham), Kay Hodson-Carlton (Ball State, Indiana), and Joanne Crow (a non-nurse faculty from the University of Texas Health Science Center at San Antonio). These educators gathered at the Health Education Media Association (HEMA) conference in New Orleans to begin a discussion about organizing an annual conference that addressed the learning laboratory issues such as technology and distance learning (INACSL, 2015). These conferences were called the Biennial North American Learning Resource Centers (LRC) Conference.

In 1995, the First National Conference on Nursing Skills Lab was organized. The two separate conferences finally merged in 2009. These conferences focused on ways to improve the practice or skill aspect in nursing learning laboratories. In 1999, another informal group met at the 3rd National Conference on Nursing Skills Laboratories and started discussing the need for clinical learning laboratory educators and leaders to network more than just once a year. In 2000, a formal meeting was held at the Eighth Biennial North American Learning Resource Centers Conference in Baltimore called "Creation of a Professional Organization for Psychomotor Skill Educators." At this meeting, a task force was created to develop a mission and vision for this group of nurse learning laboratory leaders and educators. In 2001, participants at the Fourth National Conference on Nursing Skills Laboratories endorsed a professional organization for nurse learning laboratory leaders and educators and the formation of a Board of Directors. In 2002, this professional organization for nursing learning laboratory leaders and educators was named the *International Nursing Association for Clinical Simulation and Learning* (INACSL, 2015). By the late 1990s and early 2000s, nurse educators and leaders knew that the addition of simulation to their existing learning laboratories or skills laboratories called for a more specific focus and created different and more specialized needs.

The first peak of simulation center openings was in 2003 to 2005 and was assisted with the foundation of INACSL in 2002, the Society for Simulation in Healthcare in 2004, and the introduction of many new simulation products by vendors (INACSL, 2015; Rosen, 2014). For example, Laerdal launched its first high-fidelity simulator "SimMan" and Gaumard released their first electronic birthing simulator "Noelle" in 2000 (Gaumard, 2012; Laerdal, 2012). In 2001, METI also launched a more affordable high-

fidelity simulator called the “ECS” (Rosen, 2014). The second peak of the opening of simulation centers was in 2008 to 2009 with the development of wireless simulation technology. According to Rosen (2014), the opening of new simulation centers started declining in 2010.

Summary

Chapter I provided an overview of the definitions of simulation and identified the definition of simulation that was used for this study. The first chapter also provided an overview of the history of simulation, the history of nursing education, and how simulation and nursing education are interwoven. Simulation has been used for thousands of years. The history of the use of simulation in aviation is closely linked to the use of simulation in healthcare. Simulation use in pre-licensure nursing has grown and evolved as nursing education has transformed over the centuries to better prepare nurses for the modern challenges of healthcare.

CHAPTER II – REVIEW OF THE LITERATURE

Chapter II presents a review of the related literature relevant to the central question in this study. The literature search method is described in detail. The findings of the literature review are summarized and analyzed. The theoretical framework for this study is also established in this chapter.

In a 2010 national survey of National League for Nursing-accredited BSN programs, between 23 to 40% reported using simulation to replace traditional clinical hours (Katz et al., 2010). In a 2015 national survey of pre-licensure nursing programs, 77.5% of programs reported using simulation to replace traditional clinical (Breymier et al., 2015). That 37.5 to 54.5% increase in the use of simulation to replace traditional clinical occurred in just five years. Replacement of traditional clinical with simulation most often occurred in the medical-surgical clinical courses (Hayden, 2010; Katz et al., 2010) followed by the obstetric nursing courses and then by the pediatric nursing courses (Hayden, 2010) in undergraduate nursing programs.

Breymier et al. (2015) found that representatives from nursing programs reported utilizing simulation to replace traditional clinical for multiple reasons: (a) they valued simulation as a teaching methodology (>90%), (b) due to lack of clinical placements (39%), (c) due to lack of a clinical facilitator (<10%), or (d) due to an administrative directive (<10%). Thirty-three percent of participants chose “other” as a reason for utilizing simulation to replace traditional clinical and reported the following reasons: (a) to offer specific or rare clinical experiences (55%), (b) to provide a make-up for lost clinical time (39%), (c) to supplement or prepare for supervised clinical experiences

(16%), or (d) to grant the request by the supervised clinical site to offer more simulation experiences (3%) (Breymier et al., 2015).

To date, no national guidelines in the U.S. exist for the number of clinical hours a pre-licensure RN must receive to graduate, nor the number of hours of simulation that can be used to replace simulation. Participants in the Katz et al. (2010) national survey reported various numbers of hours or percentages of traditional clinical time that was being replaced by simulation; thus, determining a mean number of hours of traditional clinical that was being replaced by simulation was difficult.

As mentioned previously in the introduction, the largest longitudinal study known to date of simulation use as a replacement of traditional clinical was published by Hayden et al. (2014) and was entitled the NCSBN National Simulation Study. In the study, Hayden et al. (2014) followed 666 associate degree and bachelor's degree-nursing students from their first clinical course until the end of their pre-licensure program and then continued to follow the study cohort 6 months into their practice as employed RNs. The overall purpose of the study was to provide state boards of nursing with "evidence on nursing knowledge, clinical competency, and the transferability of learning from the simulation laboratory to the clinical setting" (Hayden et al., 2014, p, S6). The three specific aims of the study were:

- To determine whether simulation [could] be substituted for traditional clinical hours in the pre-licensure nursing curriculum,
- To determine the educational outcomes of undergraduate nursing students in the core clinical courses when simulation [was] integrated throughout the core nursing curriculum, and

- To determine whether varying levels of simulation in the undergraduate curriculum [impacted] the practice of new graduate nurses in their first clinical positions (Hayden et al., 2014, p. S6).

The participants in the NCSBN National Simulation Study were divided into three research groups. Students in the control group participated in simulation to replace no more than 10% of their traditional clinical hours. Students in the 25% group participated in simulations that replaced 25% of their traditional clinical hours. Students in the 50% group participated in simulation that replaced 50% of their traditional clinical hours.

Knowledge was measured using the ATI RN Comprehensive Predictor® (Assessment Technologies Institute, LLC), which is an online, standardized, multiple choice, proctored examination. Clinical competency was measured using the Creighton Competency Evaluation Instrument (CCEI), the New Graduate Nurse Performance Survey, and the Global Assessment of Clinical Competency and Readiness for Practice. Critical thinking was measured using the Critical Thinking Diagnostic©, developed by the Nursing Executive Center. Hayden et al. (2014) also utilized participants' scores on the National Council Licensure Examination (NCLEX®) as a measurement of participants' knowledge, skill level, and abilities as an entry-level nurse. Researchers also used the Clinical Learning Environment Comparison Survey (CLECS) to assess how well participants felt their learning needs were met in simulation versus traditional clinical.

At the conclusion of the longitudinal study, Hayden et al. (2014) determined that there were no significant differences amongst any of the study groups in the students' knowledge at the end of the nursing program, clinical competency, or overall readiness for practice. The educational outcomes were the same for all study groups (i.e., ≤ 10%,

25%, or 50% traditional clinical hours being replaced with simulation). The NCLEX pass rates were similar in all three study groups. All three study groups had passing NCLEX scores above the 2013 national average passing rate of 80%. Hayden et al. concluded, "this study provides strong evidence supporting the use of simulation as a substitute for up to 50% of the traditional clinical time" (p. S36).

Due to the landmark results from the NCSBN National Simulation Study (Hayden et al., 2014), simulation was validated as a replacement for traditional clinical that produces equal outcomes in undergraduate nursing education as long as several rigorous, standardized, and controlled elements are put into place including:

- a standardized simulation process for student and faculty orientation, debriefing, training, and evaluation;
- a shared faculty mental model of how simulation experiences are run;
- integration of the INACSL Standards of Best Practice: Simulation^{SM} into the simulation process; and
- the use of a simulation-to-traditional clinical replacement ratio of one hour of simulation to replace one hour of traditional clinical.

In other words, the results of the NCSBN study support substituting 1 hour of simulation for 1 hour of traditional clinical (i.e., a 1:1 simulation-to-traditional clinical replacement ratio), in undergraduate nursing programs.

Statement of Problem

Although the results of the NCSBN study support using a 1:1 ratio for simulation-to-traditional clinical replacement time in undergraduate nursing education, no standard ratio of clinical replacement time is currently being used in the U.S. Many undergraduate

nursing programs are using 1:2, 1:3, or even 1:4 ratios for simulation-to-traditional clinical replacement without empirical evidence that doing so produces the same outcome of using a 1:1 ratio for simulation-to-traditional clinical replacement. Additionally, three state nursing education regulation agencies (i.e., Mississippi, Ohio, and Virginia) have implemented policies requiring pre-licensure nursing programs to utilize a 1:1 simulation-to-traditional clinical replacement ratio if they elect to use simulation to replace a percentage of clinical time.

Review Objective and Question

The objective of this literature review was to identify the best evidence on the amount of time that should be spent in simulation to replace traditional clinical while producing the same outcomes. The literature review was undertaken to answer the following specific question: "What are the outcomes of using different ratios of simulation-to-clinical replacement time in undergraduate nursing education?" For example, what are the outcomes of using a 1:1 ratio (1 hour of simulation to replace 1 hour of traditional clinical), 1:2 ratio (i.e., 1 our of simulation to replace 2 hours of traditional clinical), 1:3 ratio (i.e., 1 hour of simulation to replace 3 hours of traditional clinical), or 1:4 ratio (i.e., 1 hour of simulation to replace 4 hours of traditional clinical) in an undergraduate nursing education program?

Search Strategy

The search strategy aimed to find published and unpublished studies, limited to the English language, and within undergraduate nursing education using a three-step approach. The initial set of keywords used for the literature search in each database was *simulation, clinical,* and *replacement.* The second set of keywords used was *simulation,*

clinical, and *ratio*. No limitations were placed on the dates in the search for unpublished or published work on the ratio of simulation-to-traditional clinical replacement time due to the newness of simulation as an area of research in nursing education.

The first step of the review of the literature was a search of the Cochrane library to ensure a systematic review did not already exist on the replacement of traditional clinical with simulation. Only one systematic review was identified in Cochrane using the search terms. However, the systematic review did not focus on the outcomes of replacing traditional clinical with simulation in undergraduate nursing programs.

The second step in the review of the literature involved searching the CINAHL, MEDLINE, and PsychINFO databases using various combinations of the search terms *simulation, clinical, replacement, ratio, and nurs** as was appropriate for each database. Each database uses slightly different indexing terms, so the search strategy was modified somewhat for each database. In some cases, the search term *nurs** was added to narrow the search results to only include articles that focused on simulation in nursing. The search was limited to peer-reviewed or research articles. No limitation was placed on dates of publication for the search to locate the maximal number of relevant articles since publications on simulation in nursing are relatively recent over the last 20 years.

The third step in the review of the literature involved searching through two publications specific to simulation using the individual search engines available on each publication's website:

1. *Clinical Simulation in Nursing*, a nursing-specific simulation journal published by the International Association for Clinical Simulation and Learning, and

2. the *Journal of the Society for Simulation in Healthcare,* a multidisciplinary research publication covering all aspects of simulation technology in healthcare.

The inclusion criteria for the literature search were kept broad to ensure that all current knowledge on the replacement of traditional clinical with simulation at different replacement ratios could be located, identified, analyzed, and included. All articles, dissertations, or theses (published or unpublished) were included in the literature search as long as the article or body of work included quantitative or qualitative data or expert opinion regarding the replacement of traditional clinical with simulation at different replacement ratios.

Findings from the Literature Search

The initial search of the literature resulted in 572 studies. The titles of the 572 studies were reviewed for relevancy and the list of articles was narrowed to 24 studies that were selected for further review. After reviewing the 24 articles, a total of 9 articles met the search criteria. The 15 articles not meeting search criteria were primarily excluded because they either: did not utilize pre-licensure nursing students as participants, did not specifically research ratios of simulation-to-traditional clinical replacement time, or studied varying percentages or number of hours of traditional clinical replaced with simulation (e.g., 10% of clinical, 6 hours of simulation). Table 1 provides a summary of the findings from the literature search including the author, categorization of the article or study, the purpose of the study, the ratio of simulation-to-traditional clinical hours used or determined, and key findings from the articles. Five of the nine relevant articles were purely descriptive studies and most utilized surveys or

interviews to explore the ratio of time or number hours of undergraduate nursing programs used to replace traditional clinical hours. Two studies were quasi-experimental and interestingly, both used a pediatric clinical setting to explore the outcomes of utilizing a 1:1 simulation-to-traditional clinical replacement ratio (Meyer et al., 2011) and a 1:2 simulation-to-traditional clinical replacement ratio (Parker et al., 2015).

Table 1

Article Summaries from Literature Search on the Replacement of Traditional Clinical with Simulation

Article	Classification of Article/Study	Purpose of Article/Study	Ratio of Simulation Hours to Traditional Clinical Hours	Key Findings/ Special Notes
Bearnson & Wiker (2005)	Descriptive	To explore the benefits and limitations of using simulation as a substitute for one traditional clinical day for first-year baccalaureate nursing students	Used 2 hours of simulation to replace one clinical day.	Student participants self-reported increased knowledge of medication side effects, patient responses to medication, increased safety while administering medications, and increased confidence in medication administration.
Breymier, Rutherford-Hemming, Horsley, Atz, Smith, Badowski, & Connor (2015)	Descriptive/Survey	To determine the ratios of simulation to supervised clinical in pre-licensure nursing curricula in the United States	> 60% utilized 1:1 simulation-to-clinical ratio. >10% utilized 1:2 simulation-to-clinical ratio. <10% utilized 2:1 simulation-to-clinical ratio. <5% utilized 3:1 simulation-to-clinical ratio. <5% utilized 1:3 simulation-to-clinical ratio. <5% utilized "other simulation-to-clinical ratio.	•45% of schools of nursing reported that they had standardized ratios for simulation substitution of clinical. •55% of schools of nursing reported that they did not have a standardized ratio of simulation substitution for clinical. •1:2 most commonly used ratio in geriatrics and beginning medical-surgical. •Varied reasons reported for choosing different replacement ratios.

Table 1 (continued).

Cornelius (2012)	Descriptive/ Mixed methods qualitative and quantitative survey	To survey the Administrators and Faculty of Practical Nursing Programs in Pennsylvania regarding the utilization of simulation in replacement of traditional clinical	A director of a practical nursing program recommended a 1:3 simulation-to-clinical replacement ratio.	The intensity of simulation was cited as the reasoning behind why a 1:3 simulation-to-traditional clinical replacement ratio could be used.
Gore & Schuessler (2013)	Expert article - non-research	To describe the implementation and evaluation of a simulation policy	1:3 simulation-to-clinical replacement ratio utilized	•The 1:3 simulation-to-clinical replacement ratio was utilized according to the authors because of the "concentrated learning that would occur" in simulation (p. e321). •Peer observation and evaluation during the simulation were not included in the ratio.
Gore, Van Gele, Ravert, & Mabire (2012)	Descriptive	To explore the differences and similarities in simulation practices in nursing education between the United States and other countries	United States 17% simulation not used to replace clinical, 58% 1:1 simulation-to-clinical ratio, 9% 1:2 simulation-to-clinical ratio, 8% 1:3 simulation-to-clinical ratio, 8% other replacement ratio International 56% simulation not used to replace clinical, 38% 1:1 simulation-to-clinical ratio, 0% 1:2	•International nurse education programs less likely to use simulation as clinical replacement but more likely to use a 1:1 simulation-to-clinical replacement ratio if they did use simulation to replace clinical. •United States nurse education programs are more likely to use varied simulation-to-clinical replacement ratios.

Table 1 (continued).

			simulation-to-clinical ratio, 0% 1:3 simulation-to-clinical ratio, 6% other replacement ratio	
Hayden (2010)	Descriptive/Survey	To assess the prevalence and practices of simulation in pre-licensure nursing programs in the United States	•83% of pre-licensure RN programs utilize a 1:1 simulation-to-clinical ratio. •10% used a replacement rate less than 1 hour of simulation time to 1 hour of clinical. •7% utilized a replacement rate of more than 1 hour of simulation to replace 1 hour of clinical.	•Substitution of clinical time with simulation was most common in medical surgical courses. •77% of participants stated that they were substituting simulation for clinical time or would do so if permitted. •69% of participants stated simulation counted as clinical time.
Meyer, Connors, Hou, & Gajewski (2011)	Quasi-experimental prospective study with convenience sample	To evaluate the effect of a pediatric simulation curriculum based on the Jeffries conceptual framework on student clinical performance in a pediatric clinical course	1:1 simulation-to-clinical ratio	•After 4 weeks of clinical, students that had experienced simulation scored significantly higher on overall clinical performance than their peers who had not experienced simulation •Students that experienced simulation scored significantly higher on skills performance •Adding the simulation experience to the clinical decreased the student/ faculty ratio from 8:1 to 6:1

Table 1 (continued).

				•The timing during the semester that the students participated in the simulation (e.g., before clinical; or week 2, 3, 5, or 7 of clinical) had no significant effect on overall student performance. •No significant effect of the simulation on clinical judgment scores was noted.
Parker, McNeill, & Howard (2015)	Quasi-experimental with convenience sample	To compare simulation and traditional clinical experience in a pediatric setting regarding educational practices, design, and student self-reported outcomes of satisfaction and self-confidence.	1:2 simulation-to-clinical ratio	•A 1:2 simulation-to-clinical ratio was selected "through examination of course and/or clinical objectives and the concentrated leaning opportunities experienced in simulation" (p. 191). •Students perceived significantly greater opportunities for collaboration with their peers in the simulated clinical setting. •Students reported significantly higher satisfaction in learning in the traditional clinical setting. •No other significant differences reported or perceived by students between the simulated

Table 1 (continued)

				and traditional clinical environments with regard to design, outcomes, or self-confidence.
Richardson, Goldsamt, Simmons, Gilmartin, & Jeffries (2014)	Comparative descriptive program evaluation (mixed methods)	To document the effects of different "doses" of simulation on faculty capacity, work-life quality for faculty and student experience	1:2 simulation-to-clinical ratio	The replacement of 50% of traditional clinical with simulation at a 1:2 ratio of simulation-to-clinical hours resulted in a 49% increase in faculty capacity without negative effects to work-life quality for faculty or student simulation/clinical experiences.

The resounding finding from the literature review was that the practice of replacing traditional clinical with simulation varies widely in pre-licensure nursing programs. Most prelicensure nursing programs utilize a 1:1 simulation-to-traditional clinical replacement ratio in both the U.S. and internationally (Breymier et al., 2015, Gore et al., 2012, Hayden, 2010). In the U.S., between 58% (Gore et al., 2012) to 83% (Hayden, 2010) of undergraduate nursing programs report using a 1:1 ratio when using simulation to replace traditional clinical. A 1:2 ratio (i.e., 1 hour of simulation to replace 2 hours of traditional clinical) is the second most common simulation-to-traditional clinical replacement ratio utilized in pre-licensure nursing programs in the U.S. and is most frequently applied in beginning medical-surgical and geriatric clinical courses (Breymier et al., 2015). Between 9% (Gore et al., 2012) and >10% of pre-licensure nursing programs in the U.S. report using a 1:2 ratio when using simulation to replace traditional clinical. The 1:3 simulation-to-traditional replacement ratio (i.e., 1 hour of simulation to replace 3 hours of traditional clinical) appears to be the third most prevalent replacement ratio used in the U.S. and is used by between <5% (Breymier et al., 2015) to 8% (Gore et al., 2012) of pre-licensure nursing programs. Simulation scenarios typically last between 15 to 30 minutes, but Hayden (2010) found that about 20% of pre-licensure nursing programs report running simulation scenarios that last more than 1 hour. Several simulation scenarios are therefore often utilized to replace an entire clinical day (Bearnson & Wilker, 2005; Hayden et al., 2014; Meyer et al., 2011).

Common themes in the descriptive studies found in the literature review regarding the reasoning behind using less time in simulation to replace traditional clinical were that the clinical objectives could be attained in less time in the simulation setting than in the

traditional clinical setting and that the simulation setting is more intense and offers a more condensed learning experience (Cornelius, 2012; Gore & Schuessler, 2013; Parker et al., 2015). Interestingly, some pre-licensure nursing programs report actually using more time in simulation to replace traditional clinical time. Hayden (2010) found that 7% of pre-licensure nursing programs in the U.S. utilized a replacement ratio of more than 1 hour of simulation to equal 1 hour of traditional clinical. For example, Breymier et al. (2015) found that around 10% of pre-licensure nursing programs utilized 2 hours of simulation to replace 1 hour of traditional clinical and close to 5% of programs used 3 hours of simulation to replace 1 hour of traditional clinical. Breymier et al. (2015) speculated that the practice of replacing traditional clinical with more simulation time may result from a lack of faith in the benefits of simulation.

The outcomes from the quasi-experimental studies found in the literature review indicate there are some positive outcomes when using either the 1:1 or the 1:2 simulation-to-traditional clinical replacement ratios. Meyer et al. (2011) utilized a 1:1 replacement ratio in a pediatric clinical course in a BSN program for 25% of the clinical course and found that students participating in simulation initially scored higher on overall clinical performance on a modified version of the Massey and Warblow (2005) Likert–style clinical evaluation tool than the students that had not yet participated in simulation. On item-level analysis, students that had participated in simulation scored higher specifically in the area of skills performance. Additionally, Meyer et al. reported that utilizing a 1:1 ratio to replace clinical resulted in decreasing the student to faculty ratio from 8:1 to 6:1. Students were rotated off to simulation every two weeks and that helped to decrease the student to faculty ratios in traditional clinical.

As mentioned previously, the largest known and most significant study utilizing a 1:1 replacement ratio was the NCSBN National Simulation Study. Hayden et al. (2014) conducted a large-scale (*N* = 666) longitudinal study of the effects in replacing traditional clinical with simulation inboard of Nursing-approved and nationally accredited pre-licensure nursing programs (i.e., ADN or BSN programs) in the U.S. Participants were studied from their initial clinical course all through their clinical courses until graduation and then beyond into 6 months of their practice as a working RN. The study participants were randomized into three different study groups:

- control: students participated in simulation that replaced no more than 10% of their traditional clinical hours;
- 25% group: students participated in simulation that replaced 25% of their traditional clinical hours; and
- 50% group: students participated in simulation that replaced 50% of their traditional clinical hours.

Hayden et al. (2014) reported no significant differences between any of the study groups in regard to clinical competency prior to licensure, comprehensive nursing knowledge assessments, NCLEX pass rates, manager ratings of overall clinical competency after licensure and hire, or readiness for practice as a new RN. Thus, the results of this study indicate simulation can be used to replace up to 50% of traditional clinical time utilizing a 1:1 replacement ratio. Furthermore, the results of the NCSBN National Simulation Study indicate that educational substitution of simulation for traditional clinical time produces the same outcomes as the utilization of a traditional

clinical teaching model in which students experience 10% or less of simulation during their clinical course.

The utilization of a 1:2 simulation-to-traditional clinical time replacement ratio is the second most utilized replacement ratio in the U.S. in undergraduate nursing programs (Breymier et al., 2015). Two quasi-experimental studies found in the literature search utilized a 1:2 ratio in using simulation to replace clinical time. Similar to the findings by Meyer et al. (2011) when using a 1:1 replacement ratio, Richardson et al. (2014) reported that the implementation of a 1:2 simulation-to-traditional replacement ratio for 50% of the clinical time in four core medical-surgical courses resulted in decreasing the student to faculty ratio each day in traditional clinical from 8:1 to 6:1 and in simulation from 16:1 to 12:1. Due to the nature of rotating students out of traditional clinical to the simulation setting, the implementation of a 1:2 simulation-to-clinical time replacement ratio resulted in each traditional clinical faculty being assigned to a total of 12 students overall (up from 8 in the prior standard curriculum) and for the simulation faculty a total of 24 students overall (up from 16 students in the prior curriculum). Richardson et al. (2014) determined that faculty capacity was increased by 45 to 49% over the course of implementing the 1:2 simulation-to-traditional clinical replacement ratio for 50% of the medical-surgical clinical course hours. Faculty capacity was defined as the number of students per faculty day for each course at each school. Despite the increased overall number of students assigned to each individual faculty member in the simulation and in the clinical setting, faculty participants reported no negative effects on their work-life quality and students reported no negative impact on their simulation or traditional clinical experiences.

The second quasi-experimental study found in the literature search was Parker et al. (2015) who studied 44 undergraduate BSN students in a child health course and utilized a 1:2 simulation-to-traditional clinical replacement ratio for roughly 24% of the total clinical time. Parker et al. noted that students self-reported greater opportunities for collaboration with their peers in the simulated setting but higher satisfaction with learning in the traditional setting. No significant differences between the simulated clinical experience and the traditional clinical experience were reported by the students in their perception of the design of the learning experiences or in their self-confidence after participating in each learning environment.

Pre-licensure nursing programs in the U.S. also use replacement ratios that go beyond the 1:1 or 1:2 simulation-to-traditional clinical replacement ratios (Breymier et al., 2015; Gore et al., 2012; Hayden, 2010). Bearnson and Wilker (2005) explored the outcomes of replacing one traditional clinical day with 2 hours of simulation in the first year of a BSN program during the students' first clinical course. Students cared for three simulated patients using a high-fidelity simulator in a 2-hour simulation experience. Although a specific replacement ratio was not listed in the article, the traditional clinical day for these students can be assumed to be longer than 2 hours. The program in Bearnson and Wilker's study likely used a replacement ratio in which less time was spent in simulation than the students would spend in traditional clinical. Bearnson and Wilker noted that the mean scores were high for each item on a researcher-developed 4-item Likert-style survey. Students reported increased knowledge of medication side effects and differences in patient responses to medication, increased ability to administer medications safely, and increased confidence in medication administration skills. In

response to three open-ended questions on the survey, students overall felt positive about their ability to increase their confidence in their skills, about learning to perform a more thorough assessment, to recognize abnormal findings, to use critical thinking, and the ability to auscultate and recognize abnormal heart and breath sounds that are not normally present in healthy patients in the traditional clinical setting. However, the students reported that overall, they felt that simulation should be used in addition to clinical instead of as a replacement to a clinical day in the qualitative statements.

The results of this comprehensive literature search on the outcomes of using different replacement ratios for simulation-to-traditional clinical hours indicate that there is no standard ratio of clinical replacement time currently being used in the U.S. Although the results of the NCSBN National Simulation Study support using a 1:1 ratio for simulation-to-clinical replacement time in undergraduate nursing education; many undergraduate nursing programs are using 1:2, 1:3, 1:4 or even 2:1 ratios for simulation-to-traditional clinical replacement without empirical evidence that doing so produces the same outcomes as using a 1:1 ratio for simulation-to-traditional clinical replacement.

In summary, there is strong evidence suggesting the use of a 1:1 replacement ratio, with the addition of other rigorous standards, can result in the same outcomes as traditional clinical. Some evidence is emerging that utilizing a 1:1 replacement ratio may improve nursing students' skills performance and overall clinical performance when compared to students that have not participated in simulation. In addition, the utilization of 1:1 and 1:2 simulation-to-traditional clinical replacement ratios can result in smaller clinical groups and increased faculty capacity if students are rotated out of their traditional clinical groups to participate in simulated clinical experiences.

Theoretical Framework

Research is conducted to test the concepts of middle-range theories or to refine conceptual models (Fawcett, 1999). Therefore, a study must be grounded in a theoretical framework in order to provide true meaning. Currently, no grand theory exists that supports the use of simulation in nursing education (Nestel & Bearman, 2015). Nurse educators utilize multiple learning theories to help learners acquire the knowledge and skills to become a practicing nurse: (a) behaviorist principles to acquire new skills (psychomotor learning domain), (b) cognitive principles to help learners understand basic nursing knowledge like the nursing process (cognitive learning domain), and (c) constructivist principles to help nursing students gain personal meaning from learned knowledge (affective learning domain) (Paige & Daley, 2009). The use of simulation in nursing education has been based upon various learner-centered practices and has been guided by multiple learning theories such as: adult learning theory (Knowles, 1968), Benner's novice to expert model, (Benner, 1984), Kolb's theory of experiential learning (Kolb, 1984), situated cognition (Lave, 1988), social cognitive theory (Bandura, 1991), and transformative learning theory (Imel, 1998; Mezirow, 1997).

Based on the results of the NCSBN National Simulation Study (Hayden, 2014), it can be posited that one learning method (i.e., simulation) can be used to replace another learning method (i.e., traditional clinical experiences) in nursing education to achieve the same learning outcomes. This study explored if simulation can be used to meet the same learning outcomes as traditional clinical but, in less time, than is typically required in the traditional clinical setting. No one theory could be located in the literature proposing that

educators can replace one pedagogy with another and meet the same outcomes, as this idea is more of a meta-theoretical concept.

The concept of metacognition best suits the supposition that a learner can meet the same learning outcomes via various learning methods. Metacognition is essentially an awareness of one's own thought processes. If one is aware of one's own thought processes, there are unending avenues by which one can come to new knowledge as one reflects upon one's learning experiences. According to Burke (2012), the simulation experience creates dissonance and learners get the opportunity to challenge assumptions, choose a specific plan of action, and experience the outcomes of their actions. The simulation experience provides novice nurses with the opportunity to experience and anticipate better ways to handle similar real-life clinical situations in less time than it usually takes in traditional clinical. Two theories were utilized in this study to (a) explain how simulation can meet the same learning outcomes as traditional clinical but in less time and (b) to guide the study design and methods used to test this theory.

The two theories that will be used to guide this study are Situated Cognition and the NLN/Jeffries Simulation Framework. Current nursing graduates require preparation to care for a variety of patients with complex and often chronic health issues. Successful nursing graduates possess a variety of mental constructs and experiences to call upon when they are faced with the challenges of caring for real patients. Thus, nursing educators often ground their curriculum in educational theories that support cognitive methods of problem-solving and critical thinking but also skill acquisition and mastery.

Situated Cognition

Situated Cognition theory started to emerge in the 1990s as theorists began to understand the importance of the context in which the learning occurs for adult learners (Wilson, 1993). Nursing is a practice-based discipline and successful nursing graduates must be able to apply to learn from one situation to another. Teaching nursing students about every patient condition and care situation a nurse will ever encounter into only 2 to 4 years of education is impractical, so nurse educators are challenged to help students learn core concepts and skills that learners can synthesize and apply in other similar and different patient care situations. According to Wilson (1993), transfer of knowledge can only occur when knowledge and learning are integrated into the setting in which they occur, so learning must be situated in an authentic practice setting for transfer to occur.

Situated Cognition contains three main interacting components that make up an authentic setting that will promote the transfer of learning from knowledge to practice: (a) people, (b) ingredients or tools, and (c) activity (Page & Daley, 2009). When applying Situated Cognition to a simulation in nursing education, the first element, people, consists of the patients, family members, and healthcare personnel that make up a clinical situation. The second element of Situated Cognition is ingredients or tools and consists of the prior knowledge or concepts that learners need prior to participating in a simulation experience. The third element of Situated Cognition, activity, is the authenticity of the real-life event, which in simulation would be called the fidelity of the scenario.

In theory, nursing students may be able to transfer knowledge more quickly to the practice setting in a simulated clinical experience, rather than in a traditional clinical setting because the educator can control and plan for the exact people, ingredients and

tools, and activity in a simulation. In a clinical learning experience, controlling every aspect of the nursing student's learning experience is impossible. In the traditional clinical setting, nursing students typically spend 6 to 12 hours caring for one or more assigned patients. The students' clinical experiences are driven by multiple random factors that occur in a natural patient care environment and standardization of the clinical learning environment is a challenge. Conversely, in a simulation, the nurse educator can control the people (patient, family members, and other healthcare team members) and the complexity or ambiguity the people bring to the clinical situation. In addition, the nurse educator can assure that nursing students are provided the opportunity to gain essential tools (knowledge and skills) prior to the simulation that will help them successfully attain learning outcomes for the simulated clinical experience. Nurse educators can control and standardize the authenticity of the learning activity in simulation by providing a realistic patient through the use of mannequins or simulators, medications and patient care equipment, sounds and smells, and timeframes.

NLN/Jeffries Simulation Framework

This researcher utilized the National League for Nursing (NLN)/Jeffries Simulation Framework (Figure 1) to design this study and to assist in defining and controlling the variables in this study. The NLN/Jeffries Simulation Framework was conceptualized based on a synthesis of information from the theoretical and empirical literature on simulation from the fields of nursing, medicine, allied health, and other non-health care disciplines. The simulation framework also incorporated concepts from educational theories such as learner-centered practice, constructivism, and socio-cultural collaboration (Jeffries & Rogers, 2012). The NLN/Jeffries Simulation Framework was

initially developed and tested for use in the Jeffries (2005) NLN/Laerdal simulation study and was then updated in 2011 by an INACSL research task force to refine some of the language and to move the model from a framework to a theory. The purpose of using the NLN/Jeffries Simulation Framework in designing this study was to assist this researcher in determining how to study the simulation variables of interest in a consistent, organized, and systematic manner.

Figure removed for electronic publication. Copyright permission only granted for printed copies.

Figure 1. The NLN/Jeffries Simulation Framework

From Jeffries, P. R. (Ed.) (2012). *Simulation in nursing education: From conceptualization to evaluation.* New York, NY: National League for Nursing (p. 37). Copyright 2012 by Lippincott Williams & Wilkins. Reprinted with permission for paper copies only. (See Appendix A).

The NLN/Jeffries Simulation Framework is composed of five conceptual elements: facilitator, participant, educational practices, simulation design characteristics, and expected outcomes. In designing this study, these five elements were used to standardize, organize, and control the variables.

Facilitator. Jeffries & Rogers (2012) describe the concept of the facilitator in simulation as an evaluator that plays the role of both the facilitator of the simulation and the evaluator of the participants. The facilitator in a simulation should provide support and guidance and create a safe place for participants to learn. The facilitators feeling comfortable with simulation and preparing for facilitation of the simulation are important. Demographic variables to consider within the facilitator concept that can have an influence on other elements in the framework are the years of experience, age, and clinical expertise of the facilitator. Essentially, the facilitator's experience and comfort level with simulation will influence the overall use and outcomes of the simulation.

Participant. The concept of *participant* encompasses the elements of the learner participating in the simulation experience. Demographic factors of the participant like age and experience in nursing care will also impact the outcomes of the simulation. According to Jeffries and Rogers (2012), the participants in a simulation are responsible for their own learning, must be motivated and self-directed, and must understand the ground rules for the simulation and the roles participants will play. Participants should always be assigned roles that are within their scope in order to assure that learning outcomes can be attainable. For example, portraying the role of a provider in a simulation would be out of the scope of an undergraduate nursing student, as an undergraduate nursing student lacks the knowledge and skills required of a provider such as a physician

or a nurse practitioner. According to Jeffries and Rogers, participants play two roles in simulations: process-based roles and response-based roles. Participants in process-based roles are active participants in the simulation experience. They make decisions about the sequence of assessments and care of the simulated patient. Participants in process-based roles in the simulation can participate in self-assessment of their progress toward learning outcomes through activities like reviewing videotapes of their participation in the simulation while using a checklist to evaluate their ability to meet learning outcomes. Participants in response-based roles are not considered active participants in the simulation experience and do not have control over the activities or outcomes of the simulation. For example, a student in the response-based role may observe the simulation and debrief on the simulation, but they do not actively affect the outcomes of the care of the simulated patient.

Educational Practices in Simulation. The concept of *educational practices in simulation* in the NLN/Jeffries Simulation Framework is important when considering the design of simulation and its ability to improve participant performance and increase participant satisfaction with their learning experience. The six components of educational practices in designing a simulation experience are active learning, feedback, student-faculty interaction, collaboration, high expectations, diverse learning, and time on task.

According to Jeffries and Rogers (2012), learners in a simulation need to be *actively involved* in order to keep learners engaged, increase critical thinking skills, and to allow educators to assess participants' problem-solving and decision-making skills. In a simulation experience, giving *feedback* is critical for the learning process. Elements to consider in designing the feedback or debriefing portion of a simulation are the timing of

the feedback (e.g., during or after the simulation) and frequency (e.g., after each group of participants or at the very end of the simulation). The simulation should be designed such that participants feel safe to make and learn from their mistakes and feedback should not interfere with the participants' learning process.

In the element of *student/faculty interaction*, Jeffries and Rogers state that the student-faculty relationship must be positive and collaborative into order to have a positive impact on the learner and the outcomes of the simulation. Simulation should have a climate of mutual respect and facilitators should give constructive feedback to foster learning. The simulation experience should also be designed such that participants can give feedback on the simulation for the purpose of refining and improving the design of the simulation. *Collaboration* amongst the participants is also essential to meeting successful learning outcomes of a simulation. Hallmark, Thomas, and Gantt (2014) noted that allowing participants to collaborate in a simulation "often escalates involvement in learning" and facilitators must assure that simulation goals and objectives are clear, concise, and "matched to the level of student learning for successful collaboration to take place" (p. 348).

During the simulation, both facilitators and participants should have *high expectations* for the simulation experience and outcomes in order to achieve positive results from the simulation. *Diverse learning* is another component of the educational practices construct. Jeffries and Rogers state that all four learning styles should be incorporated into a simulation experience, which is visual, auditory, tactile, and kinesthetic. For example, in planning for a pediatric respiratory distress scenario the facilitator would want to program the pediatric simulated patient to be showing visual

signs of respiratory distress such as respiratory retractions (visual learner), have an audible alarm for decreased oxygen saturation (auditory learner), set the simulator to have wheezing sounds upon auscultation of the lungs with a stethoscope and tachypnea while counting respirations (tactile learner), and provide assessment and treatment tools to participants in the care room such as a spO_2 monitor, stethoscope, nasal cannula, and oxygen mask (kinesthetic learner). Hallmark et al. (2014) also state that facilitators designing simulation experiences should incorporate the learning needs of the diverse student in modern nursing classes that may vary based on age, gender, life experience, socioeconomic status, ethnic background, values about learning, preference for independent or group learning, number of degrees held prior to nursing, and level of English proficiency.

The final component of the educational practices concept in the NLN/Jeffries Simulation Framework is *time on task.* During a simulation experience, it is important for facilitators to allow time for an orientation or “warm-up” period prior to the simulation and to plan realistic timeframes for students to accomplish the objectives of the simulation (Shearer & Davidhizar, 2003). The simulation experience should provide students an opportunity to learn time management that is appropriate for their knowledge, experience, and skill level (Bland, Topping, & Wood, 2011). Simulation should allow students the opportunity to develop elements of deliberate practice by allowing time for repetitive practice (Walton, Chute, & Ball, 2011) that specifically focuses on learner clinical improvement (Duvivier, Muijtens, Moulaert, van der Vleuten, & Scherpbier, 2011).

Simulation Design Characteristics. The *simulation design and characteristics* concept of the NLN/Jeffries Simulation Framework contains five components objectives/information, fidelity, problem-solving, student support, and reflective thinking (debriefing). According to Jeffries and Rogers (2012), the *objectives* of the simulation must reflect the intended outcomes, specify learner behaviors, and allow sufficient detail to allow the learner to participate effectively. In designing a simulation experience, *fidelity,* or how well the simulation experience mimics reality is an important consideration. Facilitators base the use of low, mid, or high-fidelity simulation upon the objectives of the simulation. In addition, facilitators consider more than just the fidelity of the manikin in the design of the simulation. Beaubien and Baker (2004) discuss utilizing three dimensions of fidelity as being the realism of equipment, the environment, and the psychological feel of the simulation (the degree to which the participant perceives the simulation to be realistic).

The complexity of simulation experiences should be designed to allow the learner to *problem solve* at an appropriate level for the knowledge and skill level of the learners. In designing a simulation, facilitators consider the method and amount of assistance or *support cues* that will be given to learners. For example, the facilitators may plan to utilize a senior nursing student acting as a confederate or helper to cue learners if they do not notice the simulated patient’s condition worsening after a certain pre-specified amount of time in designing a simulation experience for beginning nursing students.

The final component of the simulation design and characteristics concept of the NLN/Jeffries Simulation Framework is *reflective thinking* or debriefing. According to Jeffries and Rogers (2011), reflective thinking should occur directly after the simulation.

Facilitators watch the simulation, demonstrate competency in debriefing methods related to the objectives of the simulation, and provide a supportive debriefing environment that fosters self-analysis.

Outcomes. The final concept of the NLN/Jeffries Simulation Framework is *outcomes*. According to Jeffries and Rogers (2011), the outcomes of the simulation need to be established prior to having students participate in the simulation. The simulation outcomes can include knowledge, skill performance, learner satisfaction, critical thinking, and self-confidence. The proper tools or instruments to measure the outcomes should also be selected in advance.

Summary

In summary, theoretical frameworks are important in the planning and design of research studies because theories assist in organizing a study, defining variables, and anchoring the generation of new information in an existing body of knowledge. The two theories used in the design of this study are situated cognition and the NLN/Jeffries Simulation Framework. Situated cognition and the learning meta-theoretical concept discussed in this chapter provide context for the hypothesis that simulation is a more efficient way to learn for undergraduate nursing students than traditional clinical. The NLN/Jeffries Simulation Framework provides an organizational structure for the study design, including the selection and definition of variables.

CHAPTER III - METHODOLOGY

Chapter III presents the problem of interest, the purpose of this study, and explains the questions that this study sought to answer. Chapter III also establishes the significance of this study. In addition, this chapter will describe the design used for this study, the sampling methods, the instruments used to measure the study outcomes, and the statistical methods used in the analysis of the data.

Statement of Problem

The findings of the literature search indicate there is a lack of research and therefore insufficient knowledge regarding the outcomes of using varying replacement ratios when using simulated clinical experiences in place of traditional clinical time in pre-licensure nursing programs. To date, no comparison studies on the outcomes of utilizing 1:1 versus 1:2 replacement ratios for the simulation-to-traditional clinical time have been published. In addition, the literature search revealed that there have been no large-scale studies of simulation-to-traditional clinical replacement ratios other than 1:1.

Based on the results from the NCSBN National Simulation Study (Hayden et al., 2014), strong evidence supports pre-licensure nursing programs replacing traditional clinical time with time in simulated clinical experiences for up to 50% of traditional clinical hours if using a 1:1 replacement ratio. Multiple descriptive studies over the last seven years reveal great variability in pre-licensure nursing programs in the choice to replace traditional clinical hours with simulation hours, the percentage of traditional clinical hours that are replaced with time in the simulation laboratory, and the ratio of replacement time used when using time in simulated clinical experiences to replace time spent in the traditional clinical setting.

Statement of Purpose

The purpose of this comparative, descriptive, cross-sectional study is to explore the outcomes of utilizing different simulation-to-traditional clinical replacement ratios in pre-licensure nursing programs in the U.S. This study will also be used to form a hypothesis for further testing about the relationship between the concepts of:

- educational practices and student outcomes within the NLN/Jeffries Simulation Framework and
- learning activities and student knowledge outcomes as part of Situated Cognition.

The independent variable, which is replacement ratios for simulation-to-traditional clinical replacement time, was defined as the number of hours students spend in simulation versus how many hours of the traditional clinical time the students actually receive credit for attending. Specifically, a 1:1 simulation-to-traditional clinical replacement ratio is interpreted as the student attending 1 hour of simulation and receiving credit for attending 1 hour of traditional clinical. A 1:2 simulation-to-traditional clinical replacement ratio is interpreted as the student attending 1 hour of simulation and receiving credit for attending 2 hours of traditional clinical.

The dependent variable, which is outcomes, was defined as nursing knowledge and as successful attainment of licensure as a Registered Nurse in the U.S. Knowledge will be measured using the Adult Medical Surgical Proctored Assessment by Assessment Technologies, Inc. (ATI). Successful attainment of licensure as a Registered Nurse in the U.S. will be measured by a pass or fail score of the National Council Licensure Exam for Registered Nurses (NCLEX-RN) The extraneous independent variables of type of pre-

licensure nursing program, school size, student demographics, faculty demographics, and simulation design were addressed through inclusion and exclusion criteria, which will be further explained in the research sample and setting sections.

Research Questions

This study seeks to answer three questions:

1. Is there a difference in ATI scores between pre-licensure nursing students who experience a 1:1 replacement ratio of simulation-to-traditional clinical in comparison to pre-licensure nursing students that experience a 1:2 replacement ratio of simulation-to-traditional clinical?
2. Is there a difference in NCLEX-RN scores (i.e., pass or fail score) between pre-licensure nursing students who experience a 1:1 replacement ratio of simulation-to-traditional clinical in comparison to pre-licensure nursing students that experience a 1:2 replacement ratio of simulation-to-traditional clinical?
3. Does the program type (i.e., ADN or BSN) make a difference in ATI scores or NCLEX-RN pass scores between pre-licensure nursing students who experience a 1:1 replacement ratio of simulation-to-traditional clinical in comparison to the students experiencing a 1:2 replacement ratio?

Significance of the Study

The significance of this study was that it directly compared the outcomes of utilizing 1:1 versus 1:2 simulation-to-traditional clinical replacement ratios, thus, adding to the body of knowledge in nursing education regarding outcomes replacing traditional clinical with simulation. No other known published or unpublished research has directly

compared the outcomes of utilizing different simulation-to-traditional clinical replacement ratios. If the study results indicate that students may be able to spend less time in simulation than in clinical and meet the same learning outcomes, nursing programs have the potential to decrease the number of nursing faculty needed to teach the curriculum, increase the number of students admitted, and decrease the burden on traditional clinical settings.

The results of this research may be particularly interesting or helpful for individuals involved in planning how simulation is integrated and utilized in undergraduate nursing programs and individuals forming guidelines, rules, and regulations regarding the replacement of traditional clinical with simulation in pre-licensure nursing programs. Specifically, the results of this study may be particularly helpful to nurse and simulation educators in pre-licensure nursing programs, nursing program administrators, clinical consortium coordinators, hospital administrators, and members of state boards of nursing and other nursing education regulation organizations.

After the results of the NCSBN National Simulation Study, nursing faculty and administrators throughout the International Nursing Association for Clinical Simulation and Learning (INACSL) have posed questions about the recommended or standardized ratio of simulation replacement hours for traditional clinical (Rutherford-Hemming et al., 2016). Members of state boards of nursing and other state-based nurse governing bodies have reviewed the results of the NCSBN National Simulation Study and are forming policies, guidelines, or position statements regarding the replacement of traditional clinical with simulation in pre-licensure nursing programs within their individual states.

The Virginia Board of Nursing published a guideline that is one of the most restrictive and indicates that pre-licensure nursing programs in Virginia that intend to use simulation in the replacement of traditional clinical hours must utilize a 1:1 replacement ratio, that simulation must not replace more than 20% of the total traditional clinical hours, and simulation cannot replace more than 50% of clinical hours in any one clinical course (Virginia Board of Nursing Guidance Document 90-24, 2013). The Mississippi Institution of Higher Learning followed suit, and as of July 2017, require that accredited nursing programs in the State of Mississippi apply for approval to replace traditional clinical with simulation hours for any more than 25% of total clinical hours and that the simulation-to-traditional clinical replacement ratio be 1:1 (Mississippi Institution of Higher Learning, 2017).

The Arizona Board of Nursing published an advisory opinion on the use of simulation that indicates pre-licensure programs in Arizona may replace traditional clinical with simulation as long as programs meet certain conditions. Conditions that allow for the replacement of traditional clinical with simulation in Arizona are that simulation not be utilized to replace all of the traditional clinical hours, simulation not be used to replace any traditional clinical in clinical courses where there are 30 or less traditional clinical hours, and provided that rigorous guidelines are met. For example, the rigorous guidelines include that INACSL guidelines are followed, specific faculty to student ratio guidelines are met, and faculty training on simulation is provided (Arizona State Board of Nursing, 2015).

The Washington State Board of Nursing indicated that simulation may be used to replace of up to 50% of traditional clinical in LPN, RN, or RN to BSN programs

provided the programs meet a rigorous set of requirements. The requirements are having a simulation manager, adequately trained faculty, simulation budget, adequate facilities, simulation policies and procedures, and the ability to tie simulation to programmatic outcomes and submit an annual simulation report to the Washington State Nursing Commission (WAC 246-840-534, 2016). The Texas Board of Nursing published a guideline on the use of simulation that allows for the use of simulation as both classroom and traditional clinical hours and puts no limit on the number or percentage of replacement (Texas Board of Nursing, 2015).

Ohio allows for the most liberal use of simulation. In Ohio, nursing programs are allowed to replace up to 100% of pediatric and obstetric clinical hours with simulated clinical experiences provided that a list of requirements are met. The requirements for simulation replacement of traditional pediatric clinical in Ohio are the faculty or teaching assistant utilizes a computer technology specialist to operate the simulator's computer; have demonstrated knowledge and skills from a recognized simulation "body of knowledge;" demonstrate continuing education in simulation; and maintain documentation that they meet the skills, knowledge, and abilities to conduct simulation experiences (OAC 4723-5-13, 2017).

Making evidence-based decisions when integrating simulation into undergraduate nursing curricula to provide relevant and quality instruction to future nurses is important. Currently, not enough evidence exists in the literature about the outcomes of utilizing simulation-to-traditional clinical replacement ratios other than 1:1 for undergraduate nursing administrators, faculty, and simulation staff to make informed decisions about what replacement ratio to utilize. The results of this study on the outcomes of utilizing

1:1 versus 1:2 simulation-to-traditional clinical replacement ratios in pre-licensure nursing programs will help guide the decisions of members of state boards of nursing, administrators of pre-licensure nursing programs, nurse educators in pre-licensure nursing programs, clinical consortium coordinators, and other traditional clinical site administrators on the use of simulation to replace traditional clinical hours.

Population and Sample

The population for this study was all of the nursing students in pre-licensure ADN and BSN programs in the U.S. The sampling plan utilized a convenience sample of nursing students selected from all of the nationally accredited pre-licensure ADN and BSN programs in the U.S. who met the following inclusion criteria.

- Students must have taken a medical-surgical nursing course in the second year or final year of their nursing curriculum during the 2016 to 2017 academic year.
- Students must have graduated from their nursing program by June 2017.

Inclusion criteria were sent in recruitment emails inviting participation in this study and the main contact at each research site was responsible for selecting students who met the inclusion criteria. Participants were excluded from the study if they were in an accelerated BSN program or degree-completion students, such as RN to BSN students. The researcher followed up with the main contact at each research site to ensure that participants did meet inclusion criteria and did not meet exclusion criteria.

Research Setting

The research setting for this study was four-year universities and community colleges that had pre-licensure nursing programs. The inclusion and exclusion criteria for

the research sites were used to control for extraneous variables. The inclusion criteria for the study sites were:

- nationally accredited ADN or BSN program by the Accreditation Commission on Education in Nursing (ACEN) or the Commission on Collegiate Nursing Education (CCNE),
- use of the ATI Adult Medical Surgical Proctored Assessment,
- use of 10% to 25% replacement of traditional clinical with simulation in the adult medical-surgical course during the final year of nursing coursework,
- use of either a 1:1 or 1:2 replacement ratio for simulation time to traditional clinical time in the second-year or senior-level adult medical-surgical course,
- simulation program existence for a minimum of two years,
- simulation program is based on concepts of the NLN/Jeffries Simulation Framework, or the framework concepts are easily identifiable in the simulation program, and
- geographically diverse sites.

The exclusion criteria for research sites were Diploma-only nursing programs, accelerated BSN-only programs, and RN to BSN-only programs.

A few assumptions were made about the participants in this study by using these inclusion criteria. It is assumed that ADN and BSN programs with accreditation in good standing with ACEN or CCNE have comparable medical-surgical course and clinical curriculum and have NCLEX pass rates at or above the national level. It is also assumed in this study that by using the NLN/Jeffries Simulation Framework or by incorporating the INACSL Standards of Practice: Simulation™ that study sites had simulation faculty

and/or staff that had received training in simulation teaching methodology and debriefing techniques.

The reason for requiring research sites to have 10 to 25% simulation is because students receiving 10 to 25% of simulation in replacement of traditional clinical showed no significant difference in ATI scores in the NCSBN National Simulation Study but those participants receiving 50% replacement of traditional clinical with simulation had significantly higher scores on the ATI exams (Hayden et al., 2014). Study sites were required to have a simulation program in existence for 2 years to ensure that the simulation program has had the time to establish a quality program. The Society for Simulation in Healthcare (SSH) has designated that new simulation programs typically take about 18 months to establish quality simulated clinical experiences and a fully operational simulation program (SSH, 2017). Simulation programs must have been in existence for 2 years before they are eligible to apply for accreditation for SSH; however, SSH accreditation was not required for inclusion in this study due to the fact that SSH accreditation is not required in the U.S. nor does the absence of SSH accreditation indicate a poor-quality simulation program.

An explanation of the inclusion and exclusion criteria for this study was sent in recruitment emails for participation in this study. The main contact at each site was initially responsible for self-selecting participants based on the listed criteria. The researcher followed up with the main contact at each research site using a checklist (Appendix B) to ensure that participating sites met inclusion criteria and did not meet exclusion criteria. Much of the inclusion criteria were also validated by the researcher using publicly accessible websites such as the ACEN or CCNE website to assess ACEN

or CCNE accreditation and each participating site's website for NCLEX pass rates and accreditation status.

Research Procedures

Sample

A publicly-available list of all of the nationally accredited ADN and BSN (N = 1,535) programs was obtained from the ACEN and CCNE websites. An email was sent to each individual that was listed as the main contact for each accredited school on the ACEN or CCNE website. The email invited the college of nursing, school of nursing, or nursing program to participate in the study if they met the inclusion criteria for the study. Additional emails were sent to ensure an adequate number of participants were achieved for the study. Participation in this study was also advertised and encouraged through nursing education listservs and professional simulation groups such as the Pacific Northwest Healthcare Simulation Collaborative, INACSL and SSH.

Out of 1,535 total ACEN or CCNE accredited nursing programs, contacts from 246 programs of nursing responded to the email recruiting participation in this study. Main contacts for each nursing program were typically deans, associate deans, directors, or simulation administration or faculty. Of the 246 nursing program contacts that responded, 221 declined participation in this study and 25 expressed interest in participating. Of the 25 main contacts that expressed interest in having their schools participate in this study, nine completed the screening process of the Checklist for Meeting Inclusion Criteria (Appendix B). The reasons given for declining participation in the study were that the main contact did not believe their nursing program met the

inclusion criteria, did not feel that they had the time to participate in the study, and some did not provide a reason for not participating in the study.

This researcher continued to recruit nursing programs as research sites for one year and sent a minimum of three follow-up emails to all 25 main contacts who expressed an interest in participating in the study. By the end of the first year of recruitment, a total of four main contacts at nursing programs had both agreed to participate as research sites and had sent research data to be used in this study. At the end of the first year of recruitment, this study lacked participants from BSN programs that had a 1:1 simulation-to-traditional clinical replacement ratio and ADN programs that had a 1:2 simulation-to-traditional clinical replacement ratios. Additional efforts were made to recruit participating nursing programs via follow-up emails and phone calls to the 25 contacts that had expressed interest in becoming a participating research site and/or had completed the Checklist for Meeting Inclusion Criteria (Appendix B). The additional recruiting period resulted in two additional participating nursing programs; thus, a total of six contacts from nursing programs sent the data required to participate in the study.

A power analysis was conducted to determine the appropriate sample size. The NCSBN National Simulation study set a precedent for an appropriate effect size of d = 0.35 for studies regarding different amounts of simulation and a power of 0.92. Using an effect size of d = 0.35, a two-tailed alpha of α =0.05 and a power of 0.90, a minimum sample total of N = 360 students were needed for this study. The total number of participants in this study was N = 878. Thus, the actual sample size for this study exceeded the minimum number required to achieve the desired level of power.

Human Subjects

This study was consistent with the policies of the Institutional Review Board (IRB) at The University of Southern Mississippi (USM) for expedited research. IRB approval was granted for this study (Appendix C) by the USM IRB prior to the collection of data (Protocol number: 17062606). IRB or College Administration approval was also gained at each institution that participated in this study and that required an internal review process for external research studies. Participating colleges were provided with a copy of the USM IRB Approval Letter and some colleges accepted that approval letter without the need for their own internal review process. Despite active recruiting methods by the researcher during the period of approval for the study, there was a lack of participants. The researcher applied for and was granted an IRB Renewal (Appendix D) in order to have time to recruit more participants (Protocol number: R17062606). Study participants experienced their existing curriculum approved by their school, college, state board of nursing, or institute of higher learning with no external manipulation or changes from this researcher.

Data Collection Instruments

Two instruments were used to measure the outcomes of this study — the ATI Adult Medical-Surgical Nursing Proctored Assessment and the NCLEX-RN™. The outcome of knowledge was measured using the ATI Adult Medical-Surgical Nursing Proctored Assessment. The ATI Adult Medical-Surgical Nursing Proctored Assessment is a 90-item standardized test designed to assess content mastery of adult medical-surgical nursing and examines specific areas addressed in the test plan for the national licensure exam for registered nurses. The items are delivered on a computer platform and

are mostly multiple-choice, but there are also some alternative format questions such as point-and-click “hot spot” items using diagrams or pictures, ordered response, fill-in-the-blank calculations, and multiple-response items where more than one answer is correct. Many schools and colleges of nursing use the Adult Medical Surgical Proctored Assessment as part of ATI’s Content Mastery Series, which is designed to help nursing students successfully prepare to pass the NCLEX-RN. The Adult Medical Surgical Proctored Assessment score is reported as a percentage between 0 to 100%. ATI also reports national data available on the mean scores and percentiles on the Adult Medical Surgical Proctored Assessment for ADN students (68.9%), BSN students (67.6%), Diploma students (not included in this study) (65.3%), and all pre-licensure nursing students together (68.3%) (ATI, 2016).

The ATI Adult Medical Surgical Proctored Assessment scoring is further broken down into proficiency levels that were determined using expert nurse educators in a cut score study (ATI, 2016). Achieving a Level 1 Proficiency Score (56.7 to 67.8%) indicates that a student has met the minimum expectations for knowledge content in the adult medical-surgical content area and is likely to just meet NCLEX-RN standards. ATI suggests that students who score in the Level 1 Proficiency range develop a rigorous plan to gain a better grasp of the knowledge required to pass the Adult Medical Surgical content on the NCLEX-RN. The Level 2 Proficiency Score (68.9 to 80.0%) indicates that the student has exceeded the minimum expectations for mastery of content in adult medical-surgical nursing and is fairly certain to meet NCLEX-RN standards. ATI advises students that fall into the Level 2 Proficiency category to continue a focused review to improve their knowledge of adult medical-surgical nursing prior to taking the NCLEX-

RN. The Level 3 Proficiency Score (81.1 to 100.0%) indicates that a student has exceeded most expectations for content mastery adult medical-surgical nursing and will most likely exceed NCLEX-RN standards. ATI recommends that students scoring in the Level 3 Proficiency range continue to review adult medical-surgical nursing content to maintain and improve knowledge in this content area. The gaps in the percentages between cut scores for the proficiency levels are due to mathematical impossibilities for a subject to receive such a score based on the 90-item assessment.

Successful attainment of licensure as an RN was measured using the pass or fail score on the NCLEX-RN®. The NCLEX-RN® is the national licensure exam that all successful graduates of pre-licensure nursing programs must take in order to receive licensure as an RN in the U.S. The exam is designed to measure minimum knowledge, skills and abilities to deliver safe and effective nurse care as an entry-level (NCSBN, 2015). The NCLEX-RN® is a computer adaptive test (CAT) meaning that it is unique for each participant using computer technology and measurement theory. Items on the exam are leveled in terms of difficulty. If the candidate answers an item correctly, the software gives the candidate a more difficult question. If the candidate answers an item incorrectly, the software gives the candidate an easier question until a minimum threshold is met for a pass or fail decision on meeting the minimum level of competency for an entry-level nurse. A candidate receives a minimum of 75 items and a maximum of 265 questions. The majority of items are multiple choice, but there are also alternative item formats such as the point-and-click "hot spots" on pictures or diagrams, fill-in-the-blank calculations, ordered response, and multiple response (NCSBN, 2015). NCLEX-RN® results (pass or fail) are communicated to the state board of nursing for each candidate.

Each state board of nursing has developed their own procedure to communicate NCLEX-RN results with candidates, but candidates usually receive their results within 6 weeks of the candidate's completion of the exam.

Data Collection Procedure

Data were collected from the six participating schools and colleges of nursing after IRB approval at the researcher's institution and the institution of each participating site. A representative from each school was chosen as the main contact with the researcher of this study. Research sites self-selected based on inclusion and exclusion criteria in the email sent out soliciting research participation. The main contact at each research site was emailed or called by the researcher to ensure inclusion criteria were met and no criteria existed that would exclude the potential research site. The main contact at each research site was asked to send the following research data from 2016 to 2017 academic school year for the participating students through a password-protected email: aggregated and de-identified demographic data (i.e., gender, age, and ethnicity/race), de-identified ATI Adult Medical Surgical Proctored Assessment scores, and NCLEX pass results for the participating students graduating in the 2016 to 2017 academic school year. Information about the school's size, public or private status, and urban or rural location was gathered by the researcher from the website of the participating research site in order to ensure that there was heterogeneity in the sample and also comparable research sites in all study groups (i.e., ADN 1:1 simulation-to-traditional clinical replacement ratio; ADN 1:2 simulation-to-traditional clinical replacement ratio; BSN 1:1 simulation-to-traditional clinical replacement ratio; and BSN 1:2 simulation-to-traditional clinical replacement ratio).

Data Analysis Procedure

IBM SPSS® version 25 was utilized to analyze all research data. Descriptive statistics were run on all data. In this study, there were two research groups and three dependent variables. The independent variable was the replacement ratio of simulation-to-traditional clinical (i.e., either a 1:1 or 1:2 simulation-to-traditional clinical replacement ratio). Thus, the two research groups were: (1) pre-licensure nursing students who experienced a 1:1 simulation-to-traditional clinical replacement ratio (i.e., the 1:1 study group); and (2) pre-licensure nursing students who experienced a 1:2 simulation-to-traditional clinical replacement ratio (i.e., the 1:2 study group). Three dependent variables were analyzed—ATI Adult Medical Surgical Proctored Assessment scores, which are reported on a scale of 0 to 100% (ratio); NCLEX pass scores, typically reported as pass or fail (nominal); and program type, BSN or ADN (nominal). A two-way ANOVA was utilized to analyze any differences in ATI Adult Medical Surgical Proctored Assessment scores between the study groups and to test if program type (BSN or ADN had any influence on ATI Adult Medical Surgical Proctored Assessment scores. Chi-Square was used to analyze the relationship between simulation-to-traditional clinical replacement ratio and NCLEX pass scores. This researcher had planned to utilize a *t*-test to analyze any differences in NCLEX pass rates, usually reported in percentages of 0 to 100% between study groups, but due to the small $N = 6$ of participating nursing programs, a t-test was not performed as results would have low statistical power.

Summary

In summary, the purpose of this study was to explore the outcomes of utilizing different simulation-to-traditional clinical replacement ratios in pre-licensure nursing

programs in the U.S. This comparative, descriptive, cross-sectional study sought to find if there was any difference in knowledge attainment using the ATI Adult Medical Surgical Proctored Assessment scores between pre-licensure nursing students that experienced a simulation-to-traditional clinical replacement ratio of 1:1 (1 hour of simulation to replace 1 hour of traditional clinical) compared to students that experienced a replacement ratio of 1:2 (1 hour of simulation to replace 2 hours of traditional clinical). This study also examined if any correlation existed between simulation-to-traditional clinical replacement ratio and successful attainment of RN licensure using NCLEX-RN® pass scores. In addition, this study examined if program type (ADN or BSN) had any effect on knowledge using ATI Adult Medical Surgical Proctored Assessment scores or successful attainment of RN licensure using NCLEX-RN® pass scores. A power analysis determined that an $N = 360$ participants were needed for this study. Participants ($N = 847$) were recruited from the 1,535 ACEN and CCNE accredited pre-licensure programs across the U.S. after IRB approval from USM. Main contacts from six nursing programs in six different states self-selected and participated in this study based on meeting a set of inclusion criteria. Main contacts from each research site sent deidentified demographic data, ATI Adult Medical Surgical Proctored Assessment scores, and NCLEX-RN® scores to the researcher. This researcher used IBM SPSS® version 25 to analyze all research data. The significance of this study is that no other published or unpublished research has directly compared the outcomes of utilizing different simulation-to-traditional clinical replacement ratios.

CHAPTER IV – FINDINGS

Chapter IV presents the findings of this study. This chapter will provide the descriptive statistics of the research sites and the participants in this study. The statistical analysis and results will be presented and explained for each research question.

This study compared the outcomes of using different ratios of replacement time when using simulation as a substitution for clinical hours in pre-licensure nursing programs. Specifically, this study compared the outcomes of pre-licensure nursing students that experienced a replacement ratio of 1 hour of simulation in substitution for 1 hour of traditional clinical to students that experienced a replacement ratio of 1 hour of simulation for every 2 hours of traditional clinical for 10 to 25% of their senior or second-level Adult Medical-Surgical Clinical course. To provide a clear picture of the differences between study groups, here is an example of how the students in each study group might have experienced clinical based on the inclusion criteria. Let us imagine there are two participating nursing programs, one in each study group. Each example participating program has 100 hours of Adult Medical Surgical clinical hours in their senior-level Adult Medical Surgical coursework. Those 100 clinical hours are spread over 10 weeks. Each participating nursing program has decided to replace 10 to 25% (10 to 25 hours) of traditional clinical hours with time in simulation. In this fictitious example:

- Study group 1 (1:1 simulation-to-traditional clinical ratio replacement ratio) would have spent 10 to 25 hours in simulation to replace the 10 to 25 hours of traditional clinical and

- Study group 2 (1:2 simulation-to-traditional clinical ratio replacement ratio) would have spent 5 to 12.5 hours in simulation to replace the 10 to 25 hours of traditional clinical.

This study compared ATI Adult Medical Surgical Proctored Assessment Scores and NCLEX-RN pass or fail scores to answer the three study questions:

1. Do ATI Adult Medical Surgical Proctored Assessment scores differ between students that receive 1:1 replacement of simulation-to-traditional clinical time and students that receive 1:2 replacement of simulation-to-traditional clinical time?
2. Do NCLEX pass/fail scores differ between students that receive 1:1 replacement of simulation-to-traditional clinical time and students that receive 1:2 replacement of simulation-to-traditional clinical time?
3. Does the program type (i.e., ADN or BSN) make a difference in ATI scores or NCLEX-RN pass scores between pre-licensure nursing students who experience a 1:1 replacement ratio of simulation-to-traditional clinical in comparison to the students experiencing a 1:2 replacement ratio?

Descriptive Statistics

Research Sites

Six total nursing programs across the U.S. participated in this study. The participating research sites were primarily colleges with ADN programs (*N* = 4) broken down into the following study groups: BSN program with a 1:1 simulation-to-traditional clinical replacement ratio (*n* = 1); BSN program with a 1:2 simulation-to-traditional clinical replacement ratio (*n* = 1); ADN program with a 1:1 simulation-to-traditional

clinical replacement ratio (n = 3); and ADN program with a 1:2 simulation-to-traditional clinical replacement ratio (n = 1). The research sites were from geographically diverse areas of the U.S. (Figure 2).

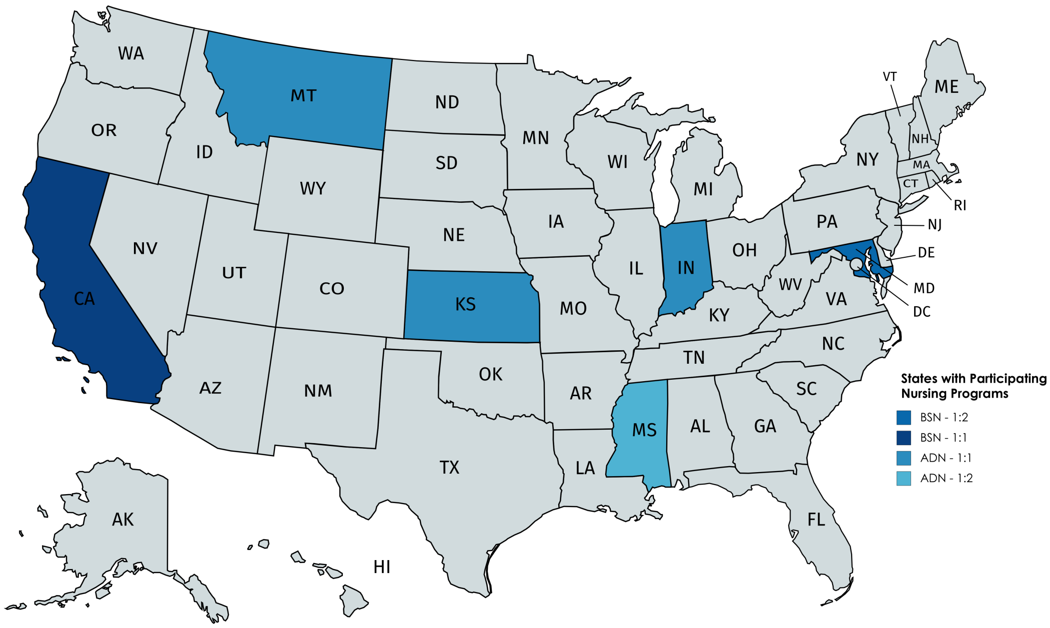

Figure 2. States with Nursing Programs that Served as Research Sites in this Study

The sample for this study came from nursing programs in six states. (i.e., California – BSN program with a 1:1 simulation-to-traditional clinical replacement ratio; Maryland – BSN program with a 1:2 simulation-to-traditional clinical replacement ratio; Indiana, Kansas, and Montana with ADN programs with 1:1 simulation-to-traditional clinical replacement ratios; and Mississippi – ADN with a 1:2 simulation-to-traditional clinical replacement ratio).

The participating schools that served as research sites for this study were primarily public n = 4, rural n = 3 (urban n = 2, suburban n = 1), and had a total student enrollment of fewer than 5,000 students annually n = 3 (Figure 3). The universities and colleges that participated in this study had a wide range of numbers of nursing students they graduated annually (n = 21-30, n > 200), but the majority graduated an average of n

< 140 pre-licensure nursing students per year (Figure 4). The participating nursing programs had simulation programs in existence for a minimum of 3 years and a maximum of 10 years with an *M* = 6.67 years (Figure 5). All participating research sites reported replacing between 10 to 25% of their total clinical hours with simulation in their second-year or senior-level adult medical-surgical. A total of 3 research sites replaced between 20 to 25% of adult medical-surgical clinical with simulation. One research site reported that they replaced 10 to 15 % of traditional clinical with simulation and one research site reported replacing 11 to 25 % of traditional clinical with simulation.

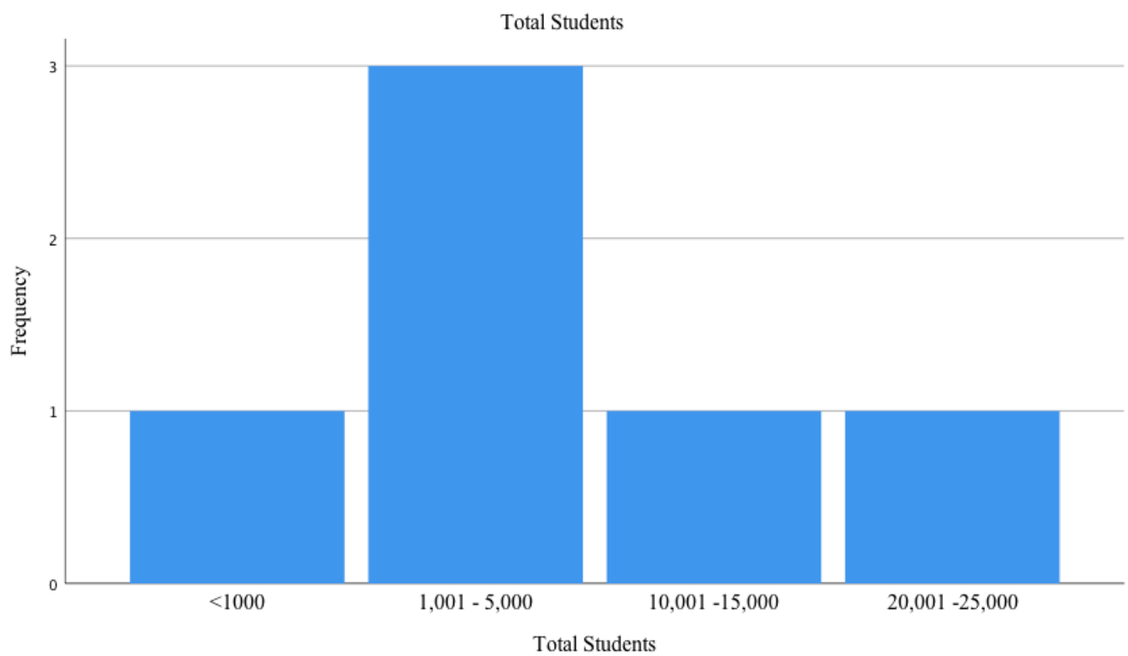

Figure 3. Total Annual Student Enrollment at Participating Universities and Colleges

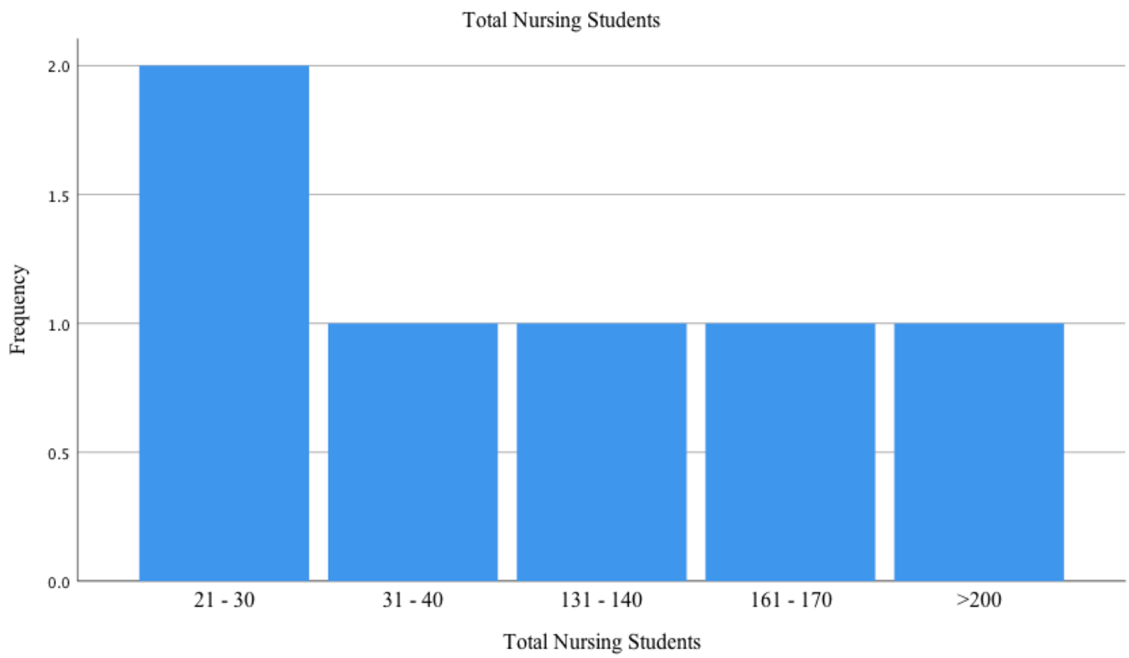

Figure 4. Total Average Annual Graduation of Pre-licensure Nursing Students

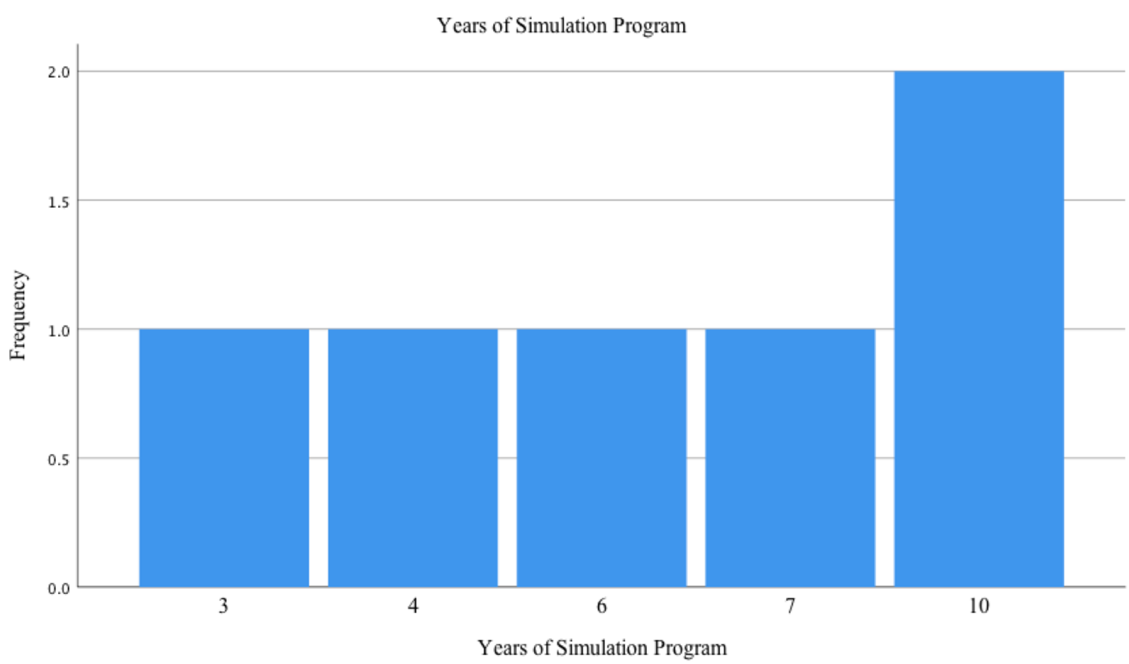

Figure 5. Years of Simulation Program Existence

An inclusion criterion for participation in this study was that nursing programs must have had simulation programs in existence for ≥ 2 years. The mean years of simulation program existence for participants in this study were 6.67 years.

Study Sample

The total number of participants in this study was *N* = 878. The sample was relatively representative of the characteristics of the nursing students in the U.S. when compared to the most recent national data collected by the National League for Nursing (2016) in their Biennial Survey of Nursing Schools. There were *N* = 831 participants that provided demographic data. The majority of participants in this study were female (78.6%; *n* = 690) and Caucasian (46.5%; *n* = 386). Participants in this study ranged from 20 to 70 years of age with an average age of 29.62 years. Each research site reported the ethnicity of participating students using their own unique ethnic categories, so those were preserved in the analysis of the study sample demographics (Table 2). The majority of participants in this study were Caucasian (46.5%) followed by Asian or Pacific Islander (15.5%). Not all participants reported their demographic data.

Table 2

Ethnicity of the Sample

Ethnicity					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	White	386	46.5	48.0	48.0
	Black- African American	51	6.1	6.3	54.3
	Asian or Pacific Islander	129	15.5	16.0	70.3
	Hispanic	92	11.1	11.4	81.7
	Middle Eastern	2	.2	.2	82.0
	Indian	1	.1	.1	82.1
	Cuban	1	.1	.1	82.2
	Turkish	1	.1	.1	82.4
	Hawaiian or other Pacific Islander	6	.7	.7	83.1
	Other	1	.1	.1	83.2
	Non-resident Alien	2	.2	.2	83.5
	Multiracial	22	2.6	2.7	86.2
	American Indian or Alaska Native	1	.1	.1	86.3
	Filipino	110	13.2	13.7	100.0
	Total	805	96.9	100.0	
Missing		26	3.1		
Total		831	100.0		

When compared to the national data, this study sample had a slightly higher percentage of male nursing students (21.1%, *n* = 185) and a much higher percentage of Asian or Pacific Islander students (15.5%; *n* = 129) than the general pre-licensure nursing student population (Male = 15%; Asian or Pacific Islander = 5.5%) (NLN, 2016). Of

note, if participants who identified their ethnic group as “Filipino” and as “Hawaiian or other Pacific Islander” were added to the ethnic group labeled “Asian or Pacific Islander,” 29.4% of participating students were actually identified as Asian or Pacific Islander. Likely the large percentage of Asian participants is due to the considerable number of participants who were from the state of California (n = 469) where immigration from Asia and the Pacific Islands is more prevalent.

The study groups varied widely in size with N = 680 students experiencing a 1:1 simulation-to-traditional clinical replacement ratio and N = 198 students experiencing a 1:2 simulation-to-traditional clinical replacement ratio (Table 3). The larger number of students experiencing a 1:1 simulation-to-clinical replacement ratio (77.4%; N = 680) in this study is consistent with the findings of previous studies that indicate the 1:1 simulation-to-clinical replacement ratio is the most frequently used clinical replacement ratio in the U.S. and ranges from 60 to 83% nationally (Breymier et al., 2015; Hayden 2010).

Table 3

Demographics of Participants by Study Group and Pre-licensure Program Type

	BSN	*ADN*	*Total*
1:1 Study Group	460	211	680
1:2 Study Group	38	160	198
Total	507	371	878

N = 878 participants in this study. 45 participants had missing ATI Adult Medical Surgical Proctored Assessment scores. 31 participants had missing NCLEX-RN scores.

The study groups also varied in gender (Figure 6) and ethnicity (Figure 7), again likely due to the states and programs (ADN or BSN) from where the participants

originated. The study group that experienced a 1:2 simulation-to-traditional clinical replacement ratio had a higher percentage of female participants (86%; *N* = 130) than the group that experienced a 1:1 simulation-to-traditional clinical replacement ratio (75.7%; *N* = 514). The study groups will be referred to as the 1:1 Study Group and the 1:2 Study Group moving forward for ease in the readability of this report.

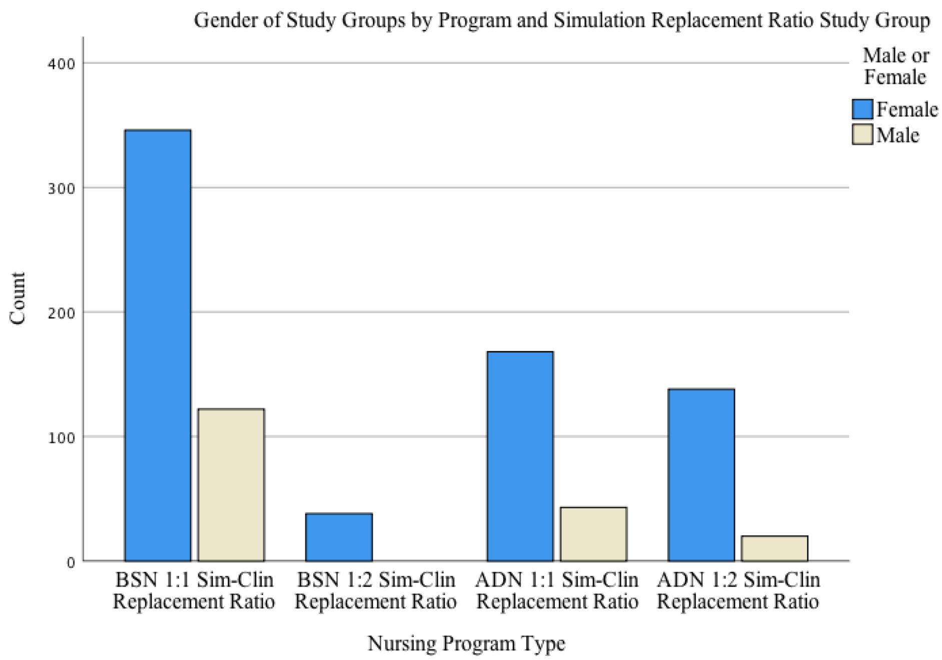

Figure 6. Gender of Study Groups by Program and Simulation Group

Both study groups had a majority of Caucasian participants (1:1 Study Group 43.9%, *n* = 287; 1:2 Study Group 65%, *n* = 99) and had roughly similar percentages of participants reporting to be Multiracial (1:1 Study Group 2.6%; *n* = 17; 1:2 Study Group 3.3%, *n* = 5). The 1:1 Study Group had a higher percentage of Asian or Pacific Islander participants (37.2 %; *n* = 243) and Hispanic participants (13.5%; *n* = 88), than the 1:2 Study Group (Asian or Pacific Islander 1.3%, *n* = 2; Hispanic 2.6%, *n* = 4). The 1:2 Study Group had a higher percentage of Black-African American participants (23.8%; *n*

= 36) when compared to the 1:1 Study Group (2.3%; *n* = 15). The differences between the study groups are again likely due to the population-based differences of the states and programs (ADN or BSN) from where the participants originated (Figure 2).

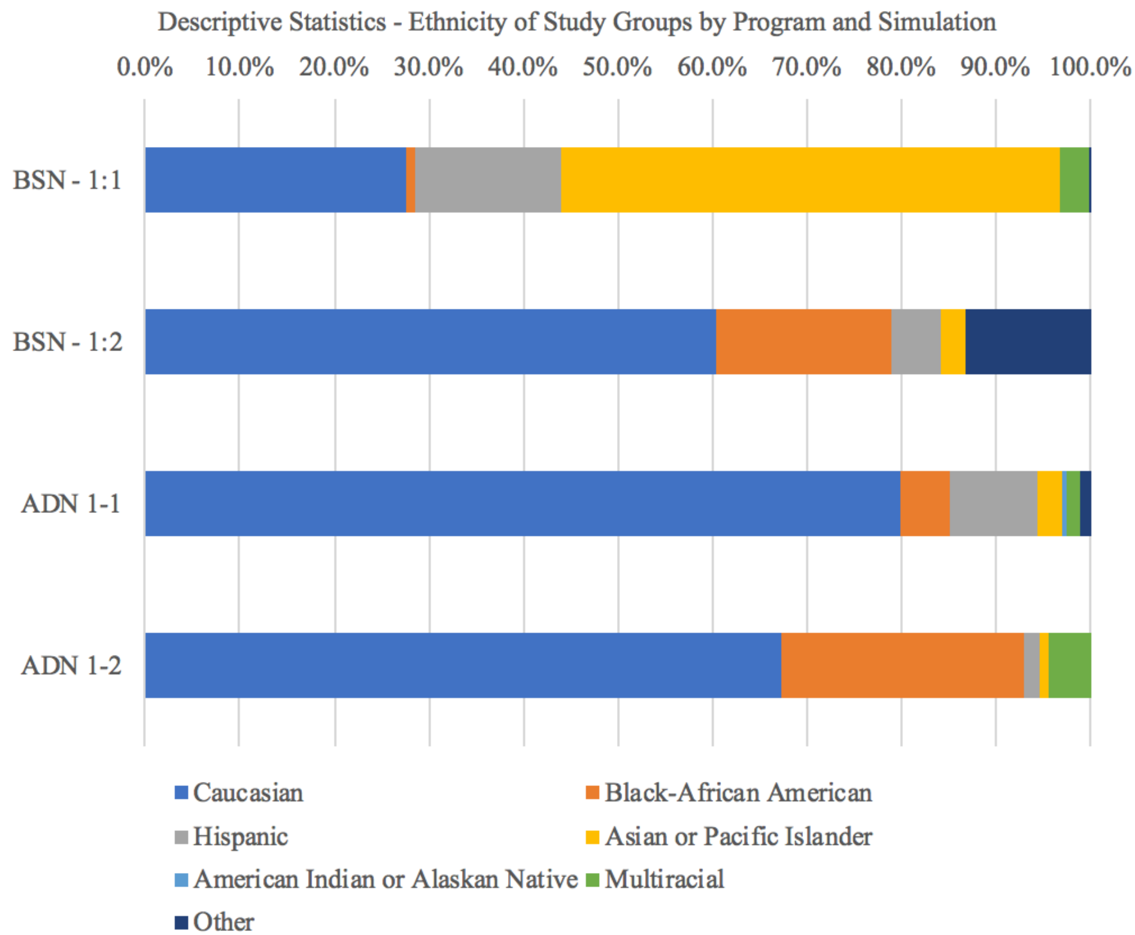

Figure 7. Ethnicity of Study Groups by Program and Simulation

The NLN (2016) reported that the percentages of minority groups in pre-licensure nursing programs in the U.S. were as follows: Black/Non-Hispanic 10.8%, Hispanic 8.1%, Asian or Pacific Islander 5.5%, American Indian 0.7%, and Other/Missing/Unknown 4.5%. Overall the sample for this study is relatively representative of the general population of pre-licensure nursing students in the U.S.

when compared to NLN data with the exceptions of this study having a higher percentage of males, Asian or Pacific Islanders, and less Black-African Americans.

There were *N* = 648 students in the study group with reported ATI Adult Medical Surgical Proctored Assessment Scores that experienced a 1:1 simulation-to-traditional clinical replacement time ratio and *N* = 185 students that experienced a 1:2 simulation-to-traditional clinical replacement time ratio. Of the total participants (*N* = 833) in this study that had reported ATI Adult Medical Surgical Proctored Assessment scores *N* = 488 were from pre-licensure BSN programs and *N* = 345 were from pre-licensure ADN programs. A further breakdown of the number of BSN and ADN students in each study group is provided in Table 4.

Table 4

Number of Participants with ATI Scores by Study Group and Pre-licensure Program

Number of Participating Students with ATI Adult Medical Surgical Proctored Assessment Scores by Study Group and Pre-licensure Program Type			
	BSN	ADN	Total
1:1 Study Group	450	198	648
1:2 Study Group	38	147	185
Total	488	345	833

Overall the students in the 1:1 simulation-to-traditional clinical time replacement ratio group had the highest numerical mean score on the ATI Adult Medical Surgical Proctored Assessment (*M* = 71.12, *SD* = 7.92) when compared to the students in the 1:2 simulation-to-traditional clinical time replacement ratio group (*M* = 69.36, *SD* = 7.48) (Table 5). In addition, the BSN students scored numerically higher (*M* = 71.17, *SD* =

7.97) when compared to the ADN students (*M* = 70.10, *SD* = 7.67). The BSN students that experienced a 1:1 simulation-to-traditional clinical replacement ratio had the highest numerical mean ATI Adult Medical Surgical Proctored Assessment score (*M* = 71.49, *SD* = 7.98). The BSN students that experienced a 1:2 simulation-to-traditional clinical replacement ratio had the lowest numerical mean ATI Adult Medical Surgical Proctored Assessment score (*M* = 67.35, *SD* = 6.78).

Table 5

Descriptive Statistics for ATI Adult Medical Surgical Proctored Assessment Scores

	BSN	*ADN*	*Overall*
1:1 Study Group	*M* = 71.49 *SD* = 7.98 *n* = 450	*M* = 70.26 *SD* = 7.74 *n* = 198	*M* = 71.2 *SD* = 7.92 *N* = 648
1:2 Study Group	*M* = 67.35 SD = 6.78 *n* = 38	*M* = 69.88 *SD* = 7.58 *n* = 147	*M* = 69.36 *SD* = 7.48 *N* = 185
Overall	*M* = 71.17 *SD* = 7.97 *N* = 488	*M* = 70.1 *SD* = 7.67 *N* = 345	

The national mean score overall for the ATI Adult Medical Surgical Proctored Assessment was *M* = 68.9; for BSN students *M* = 67.6; and for ADN students *M* = 68.9 (ATI, 2016).

Both study groups had ATI Adult Medical Surgical Proctored Assessment mean scores that fell within the ATI Content Mastery Series (2016) Level II proficiency cut score (68.9 to 80.0%), meaning that on average, both study groups were considered to exceed minimum expectations for content knowledge in adult medical-surgical nursing and would be fairly likely to pass the NCLEX RN™ standards in adult medical-surgical nursing. Both study groups also had mean scores on the ATI Adult Medical Surgical

Proctored Assessment that were above the national reported mean published by ATI (*M* = 68.3%). The ADN students in both study groups had ATI Adult Medical Surgical Proctored Assessment mean scores above the national reported mean scores for ADN programs (*M* = 68.9). The BSN students in the 1:2 simulation-to-traditional clinical replacement ratio study group were the only students with a mean score (*M* = 67.35) on the ATI Adult Medical Surgical Proctored Assessment that fell below both the overall national mean score (*M* = 68.9) and for BSN students (*M* = 67.6) (ATI, 2016).

This study had a total of *N* = 847 students with reported NCLEX pass or fail scores. The study group that experienced a 1:1 simulation-to-traditional clinical replacement ratio (*N* = 673) had the numerically highest percentage of NCLEX pass scores at 95.1%. The BSN students (*N* = 506) in this study had a higher numerical percentage of NCLEX pass scores (95.1%) than the ADN students (*N* = 341, 94.4%). Table 6 displays the complete descriptive statistics for NCLEX pass rates in this study.

Table 6

Descriptive Statistics for NCLEX Pass Scores

	BSN	*ADN*	*Overall*
1:1 Study Group	*95.3%*	*94.6%*	*95.1%*
1:2 Study Group	*92.1%*	*94.1%*	*93.7%*
Overall	*95.1%*	*94.4%*	

Testing Research Question 1

Research question one was: do ATI Adult Medical Surgical Proctored Assessment scores differ between students that receive 1:1 replacement of simulation-to-traditional

clinical time and students that receive 1:2 replacement of simulation-to-traditional clinical time? The pre-licensure nursing group that received a 1:1 replacement ratio of simulation-to-traditional clinical time ($N = 648$) was associated with an ATI Adult Medical Surgical Assessment score $M = 71.12$ ($SD = 7.92$). In contrast, the pre-licensure nursing group that received a 1:2 replacement ratio of simulation-to-traditional clinical time ($N = 185$) was associated with a numerically smaller ATI Adult Medical Surgical Proctored Exam score $M = 69.36$ ($SD = 7.48$).

In this study, there were numerically different mean ATI Adult Medical Surgical Assessment scores between the study groups. It is understood that pre-licensure nursing program type (BSN or ADN) may also have an effect on ATI Adult Medical Surgical Proctored Assessment scores. A two-way analysis of variance was used to test the hypothesis that different simulation-to-traditional clinical replacement ratios and/or pre-licensure nursing program type may be associated with differences in ATI Adult Medical Surgical Proctored Assessment Scores. The effect of the interaction between the pre-licensure nursing program type and the simulation-to-traditional clinical replacement group will be discussed in answer to question 3.

Table 7

Levene's F Test for Equality of Error Variances

Levene's Test of Equality of Error Variances[a,b]					
		Levene Statistic	df1	df2	Sig.
ATI Med-Surg Score	Based on Mean	.316	3	829	.814
	Based on Median	.363	3	829	.760
	Based on Median and with adjusted df	.363	3	820.776	.780
	Based on trimmed mean	.326	3	829	.807

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: ATI Med-Surg Score

b. Design: Intercept + Replacement + Program + Replacement * Program

The assumption of homogeneity of variances was tested and satisfied using Levine's *F* Test for Equality of Variances $F(829) = .316$, $p = .814$ (Table 7). The two-way analysis of variance showed that the replacement ratio of simulation-to-traditional clinical (1:1 versus 1:2) had a significant main effect $F(1, 829) = 8.37$, $p = .004$, partial $\eta^2 = .01$, observed power = .824 (Table 8). A 1:1 simulation-to-traditional clinical replacement time ratio was associated with a significantly higher mean score on the ATI Adult Medical Surgical Proctored Assessment. This statistically significant difference in ATI Adult Medical Surgical Proctored Assessment mean scores, however, does not have meaningful clinical significance in nursing education. The mean scores of both study groups fall within the Level II proficiency cut score (68.9 – 80.0) which means that on average both students in the 1:1 and 1:2 simulation-to-traditional clinical replacement ratio groups were likely to exceed minimum competency in adult medical-surgical

nursing (ATI, 2016). The $\eta^2 = .010$ for the simulation replacement ratio and can be interpreted that 1% of the variability in ATI Adult Medical Surgical Proctored Assessment scores can be explained by a 1:1 versus a 1:2 simulation-to-traditional clinical replacement ratio. A $\eta^2 = .010$ is considered a small effect (Polit & Beck, 2012).

Table 8

Two-Way ANOVA on ATI Adult Medical Surgical Proctored Assessment Scores

Tests of Between-Subjects Effects

Dependent Variable: ATI Medical Surgical Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected Model	850.211[a]	3	283.404	4.651	.003
Intercept	1926747.08	1	1926747.08	31620.626	.000
Replacement	509.734	1	509.734	8.365	.004
Program	42.359	1	42.359	.695	.405
Replacement * Program	353.024	1	353.024	5.794	.016
Error	50513.654	829	60.933		
Total	4218138.20	833			
Corrected Total	51363.864	832			

Tests of Between-Subjects Effects

Dependent Variable: ATI Medical-Surgical Score

Source	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	.017	13.953	.893
Intercept	.974	31620.626	1.000
Replacement	.010	8.365	.824
Program	.001	.695	.132
Replacement * Program	.007	5.794	.627

a. R Squared = .017 (Adjusted R Squared = .013)

b. Computed using alpha = .05

Testing Research Question 2

The second research question of this study was: do NCLEX pass/fail scores differ between students that receive 1:1 replacement of simulation-to-traditional clinical time and students that receive 1:2 replacement of simulation-to-traditional clinical time? A total of N = 847 students had NCLEX scores reported for this study. The students that experienced a 1:1 simulation-to-traditional clinical replacement ratio had a numerically higher percentage of passing NCLEX scores (95.1%) than students in the study group that experienced a 1:2 simulation-to-traditional clinical replacement ratio (93.7%) (Table 9).

A χ^2 test was used to determine if any relationship existed between simulation-to-traditional clinical replacement ratio (1:1 versus 1:2) and NCLEX pass or fail scores. There was no significantly significant relationship between simulation-to-traditional clinical replacement ratio (1:1 versus 1:2) and NCLEX pass or fail scores χ^2 (1, N =847) .565, p = .452 (Table 10). Neither study group (1:1 versus 1:2 simulation-to-traditional clinical replacement ratio) was more likely to pass or fail the NCLEX.

Table 9

Descriptive Statistics for NCLEX Scores by Replacement Ratio Study Group

			NCLEX Score		
			Pass	Fail	Total
1:1 vs. 1:2	1:1 Simulation to Traditional Clinical Ratio	Count	640	33	673
		% within 1:1 vs. 1:2	95.1%	4.9%	100.0%
	1:2 Simulation to Traditional Clinical Ratio	Count	163	11	174
		% within 1:1 vs. 1:2	93.7%	6.3%	100.0%
Total		Count	803	44	847
		% within 1:1 vs. 1:2	94.8%	5.2%	100%
		% within NCLEX Score	100.0%	100.0%	100.0%
		% Total	94.8%	5.2%	100.0%

Table 10

Chi-Square Results for Simulation Replacement Ratio and NCLEX Score

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-Sided)
Pearson Chi-Square	.565[a]	1	.452		
Continuity Correction[b]	.314	1	.576		
Likelihood Ratio	.539	1	.463		
Fisher's Exact Test				.446	.280
Linear-by-Linear Association	.564	1	.453		
N of Valid Cases	847				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.04.

b. Computed only for a 2x2 table.

Testing Research Question 3

The third research question for this study was: does the program type (i.e., ADN or BSN) make a difference in ATI scores or NCLEX-RN pass scores between pre-licensure nursing students who experience a 1:1 replacement ratio of simulation-to-traditional clinical in comparison to the students experiencing a 1:2 replacement ratio? In the study sample, the BSN students (*N* = 488) had a numerically higher mean score (*M* = 71.17, *SD* = 7.97) on the ATI Adult Medical Surgical Proctored Assessment than students in ADN programs (*N* = 345, *M* = 70.1, *SD* = 7.67). As mentioned under question one, a two-way analysis of variance was utilized to test the effect of different simulation-to-traditional clinical replacement ratios (1:1 versus 1:2) and different types of pre-licensure nursing programs (BSN versus ADN) on the ATI Adult Medical Surgical Proctored Assessment score.

Program Type and ATI Adult Medical Surgical Proctored Assessment score

The type of pre-licensure nursing program did not have a significant main effect on the ATI Adult Medical Surgical Proctored Assessment score $F(1, 829) = .695$, $p = .405$ (Table 8). As mentioned under question one, simulation-to-traditional clinical replacement ratio did have a significant main effect $F(1, 829) = 8.37$, $p = .004$. Further examination of the results from the two-way analysis of variance also revealed a significant interaction between the simulation-to-traditional clinical time replacement ratio (1:1 versus 1:2) and type of pre-licensure nursing program (BSN versus ADN) $F(1, 829) = 5.79$, $p = .016$, partial $\eta^2 = .007$, observed power .627 (Table 8). The $\eta^2 = .007$ means that .7% of the variability in ATI Adult Medical Surgical Proctored Assessment Scores can be explained due to the interaction between the simulation-to-traditional clinical replacement ratio and the program type (i.e., BSN or ADN). A $\eta^2 = .007$ is considered a small effect (Polit & Beck, 2012).

However, this researcher conducted further analysis on the intercept between the variables of simulation-to-traditional clinical replacement and pre-licensure nursing program type by conducting pairwise comparisons due to the large difference in sample sizes amongst groups (BSN 1:1 $n = 450$, BSN 1:2 $n = 38$, ADN 1:1 $n = 198$, ADN 1:2 $n = 147$) (Table 11). There was a significant difference $F(1, 829) = 9.937$, $p = .002$. The $\eta^2 = .012$, observed power = .883 (Table 12). A $\eta^2 = .012$ means that the difference in simulation-to-traditional clinical replacement ratio intersected with the BSN program and had a combined effect of 1.2% (a small effect) between mean ATI scores of the BSN students in the 1:1 study group and the BSN students in the 1:2 study group. The result of a significant difference between the mean ATI Adult Medical Surgical Proctored

Assessment scores between the BSN students that experienced a 1:1 replacement ratio (*n* = 450) and the BSN students that experienced a 1:2 replacement ratio (*n* = 38) is likely due to the large difference in the sample sizes between the two study groups.

Table 11

Pairwise Comparison: Interaction Between Program Type and Simulation Replacement Ratio

Pairwise Comparisons							
Dependent Variable: ATI Medical Surgical Score							
						95% Confidence Interval for Difference[b]	
Program Type	(I) 1:1 v 1:2	(J) 1:1 v 1:2	Mean Difference (I-J)	Std. Error	Sig.[b]	Lower Bound	Upper Bound
BSN	1:1 Simulation to clinical Ratio *n* = 450 *M* = 71.49	1:2 Simulation to Clinical Ratio *n* = 38 *M* = 67.35	4.157*	1.319	.002	1.568	6.745
	1:2 Simulation to Clinical Ratio *n* = 38 *M* = 67.35	1:1 Simulation to Clinical Ratio *n* = 450 *M* = 71.49	-4.1567*	1.319	.002	-6.745	-1.568
ADN	1:1 Simulation to Clinical Ratio *n* = 198 *M* = 70.26	1:2 Simulation to Clinical Ratio *n* = 147 *M* = 69.88	.381	.850	.654	-1.287	2.049
	1:2 Simulation to Clinical Ratio *n* = 147 *M* = 69.88	1:1 Simulation to Clinical Ratio *n* = 198 *M* = 70.26	-.381	.850	.654	-2.049	1.287

Based on estimated marginal means

*. The mean difference is significant at the .05 level

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Table 12

Univariate Test: Interaction Between Program Type and Simulation Replacement Ratio

Univariate Tests									
Dependent Variable: ATI Medical Surgical Score									
Program Type		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent-Parameter	Observed Power[a]
BSN	Contrast	605.47	1	605.47	9.937	.002	.012	9,937	.883
	Error	50513.65	829	60.93					
ADN	Contrast	12.226	1	12.226	.201	.654	.000	.201	.073
	Error	50513.654	829	60.933					

Each F tests the simple effects of 1:1 v 1:2 within each level combination of the other effects shown. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

Program Type and NCLEX Pass/Fail Score

Simulation-to-traditional clinical replacement ratio (1:1 versus 1:2) was the main independent variable of this study; however, the type of pre-licensure nursing program may also have a correlation with a certain NCLEX pass or fail score. A crosstabulation was used to explore if there was a relationship between pre-licensure nursing program type and NCLEX score. Separate crosstabulations were run on both BSN (Table 13) and ADN (Table 14) students who experienced 1:1 versus 1:2 simulation-to-traditional clinical replacement ratios. The BSN students that experienced a 1:1 simulation-to-traditional clinical replacement ratio had the numerically highest NCLEX pass rate (95.3%). The BSN students that experienced a 1:2 simulation-to-traditional clinical replacement ratio had the numerically lowest NCLEX pass rate (92.1%).

Table 13

Crosstabulation of BSN students within Study Groups and NCLEX Scores

BSN - Nursing Program Type * NCLEX Score Crosstabulation				
			NCLEX Score	
			Pass	Fail
Nursing Program Type	BSN 1:1 Sim-Clin Replacement Ratio	Count	446	22
		Expected Count	444.9	23.1
		%within Nursing Program Type	95.3%	4.7%
		% within NCLEX Score	92.7%	88.0%
		% of Total	88.1%	4.3%
		Residual	1.1	-1.1%
	BSN 1:2 Sim-Clin Replacement Ratio	Count	35	3
		Expected Count	36.1	1.9
		% within Nursing Program Type	92.1%	7.9%
		% within NCLEX score	7.3%	12.0%
		% of Total	6.9%	0.6%
		Residual	-1.1	1.1
Total		Count	481	25
		Expected Count	481.0	25.0
		% within Nursing Program Type	95.1%	4.9%
		% within NCLEX score	100.0%	100.0%
		% of Total	95.1%	4.9%

Table 14

Crosstabulation of ADN Students within Study Groups and NCLEX Scores

ADN - Nursing Program Type * NCLEX Score Crosstabulation				
			NCLEX Score	
			Pass	Fail
Nursing Program Type	ADN 1:1 Sim-Clin Replacement Ratio	Count	194	11
		Expected Count	193.6	11.4
		%within Nursing Program Type	94.6%	5.4%
		% within NCLEX Score	60.2%	57.9%
		% of Total	56.9%	3.2%
		Residual	.4	-.4
	ADN 1:2 Sim-Clin Replacement Ratio	Count	128	8
		Expected Count	128.4	7.6
		% within Nursing Program Type	94.1%	5.9%
		% within NCLEX score	39.8%	42.1%
		% of Total	37.5%	2.3%
		Residual	-.4	.4
Total		Count	322	19
		Expected Count	322.0	19.0
		% within Nursing Program Type	94.4%	5.6%
		% within NCLEX score	100.0%	100.0%
		% of Total	94.4%	5.6%

In order to examine if any relationship existed between simulation replacement ratio (1:1 versus 1:2) and NCLEX pass scores within types of pre-licensure nursing programs a χ^2 test was used. There was no relationship between simulation-to-traditional clinical replacement ratio (1:1 versus 1:2) and NCLEX pass rate within the BSN students that participated in this study χ^2 (1, *N* =506) .763, *p* = .382 (Table 15). There was also no relationship between simulation-to-traditional clinical replacement ratio (1:1 versus 1:2) and NCLEX pass rate within the ADN students that participated in this study χ^2 (1, *N* =341) .041, *p* = .839 (Table 16). Thus, simulation-to-traditional clinical replacement ratio (1:1 versus 1:2) had no relationship with NCLEX pass scores within BSN programs, nor in ADN programs.

Table 15

Chi-Square Results BSN Participants - Simulation Replacement Ratio and NCLEX Score

Chi-Square Tests BSN Students					
	Value	df	Asymptomatic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.763[a]	1	.382		
Continuity Correction[b]	.235	1	.628		
Likelihood Ratio	.661	1	.416		
Fisher's Exact Test				.422	.287
Linear-by Linear Association	.762	1	.383		
N of Valid Cases	506				

a. 1 cell (25.0%) have expected count less than 5. The minimum expected count is 1.88.

b. Computed only for a 2x2 table

Table 16

Chi-Square Results ADN Participants - Simulation Replacement Ratio and NCLEX Score

Chi-Square Tests ADN Students					
	Value	df	Asymptomatic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.041[a]	1	.839		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.041	1	.836		
Fisher's Exact Test				.815	.509
Linear-by Linear Association	.041	1	.839		
N of Valid Cases	341				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.58.

b. Computed only for a 2x2 table

A Fisher's exact test is sometimes suggested to test significant differences in proportions when there are cells with small frequencies of five or fewer (Polit & Beck, 2012) and when the overall sample size is less than 1,000 (McDonald, 2014). In this study data, only three BSN students in the 1:2 study group had failing NCLEX-RN scores (Table 13) and the overall study sample was $N = 847$; thus, a Fisher's exact test was used in addition to the χ^2 test in order to examine the effect of simulation replacement ratio within each program type (BSN and ADN) on NCLEX-RN scores. The simulation-to-traditional clinical replacement ratio (1:1 versus 1:2) had no relationship to NCLEX-RN scores within the BSN student groups ($p = .422$) (Table 15). The simulation-to-traditional clinical replacement ratio (1:1 versus 1:2) also had no relationship to NCLEX-RN scores within the ADN student groups ($p = .815$) (Table 16).

Summary

Chapter IV discussed the findings when analyzing the data gathered in this study. The analysis indicated that there is a statistically significant difference between the mean ATI Adult Medical Surgical Proctored Assessment scores between the study groups (1:1 versus 1:2 simulation-to-traditional clinical replacement ratio. The analysis indicated that there is no statistically significant correlation between simulation-to-traditional clinical replacement ratio (1:1 versus 1:2) and NCLEX scores. Further, the type of pre-licensure nursing program within the study groups (BSN or ADN) did not have a statistically significant relationship with NCLEX scores. Finally, there was a significant difference in the ATI Adult Medical Surgical Proctored Assessment mean scores between the BSN students that experienced a 1:1 simulation-to-traditional replacement ratio and the BSN students that experienced a 1:2 simulation-to-traditional replacement ratio. However, further statistical analysis indicated that the difference in ATI Adult Medical Surgical Proctored Assessment mean scores was likely due to the large sample size difference between the BSN students in the 1:1 simulation-to-traditional clinical replacement study group (n = 450) and the BSN students in the 1:2 simulation-to-traditional clinical replacement study group (n = 38).

CHAPTER V – SUMMARY, DISCUSSION, AND CONCLUSION

Chapter V will summarize the findings in this research study, relate the findings in this study to prior similar studies, discuss how this study relates to the theoretical frameworks used for this study, provide an overview of the limitations, give implications for nursing education, and provide recommendations for future research.

Summary

The main goals of this study were to a) determine if there were differences in knowledge in students that experienced 1 hour of simulation to replace 1 hour of traditional clinical (1:1) versus students that experienced 1 hour of simulation to replace 2 hours of traditional clinical (1:2) in a senior- or second-level adult medical-surgical course, b) determine if there was any difference in ability to successfully attain licensure between students that experienced 1:1 versus 1:2 simulation-to-traditional clinical replacement ratios, and c) to determine if the outcomes varied depending on if students in the study groups were in a BSN or ADN pre-licensure nursing program. The findings of this study provide new knowledge about the outcomes of using simulation in replacement of traditional clinical in pre-licensure nursing programs.

The results of this study indicate the use of a 1:1 or 1:2 simulation-to-traditional clinical replacement ratio can be used in a second-year or senior-level adult medical-surgical course without meaningful differences in the knowledge outcomes. There were statistically significant differences in mean scores on the ATI Adult Medical Surgical Proctored Assessment, with the students in the 1:1 simulation-to-traditional clinical replacement ratio group scoring higher than the students in the 1:2 simulation-to-traditional clinical group. However, both study groups mean scores fell within the Level

II proficiency cut score meaning that both study groups exceeded the minimum level of competency in adult medical-surgical nursing and could be reliably expected to pass the NCLEX RN™ (ATI, 2016). In other words, the results of this study indicate that although students that experience a 1:1 simulation-to-traditional clinical replacement ratio may score higher on the ATI Adult Medical Surgical Proctored Assessment, it would be unlikely that those students would have perceivable differences in their nursing knowledge apart from that test. Pre-licensure nursing programs may use either 1 hour of simulation to replace 1 hour of traditional clinical (i.e., 1:1 replacement ratio) or 1 hour of simulation to replace 2 hours of traditional clinical (i.e., 1:2 replacement ratio) without meaningful differences in knowledge outcomes.

In addition, these study findings indicate that replacement ratio of simulation-to-traditional clinical (1:1 versus 1:2) has no significant correlation with NCLEX RN™ scores. Both study groups had NCLEX RN™ pass rates well above the national average NCLEX RN™ pass rate of 84.57% (National Council of State Boards of Nursing, 2017) (Table 6). The results of this study indicate that the use of a 1:1 or 1:2 simulation-to-traditional clinical replacement ratio can be used in second-year or senior-level adult medical-surgical courses without a significant impact on new nurse graduates' abilities to attain licensure as an RN in the U.S.

Finally, the researcher sought to determine if program type (BSN or ADN) as a variable had any impact on ATI Adult Medical Surgical Proctored Assessment scores or NCLEX pass/fail scores. The findings of this study indicate that there is a significant interaction between the simulation-to-traditional clinical replacement ratio (1:1 versus 1:2) and program type (BSN versus ADN). However, further analysis showed that the

significant difference in ATI scores was between the BSN students that experienced a 1:1 simulation-to-traditional clinical replacement ratio ($n = 450$) and the BSN students that experienced a 1:2 simulation-to-traditional clinical replacement ratio ($n = 38$). The large difference in sample sizes of those two groups is likely the reason that there was a statistical interaction between simulation-to-traditional clinical replacement ratio and type of pre-licensure nursing program. In addition, there was no significant relationship between simulation-to-traditional clinical replacement ratio and NCLEX pass rate in either the BSN or ADN students in this study. Therefore, a 1:1 or 1:2 simulation-to-traditional clinical replacement ratio can be safely implemented in the senior-level or second-year of BSN or ADN programs without meaningful or significant differences to either of their knowledge outcomes or ability to attain licensure as an RN.

This study involved participants from six nursing programs located in six different states across the U.S. The study sample was diverse in gender, ethnicity, and age of pre-licensure nursing students. The diversity of the research sites and participants themselves is a strength in this study that allows for generalizability of study results. The rigorous inclusion criteria for participation in this study was largely based off of the NLN/Jeffries Simulation Framework and is also a strength of this study. Using the NLN/Jeffries Simulation Framework for inclusion criteria provided control over the quality of simulation programs at participating research sites. The results of this study provide strong and valid evidence that support the use of either a 1:1 or 1:2 simulation-to-traditional clinical replacement ratio in pre-licensure nursing programs.

Discussion

The section will give an overview of how the findings of this study compare with other similar studies. The results of this study align with the findings of previous research regarding the prevalence of the use of simulation-to-traditional clinical replacement ratios in the U.S. and the outcomes of using simulation to replace traditional clinical. An updated literature search, which utilized the original literature search criteria listed in Chapter II, was conducted at the conclusion of this study in order to determine if any new evidence had emerged in the literature on simulation-to-traditional clinical replacement rates. Three recent publications were found on the knowledge outcomes of simulation-to-traditional clinical replacement ratios and one recent publication was found on simulation and NCLEX pass rates. No new studies, published or unpublished, were found that directly compared the outcomes of different simulation-to-traditional clinical replacement ratios. The findings in this study will be compared to more recent study findings in this discussion section.

Pre-licensure Nursing Program Use of Simulation-To-Traditional Clinical Replacement Ratios

In my study, 67% ($N = 4$) of the participating research sites utilized a 1:1 simulation-to-traditional clinical replacement ratio and 33% ($N = 2$) utilized a 1:2 simulation-to-traditional clinical replacement ratio. Prior studies surveying the use of simulation-to-traditional clinical replacement ratios found that a 1:1 simulation-to-traditional clinical ratio is the most commonly used in the U.S. at a prevalence of 58% (Gore et al., 2012), 60% (Breymier et al., 2015) or up to 83% (Hayden, 2010) (Table 17). A more current survey of the use of simulation in pre-licensure nursing programs

(Smiley, 2019) also found that a 1:1 simulation-to-traditional clinical replacement ratio is the most commonly used ratio for simulation-to-traditional clinical replacement time in the U.S. and that the NCSBN National Simulation Study continues to have an impact on how simulation is being used in pre-licensure nursing programs. Another interesting finding is that there was not a standard nomenclature for how studies are defining simulation-to-traditional clinical replacement ratios. For example, Hayden (2010) used the terminology "less than one hour of simulation equal to one hour of clinical" whereas Smiley (2019) used the terminology "one clinical hour greater than one simulation hour." Thus, in Hayden's study, a 1:2 replacement ratio would mean that students received 1 hour of simulation to replace 2 hours of traditional clinical. However, in Smiley's study, a 1:2 replacement ratio would mean that students would receive 1 hour of traditional clinical to replace 2 hours of simulation. Standard nomenclature is needed in the study of simulation-to-traditional clinical replacement ratios.

Table 17

Comparison of Prevalence of Simulation-to-Traditional Clinical Replacement Ratio Use

Comparison of 1:1 versus 1:2 Prevalence Amongst Recent Studies					
	Hayden (2010)	Gore et al. (2012)	Breymier et al. (2015)	Smiley (2019)	Zyniewicz (2019)
1:1 Replacement Ratio	Up to 83%	58%	60%	77.8%	67%
1:2 Replacement Ratio	*10%	9%	10%	*13.2%	33%

* inclusive of other simulation to replacement ratios where time in simulation was less than that in traditional clinical (e.g., 1:2, 1:3, 1:4)

Knowledge Outcomes

In this study, the researcher found that there was a significant difference in the mean scores on the ATI Adult Medical Surgical Proctored Assessment between the students in the 1:1 versus 1:2 simulation-to-traditional clinical ratio study groups with the students in the 1:1 group having a statistically significantly higher mean score. There was a significantly larger number of students in the 1:1 study group (*N* = 648) when compared to the 1:2 study group (*N* = 185). Although Levene's Test indicated homogeneity of variance between the study groups for the two-way ANOVA, this researcher decided to further analyze the data to see if there was a difference in statistical significance if a random sample of the participants in the 1:1 study group was compared to the participants in the 1:2 study group.

A random sample of *n* = 141 participants was taken from the 1:1 study group total (*N* = 648). One t-test was conducted on the ATI Adult Medical Surgical Proctored Assessment mean scores using the original two study groups. The second t-test was run on the ATI Adult Medical Surgical Proctored Assessment mean scores on the study groups comparing the random sample from the 1:1 study group compared to the 1:2 study group. The t-test on the original two study groups showed a significant difference between the mean ATI Adult Medical Surgical Proctored Assessment scores of the 1:1 study group (M =71.117, SD = 7.9245) and the 1:2 study group (M = 69.357, SD = 7.4776), t (831) = 2.697, p = .007. The t-test on the ATI Adult Medical Surgical Proctored Assessment scores comparing the mean scores of the random sample from the 1:1 study group (M = 71.605, SD = 7.6452) to the original 1:2 study group (M = 69.357, SD = 7.4776) also showed a significant difference t (526) = 2.697, p = .001. The level of

significant difference between mean scores on the ATI Adult Medical Surgical Proctored Assessment actually increased by randomly decreasing the sample in the 1:1 study group; however, since both t-tests resulted in a significant difference, the original study groups were used in the analysis.

In the NCSBN National Simulation Study (Hayden et al., 2014) students experiencing 50% replacement of traditional clinical hours with simulation at a 1:1 simulation-to-clinical replacement ratio scored higher on ATI tests when compared to participants that had 10 or 25% replacement of traditional clinical with simulation, although the actual percentage difference between groups on the ATI Adult Medical Surgical Proctored Assessment was only about 3 percentage points. The finding in this study that the 1:1 study group had a higher mean score on the ATI Adult Medical Surgical Proctored Assessment than the 1:2 study group by 1.84 percentage points is similar to the results in the NCSBN National Simulation Study and could indicate that more time spent in simulation gives students a slight advantage in knowledge attainment and retention of adult medical-surgical nursing concepts. A difference in only 1.84 percentage points in this study or a difference in 3 percentage points in the NCSBN National Simulation Study may be statistically significant but has little meaning in application unless pre-licensure nursing programs are using the ATI Adult Medical Surgical Proctored Assessment for high-stakes testing and have a strict cut score within the levels of proficiency as defined by ATI (2016).

Furthermore, results of a recent study comparing a 1:2 simulation-to-traditional clinical replacement ratio study group (for 50% of total adult medical-surgical clinical hours) to a group that experienced traditional clinical only showed that students in the 1:2

study group had statistically significant higher mean scores on both adult medical-surgical and exit HESI exams than the student group that experienced only traditional clinical (Curl, Smith, Chisholm, McGee, & Das, 2016). HESI is another instrument commonly used as an NCLEX preparation predictor. Of note, the students in the Curl et al. (2016) study received a pre-lab and debriefing as part of their time spent in simulation.

Other studies have indicated no statistically significant difference or no correlation between simulation-to-traditional clinical replacement and knowledge outcomes. Burbach, Struwe, Young, and Cohen (2019) found that no significant correlation existed between simulation performance and nursing care knowledge when using grade point average as a measure of knowledge. Similarly, Soccio (2017) found mental health knowledge did not differ between BSN students that received 25% replacement of traditional clinical versus students that received only traditional clinical. There are mixed results in the literature on the effects of different simulation-to-traditional clinical replacement ratios or simulation replacement rates on knowledge outcomes for pre-licensure nursing students. This study found that different simulation-to-traditional clinical replacement ratios had no meaningful effect on ATI Adult Medical Surgical Proctored Assessment scores.

Successful Attainment of Licensure

This researcher only found one recent publication on simulation and successful attainment of RN licensure in the repeated literature review. Simulation performance may actually be a better indicator of knowledge attainment and successful attainment of licensure. Brackney, Hayes-Lane, Dawson, and Koontz (2017) found that students rated as lacking confidence or flawed by faculty during a senior capstone simulation

experience were less likely to pass the NCLEX on the first attempt. No other recent studies published or unpublished were found on simulation and the successful attainment of RN licensure.

In synthesizing the results of the study completed in this report, the NCSBN National Simulation Study, and the results of other recent studies on simulation and knowledge outcomes, it is safe to conclude that pre-licensure nursing programs can implement a 1:1 or 1:2 simulation-to-traditional clinical replacement ratio without a meaningful difference in knowledge outcomes or attainment of licensure as an RN provided that the simulation program is of high quality and follows national best practices.

Theoretical Framework and the Study Results

This study was based on the meta-theoretical concept that one learning method can be used to replace another method in nursing education to achieve the same learning outcomes in less time. Situated Cognition (Page & Daley, 2009) was the theoretical framework used for this study under the meta-theoretical concept. Situated Cognition posits that three interacting components (people, ingredients or tools, and activity) will allow for learners to transfer learning from knowledge into practice. Using Situated Cognition, it was theorized in this study that providing control over clinical learning for pre-licensure nursing students in a simulated clinical environment could promote a transfer of learning from knowledge to practice in half the time of clinical. The results of this study provide support for the use of Situated Cognition as a theoretical framework for simulation.

The researcher used the NLN/Jeffries Simulation Framework (2012) to design this study's inclusion criteria to provide control over the variable factors within Situated Cognition and, more specific to simulation, the variables in the NLN/Jeffries Simulation Framework of participant, educational practices, and simulation design characteristics in the study design. The results of this study provide evidence in support of the meta-theoretical concept that simulation can be used to meet the same educational outcomes as traditional clinical in half the time. Further, the results of this study support the theory of Situated Cognition in that a pre-licensure nursing program that provides quality facilitators, a quality simulation program or facility, and high-fidelity simulation can produce positive educational outcomes in the transfer of knowledge to practice as evidenced by competency scores on the ATI Adult Medical Surgical Proctored Assessment and successful attainment of licensure as an RN.

Strengths of this Study

This study showed rigor in study design by use of the NLN/Jeffries Simulation Framework. The dependent variables were also measured using the same instruments as the NCSBN National Simulation Study, currently the standard for simulation research. The research sites in this study were geographically diverse. The participants were diverse and fairly representative of pre-licensure nursing students in the U.S. The study findings are generalizable to nationally accredited pre-licensure nursing programs who have been actively using simulation for 2 or more years, have an NCLEX-RN pass rate above the national average, and use the NLN/Jeffries Simulation Framework or INACSL Standards of Best Practice in their simulation program.

Limitations

All studies have limitations. Several limitations were identified in this study. The first major challenge in completing this study was a low response rate (16%) and difficulty in finding programs that fit the inclusion criteria of this study. A lower response rate was expected due to the specific inclusion criteria. One interesting observation in completing this study is that the most common reason given for declining participation by representatives from potential research sites was that their program did not utilize the ATI Adult Medical Surgical Proctored Assessment. Many deans, directors, and nursing program administrators reported using ATI in past years but had moved on to using other NCLEX preparation testing programs during the timeframe of my study. The lesson learned by this researcher is that instruments in nursing can fall in and out of favor for various reasons and, when possible, it is wise to take into consideration these changes in usage of NCLEX preparation tools when designing a study using only one particular NCLEX preparation tool.

Additionally, the study design used in this study was comparative, descriptive, and cross-sectional, so this study lacked some statistical control over extraneous variables as there was no randomization of participants into the two study groups. As an example, one participating research site had LPN to RN students and paramedic to RN students in their traditional ADN program, but that demographic data was not provided. There could be differences in how LPN to RN and paramedic to RN students score on the ATI or on the NCLEX that could not be accounted for in the findings of this study. Thus, there could be decreased statistical power of the findings in this study.

There were three assumptions made with the selection criteria in this study and those assumptions could be erroneous. The first assumption was that national accreditation by ACEN or CCNE is equated with both quality nursing programs and similar pre-licensure nursing curriculum. It is recognized that there were likely curricular differences amongst the participating research sites. The second assumption was that the use of the NLN/Jeffries Simulation Framework and/or the INACSL Standards of Best Practice equated with similar quality simulation experiences. However, the exact simulation scenarios that participants experienced were not controlled in this study. The third assumption in this study was that requiring research sites to have simulation programs in existence for a minimum of two years would provide for quality simulation experiences for the participants. SSH requires that simulation programs be in existence for a minimum of two years prior to applying for SSH accreditation. However, the absence of accreditation is not necessarily indicative of a lack of quality in simulation programs. Overall, the assumption in this study was that the participants would have similar quality curricular and simulation experiences by requiring research sites to be accredited by ACEN or CCNE, utilize the NLN/Jeffries Simulation Framework or INACSL Standards of Best Practice, and have a simulation program in existence for a minimum of two years.

Additionally, selection bias may have been present in this study as the study design was cross-sectional and representative of prospective research sites that self-selected into this study based on meeting the inclusion criteria of this study. Due to the self-selection process, the sample sizes of study groups were radically different from the group of BSN students that experienced a 1:1 simulation-to-traditional clinical

replacement ratio (n = 450) ending up almost twelve times the size as the BSN students that experienced a 1:2 simulation-to-traditional clinical replacement ratio (n = 38) although homogeneity of variance between study groups was shown to be present. The differing sample sizes could have increased the margin of error.

Finally, statistical conclusion validity could have been threatened based on intervention fidelity. To explain, the participating research sites reported a wide range of differing simulation-to-traditional clinical replacement percentages within the acceptable limit of 10 to 25% of simulation replacement of total clinical hours used in this study. One participating research site even reported that students who attended different campuses within their program may have had different percentages of simulation replacement ranging from 11 to 25%.

Implications for Nursing Education

The findings of this study support the use of either a 1:1 or 1:2 simulation-to-traditional clinical replacement ratio in second-year or senior-level adult medical-surgical courses for 10 to 25% of the total traditional clinical hours. To explain, if allowed by accreditation organizations and state regulation agencies, nurse educators in a program with 100 total clinical hours in the second or senior-level adult medical-surgical course could choose to replace those traditional clinical hours with 10 to 25 hours of simulation (i.e., at a 1:1 replacement ratio) or with 5 to 12.5 hours of simulation (i.e., at a 1:2 replacement ratio) without detrimental effects to the students' ability to master adult medical-surgical content or to attain national licensure as a RN.

Implementing simulation in replacement of traditional clinical in a pre-licensure nursing program can be a daunting task for nurse educators. Nursing faculty and

administrators often have to consider state regulations, institutional policies, budgetary impact, and faculty workload. A complicating factor is that there is no evidence to support current numbers of clinical hours in pre-licensure curriculum. In fact, a recent study found that only ten states require a certain number of clinical hours for pre-licensure nursing education, 24 states allow some portion of simulation to replace clinical, and 15 states specify the actual amount of simulation that can replace clinical hours (Bowling, Cooper, Kellish, Kubin, & Smith, 2018). According to Kardong-Edgren (2015) often only traditional clinical is accounted for in university or college workload credit policies. Blodgett, Blodgett, & Kardong-Edgren (2018) propose a model for simulation faculty workload determination that includes both simulation replacement percentage and the simulation-to-clinical hours ratio as key elements to consider when determining simulation faculty workload. Blodgett et al. (2018) state that a 1:1 simulation-to-traditional clinical replacement ratio directly increases faculty workload, whereas 1:2 or 1:3 simulation-to-traditional clinical replacement ratios more adequately take into account all workload aspects of simulation as applied in a pre-licensure nursing program.

For nursing programs that struggle with finding an adequate number of clinical sites or qualified clinical faculty to teach adult medical-surgical content, the findings of the study in this report indicate that pre-licensure nursing programs may be able to approach those programmatic clinical challenges by implementing a 1:2 simulation-to-traditional clinical replacement ratio. To explain, the results of this study indicate that students can safely spend one-half of the time in simulation as they would normally spend in clinical for 10 to 25% of second-year or senior-level adult medical-surgical

clinical time without any negative impact on their ability to master adult medical-surgical content nor in their ability to attain licensure as an RN. Using the above example of a program that has 100 hours of second-year or senior-level adult medical-surgical clinical hours, implementing a 1:2 simulation-to-traditional clinical replacement ratio could reduce the total financial impact and faculty workload of that clinical course by 5 to 12.5 hours multiplied by the number of student clinical groups. To provide further clarity, if the example nursing program had 100 students with clinical groups of 10 students, the impact would be (10 students x 5 hours; 10 students x 12.5 hours) a decrease in the financial impact of that course by 50 to 125 hours. In a time of financial challenge to many institutions of higher learning, the ability to find safe and effective areas for budgetary cuts is crucial. Similarly, Richardson et al. (2014) found that a 50% replacement of traditional clinical with simulation correlated with a 49% increase in faculty capacity (i.e., ability to take on more of a student load in clinical and simulation) without negative effects to work-life quality for faculty or student simulation and clinical experiences.

In addition, the findings of this study indicate that pre-licensure nursing students can meet the same program outcomes for content mastery and successful attainment of RN licensure in half the time of the 10 to 25% of their adult medical-surgical clinical course that may be spent in simulation. These study findings support the theory that clinical outcomes can be met in simulation in half the time. The implication of the results of this study is that pre-licensure nursing students in a program that replaced 10 to 25% of traditional clinical with simulation at a 1:2 simulation-to-traditional clinical replacement ratio could potentially meet course outcomes in less time and progress along

nursing curriculum at a faster rate than students in programs that use traditional clinical or 1:1 simulation-to-traditional clinical replacement ratios.

Furthermore, findings of this study do not support a mandate of using only 1:1 simulation-to-traditional clinical replacement ratios as some state nursing regulation agencies have directed. The findings in this study provide information for leaders in nursing education to further debate and make evidence-based decisions about the use of simulation in pre-licensure nursing education. Based on the results of this study, state nursing regulation agencies should consider either 1:1 or 1:2 simulation-to-traditional clinical replacement ratios as adequate to meet course and programmatic outcomes in pre-licensure nursing.

Recommendations for Future Research

This goal of this study was to identify any differences in content knowledge-mastery or in successful attainment of licensure as an RN in pre-licensure nursing students that experienced a 1:1 versus a 1:2 simulation-to-traditional clinical replacement ratio in the second or senior-level Adult Medical-Surgical course. Expansion of this study to include other factors is needed. This study investigated the outcomes of 1:1 versus 1:2 simulation-to-traditional clinical replacement ratios, but other replacement ratios may also be effective. Further research on the outcomes of other simulation-to-traditional clinical replacement ratios (e.g., 2:1, 1:3, and 1:4) is needed. In addition, further study is needed to determine the outcome of utilizing different simulation-to-traditional clinical replacement ratios in other courses in pre-licensure nursing programs (e.g., fundamentals, community health, maternal-child, mental health, etc.). This study explored the outcomes of using different simulation-to-traditional clinical replacement ratios on pre-licensure

nursing students' knowledge-based competencies. Further investigation is needed to understand the impact of using different simulation-to-traditional clinical replacement ratios on clinical competencies. For example, a researcher might investigate the impact of a 1:1 or 1:2 simulation-to-traditional clinical replacement ratio on clinical competency using the New Graduate Nurse Performance Survey (Berkow, Virkstis, Stewart, & Conway, 2008) or the Global Assessment of Clinical Competency and Readiness for Practice (Budden, 2013).

Conclusion

This study provides strong evidence that pre-licensure nursing programs can safely use a 1:1 or 1:2 simulation-to-traditional clinical replacement ratio in the second or senior-level adult medical-surgical clinical course without having clinically significant differences in ATI Adult Medical Surgical Proctored Assessment scores or having an impact on NCLEX pass rates. Deans and directors of pre-licensure nursing programs can be confident in replacing 10 to 25% of a second or senior-level adult medical-surgical clinical course with a 1:1 or 1:2 simulation-to-traditional clinical replacement ratio provided that conditions are comparable to those described in this study. The study conditions were having a nationally accredited pre-licensure nursing program, a simulation program in existence for 2 or more years, and having a simulation program based on the NLN/Jeffries Simulation framework and/or the INACSL Standards of Best Practice

APPENDIX A – Permission to Use NLN/Jeffries Simulation Framework

Book Perm: NLN Sim Framework for dissertation [Incident: 160730-000179]

W Wolters Kluwer Rights and Permissions <permissions@lww.com>

Reply

Thu 8/4/2016, 10:19 AM

Tiffany Zyniewicz

Inbox

Action Items

Recently you requested personal assistance from our on-line support center. Below is a summary of your request and our response.

If you are receiving this in response to a request you made, a summary is below. If you have not made a request, the following is a communication on behalf of your LWW Sales Representative.

Thank you for allowing us to be of service to you.

To access your question from our support site, click here.

Subject

Book Perm: NLN Sim Framework for dissertation

Discussion Thread

Response Via Email (Caren Erlichman) 08/04/2016 01:19 P

Thanks Tiffany.

Your request to use the NLN/Jeffries Simulation Framework in your dissertation at the University of Southern Mississippi is granted for print format only.

I am including a link (below) to our Terms and Conditions. Please consider those, and this email, your official grant of permission. Thank you.

www.lww.com/healthpermissions-terms

Sincerely,

Caren Erlichman
Health Permissions Group
Health Learning, Research & Practice
Wolters Kluwer

Customer By Web Form (Tiffany Zyniewicz)	08/04/2016 01:11 PI

Dear Caren,

It should be no problem at all to remove the NLN/Jeffries Simulation Framework prior to it being submitted to Proquest. I understand that the figure will only be permissible for use in my print copies.

Thank you and please let me know if you need anything else.

Tiffany

Response Via Email (Caren Erlichman)	08/04/2016 09:00 AI

Good morning Tiffany.

Thank you for the information; we do not allow our content to be posted on ProQuest. We can grant you permission to use the figure in your print copies, but it would have to be removed before it was sent to ProQuest. Would you be able to do that?

Caren

Customer By Web Form (Tiffany Zyniewicz)	08/04/2016 04:39 AI

Dear Caren,

As far as I understand, my dissertation will be posted after the final defense in the password-protected database called Proquest Dissertations and Theses Global.

Please let me know if you have any further questions.

Best,
Tiffany

Response Via Email (Caren Erlichman)	08/03/2016 10:42 PI

Hello Tiffany.

Thank you for contacting us. Can you please tell me where your dissertation will be posted?

Caren Erlichman
Health Learning, Research and Practice

APPENDIX B – Checklist for Meeting Inclusion Criteria

Check List for Meeting Inclusion Criteria
for the study:
SIMULATION AS REPLACEMENT FOR TRADITIONAL CLINICAL IN PRELICENSURE NURSING EDUCATION: OUTCOMES OF DIFFERENT RATIOS OF REPLACEMENT TIME FOR TRADITIONAL CLINICAL WITH SIMULATION

School or College of Nursing ID Code # ______________

Directions: The researcher will use this form during a phone call with the representative from each College or School of Nursing or Nursing Program participating in this study to ensure that inclusion criteria are met and exclusion criteria are not met.

INCLUSION CRITERION #1: ADN or BSN program with accreditation from ACEN or CCNE with good standing.

1. Is your program ADN or BSN? ADN _____ BSN _____ Other _____
   (Excluded if the program is LPN, RN to BSN, RN to MSN, MSN, or RN to PhD)
2. Do you have accreditation from ACEN or CCNE? ACEN ______ CCNE______
3. When is your accreditation up for renewal? Year _______
4. Is your accreditation in good standing? Yes _____ No_____
5. Were there any provisions to your accreditation or reaccreditation?
   Yes _____ No_____
6. Overall inclusion criterion met? Yes_____ No_____

INCLUSION CRITERION #2: Use of ATI Adult Medical Surgical Proctored Exam

1. Will the students in the second or senior year of their program for the 2016-2017 academic school year be taking the ATI Adult Medical Surgical Proctored Exam?
   Yes _____ No_____
2. Overall inclusion criterion met? Yes_____ No_____

INCLUSION CRITERION #3: Use of 10-25% replacement of traditional clinical with simulation in the adult medical-surgical course during the final year of nursing coursework

1. What percentage of clinical hours were replaced with simulation hours in the senior-level or second-year adult medical-surgical course in the 2016-2017 academic year ? (e.g. 10 hours in the simulation lab to replace 10 hours of traditional clinical for a 100-hour clinical would equal 10% of clinical)
   _______%
2. Overall inclusion criterion met? Yes_____ No_____

INCLUSION CRITERION #4: Use of either a 1:1 or 1:2 replacement ratio in for simulation time to traditional clinical time in the second-year or senior-level adult medical-surgical course

1. Please answer this question thinking about the senior-level or second-year adult medical surgical course in the 2016-2017 academic year. For the time that students spent in the simulation lab to replace traditional clinical time, which is true for your school:

a) ______ Students spent 1 hour of simulation to replace 1 hour of clinical (e.g. for an 8 hour clinical day, students would instead spend 8 hours in a simulated clinical experience).
b) ______ Students spent 1 hour of simulation to replace 2 hours of clinical (e.g. for an 8 hour clinical day, students would instead spend 4 hours in a simulated clinical experience)
c) ______ Other (not eligible)

2. Overall inclusion criterion met? Yes_____ No_____

INCLUSION CRITERION #5: The simulation program must have been in existence for a minimum of two years.

1. How many years has the simulation program been in operation in the pre-licensure nursing program at your institution? _____ Years.
2. Overall inclusion criterion met? Yes_____ No_____

INCLUSION CRITERION #6: The simulation program must be based on the NLN/Jeffries Simulation Framework or have incorporated the INACSL Standards of Best Practice: SimulationSM

1. Which is true for the simulation program in the pre-licensure nursing program at your institution?
   a. The simulation program is based on the NLN/Jeffries Simulation Framework
      Yes ______ No ______
   b. The simulation program has incorporated the INACSL Standards of Best Practice
      Yes ______ No______
   c. The simulation program is based on another framework or is not based on a framework at this time
      Yes _____ No _____
2. Overall inclusion criterion met? Yes _____ No _____

INCLUSION CRITERION #7: The data provided must be from pre-licensure nursing students having received adult medical surgical clinical coursework in the senior or second year of the nursing curriculum in the 2016-2017 academic year and that have graduated by June 30, 2017.

1. Did the second-year or senior-level pre-licensure nursing students at your institution during the 2016-2017 year receive an adult medical surgical course?
   Yes ____ No_____
2. Did the second-year or senior level pre-licensure nursing students at your institution during the 2016-2017 year take the ATI Adult Medical Surgical Proctored Exam?
   Yes _____ No _____
3. Will the de-identified ATI Adult Medical Surgical Proctored Exam scores and NCLEX-RN pass/fail scores come from students that graduated by June 30, 2017?
   Yes _____ No _____
4. Overall inclusion criterion met? Yes _____ No _____

APPENDIX C – IRB Approval Letter

THE UNIVERSITY OF
SOUTHERN MISSISSIPPI

INSTITUTIONAL REVIEW BOARD
118 College Drive #5147 | Hattiesburg, MS 39406-0001
Phone: 601.266.5997 | Fax: 601.266.4377 | www.usm.edu/research/institutional.review.board

NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months. Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 17062606
PROJECT TITLE: Simulation as Replacement for Traditional Clinical In Prelicensure Nursing Education: Outcomes of Different Ratios of Replacement Time for Traditional Clinical with Simulation
PROJECT TYPE: New Project
RESEARCHER(S): Tiffany Zyniewicz
COLLEGE/DIVISION: College of Nursing
DEPARTMENT: System's Leadership and Health Outcomes
FUNDING AGENCY/SPONSOR: N/A
IRB COMMITTEE ACTION: Expedited Review Approval
PERIOD OF APPROVAL: 06/27/2017 to 06/26/2018
Lawrence A. Hosman, Ph.D.
Institutional Review Board

APPENDIX D – IRB Renewal Approval Letter

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

INSTITUTIONAL REVIEW BOARD
118 College Drive #5147 | Hattiesburg, MS 39406-0001
Phone: 601.266.5997 | Fax: 601.266.4377 | www.usm.edu/research/institutional.review.board

NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: R17062606
PROJECT TITLE: Simulation as Replacement for Traditional Clinical In Prelicensure Nursing Education: Outcomes of Different Ratios of Replacement Time for Traditional Clinical with Simulation
PROJECT TYPE: Renewal of a Previously Approved Project
RESEARCHER(S): Tiffany Zyniewicz
COLLEGE/DIVISION: College of Nursing
DEPARTMENT: System's Leadership and Health Outcomes
FUNDING AGENCY/SPONSOR: N/A
IRB COMMITTEE ACTION: Expedited Review Approval
PERIOD OF APPROVAL: 06/27/2018 to 06/26/2019
Lawrence A. Hosman, Ph.D.
Institutional Review Board

REFERENCES

Abrahamson, S., Clark, A.P., Denson, J.S., Ronzoni, T., & Taback, L. (1970). *U.S. Patent No. 3,520,071.* Washington, DC: U.S. Patent and Trademark Office.

Abrahamson, S., Denson, J.S., & Wolf, R.M. (1969). Effectiveness of a simulator in anesthesiology training. *Academic Medicine, 44*, 515-519.

Accreditation Council for Graduate Medical Education. (2015). *ACGME program requirements for graduate medical education in general surgery*. Retrieved from http://www.acgme.org/Portals/0/PFAssets/ProgramRequirements /440_general_surgery_07012015.pdf?ver=2016-03-23-113937-933

Adam Rouilly, (2013). *Our history*. Retrieved from http://www.adam-rouilly.co.uk/content/history.aspx

Allerton, D. (2009). *Principles of flight simulation.* West Sussex: John Wiley & Sons.

American Association of Colleges of Nursing. (2008). *The essentials of Baccalaureate education for professional nursing practice.* Retrieved from http://www.aacn.nche.edu/education-resources/essential-series

Arizona State Board of Nursing. (2015). *Advisory opinion: Education use of simulation in approved RN/LPN programs*. Retrieved from https://www. azbn.gov/resources/advisory-opinions/

Assessment Technologies Institute, Inc. (2016). *RN content mastery series 2016: Mean percentile rank lookup tables*. Available from Assessment Technologies Institute, Inc. 11161 Overbrook Road Leawood, KS.

Assessment Technologies Institute, Inc. (2016). *RN content mastery series 2016: Proficiency levels*. Available from Assessment Technologies Institute, Inc. 11161 Overbrook Road Leawood, KS.

Association of Standardized Patient Educators. (2016). *Overview*. Retrieved from http://www.aspeducators.org/node/48

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes, 50,* 248-287.

Barrows, H.S. (1993). An overview of the uses of standardized patients for teaching and evaluating clinical skills. *Academic Medicine, 68*(6), 443-451.

Barton, A., Armstrong, G., Preheim, G., Gelmon, S.B., & Andrus, L.C. (2009). A national Delphi to determine developmental progression of quality and safety competencies in nursing education. *Nursing Outlook, 57*, 313-322. doi:10.1016/j.outlook.2009.08.003

Bearnson, C.S., & Wiker, K.M. (2005). Human patient simulators: A new face in baccalaureate nursing education at Brigham Young University. *Journal of Nursing Education*, *44*, 421-425

Beaubien, J.M., & Baker, D.P. (2004). The use of simulation for training teamwork skills in health care: How low can you go? *Quality & Safety in Health Care, 13*(suppl. 1). i51-i56.

Benner, P. (1984). *From novice to expert: Excellence and power in clinical nursing practice*. Menlo Park, CA: Addison-Wesley Publishing Co., Nursing Division.

Berkow, S., Virkstis, K., Stewart, J., & Conway, L. (2008). Assessing new graduate nurse performance. *Journal of Nursing Administration, 38*(11), 468-474.

Bersky, A., Krawczak, J., & Kumar, T. (1998). Computerized clinical simulation testing: a new look for the NCLEX-RN examination. *Nurse Educator, 23*(1), 20-25.

Bland, A., Topping, A., & Wood, B. (2011). A concept analysis of simulation as a learning strategy in the education of undergraduate nursing students. *Nursing Education Today, 31,* 664-670. doi:10.1016/j.nedt.2010.10.013

Blodgett, N., Blodgett, T., & Kardong-Edgren, S. (2018). A proposed model for simulation faculty workload determination. *Clinical Simulation in Nursing, 18*, 20-27. doi: 10.1016?j.ecns.2018.01.003

Bloomfield, A. R. (1916). A demonstration room. *American Journal of Nursing, 16*(8), 705-707.

Bowling, A., Cooper, R., Kellish, A., Kubin, L., & Smith, T. (2018). No evidence to support number of clinical hours necessary for nursing competency. *Journal of Pediatric Nursing, 39*, 27-36. doi: 10.1016/j.pedn.2017.12.0.12

Brackney, D., Hayes Lane, S., Dawson, T., & Koontz, A. (2017). Simulation performance and national council licensure examination for registered nurses outcomes: Field research perspectives. *Creative Nursing, 23*(4), 255-265. doi: 10.1891/1078-4535.23.4.255

Brady, D.S. (2011). Using Quality and Safety Education for Nurses (QSEN) as a pedagogical structure for course redesign and content. *International Journal of Nursing Education Scholarship, 8*(1), 1-18. doi: 10.2202/1548-923X.2147

Bremner, M., & Brannan, J. (2000). A computer simulation for the entry-level RN: enhancing clinical decision making. *Journal for Nurses in Staff Development, 16*(1), 5-9.

Breymier, T.L., Rutherford-Hemming, T., Horsley, T.L., Atz, T., Smith, L.G., Badowski, D., & Connor, K. (2015). Substitution of clinical experience with simulation in pre-licensure nursing programs: A national survey in the United States. *Clinical Simulation in Nursing, 11*, 472-478. http://dx.doi.org/10.1016/j.ecns.2015.09.004

Brown, E.L. (1948). *Nursing for the future: A report prepared for the National Nursing Council.* New York, NY: Russell Sage Foundation.

Brown, E.L. (1972). Characteristics of ADN program. In S. Rasmussen (Ed.), *Technical nursing: Dimensions and dynamics* (pp. 29-37). Philadelphia, PA: Davis.

Budden, J. (2013). *The intra-rater reliability of nurse supervisor competency ratings*. Unpublished manuscript. National Council of State Boards of Nursing, Chicago, IL.

Burbach, B., Struwe, L., Young, L., & Cohen, M. (2019). Correlates of student performance during low stakes simulation. *Journal of Professional Nursing, 35*(1), 44-50. doi:10.1016?j.profnurs.2018.06.002

Burke, H. (2012). Social cognitive theory, metacognition, and simulation learning in nursing education. *The Journal of Nursing Education, 51*(10), 543-548.

Cato, M. (2012). Using simulation in nursing education. In P.R. Jeffries (Ed.), *Simulation in nursing education: From conceptualization to evaluation* (2nd ed.) (1-12). New York, NY: National League for Nursing.

Cheney, F.W. (2010). The American Society of Anesthesiologists closed claims project: the beginning. *Anesthesiology, 115,* 957-960.

Committee on the Function of Nursing. (Ginzberg, E., chair). (1948). *A program for the nursing profession by the committee on the function of nursing*. New York, NY: Macmillan Company.

Cooper, J. B., & Taqueti, V. R. (2004). A brief history of the development of mannequin simulators for clinical education and training. *Quality and Safety in Health Care, 13*(Suppl. 1), i11-i18.

Cornelius, C. A. (2012). *Simulation usage as a partial replacement of traditional clinical: A study of administrator and faculty perceptions in practical nursing programs in Pennsylvania* (Doctoral dissertation). Available from ProQuest Dissertations and Thesis Database. (UMI No. 3546699)

Cronenwett, L., Sherwood, G., Barnsteiner, J., Disch, J., Johnson, J., Mitchell, P., & ... Warren, J. (2007). Quality and safety education for nurses. *Nursing Outlook, 55*(3), 122-131.

Curl, E., Smith, S., Chisholm, L., McGee, L., & Das, K. (2016). Effectiveness of integrated simulation and clinical experiences compared to traditional clinical experiences for nursing students. *Nursing Education Perspectives, 37*(2), 72-77. doi: 10.5480/15-1647

Davis, H. E. (1932). A workable nursing laboratory. *American Journal of Nursing, 32*(4), 387-391.

Decker, S.I., Anderson, M., Boese, T., Epps, C., McCarthy, J., Motola, I., … Scolaro, K. (2015). Standards of best practice: Simulation standard VIII:

Simulation-enhanced interprofessional education (Sim-IPE). *Clinical Simulation in Nursing, 11,* 293-297.

Duvivier, R. J., Muijtens, A. M., Moulaert, V., van der Vleuten, C., & Scherpbier, A. (2011). The role of deliberate practice in the acquisition of clinical skills. *BMC Medical Education, 11*(101), 1-7. doi: 10.1186/1472-6920-11-101

Ellis, J.R., & Hartley, C.L. (2004). *Nursing in today's world: trends, issues & management.* (8th ed.) New York, NY: Lippincott Williams & Wilkins.

Faison, K. (2012). Nursing education: a historical overview. *JOCEPS: The Journal Of Chi Eta Phi Sorority, 56*(1), 2-4.

Fawcett, J. (1999). *The relationship of theory and research* (3rd ed.). Philadelphia, PA: FA Davis.

Forest, B.L. (1972). The utilization of technical nurses. In S. Rasmussen (Ed.). *Technical nursing: Dimensions and dynamics* (pp. 93-99). Philadelphia, PA: Davis.

Forneris, S. G., Crownover, J. G., Dorsey, L., Leahy, N., Maas, N. A., Wong, L., & ... Zavertnik, J. E. (2012). Integrating QSEN and ACES: An NLN Simulation Leader Project. *Nursing Education Perspectives, 33*(3), 184-187. 4p. doi:10.5480/1536-5026-33.3.184

Gaba, D. M. (2004). The future vision of simulation in healthcare. *Quality and Safety in Healthcare*, *13*(2), 126–135.

Gaba, D.M., & DeAnda, A. (1988). A comprehensive anesthesia simulation environment: Re-creating the operating room for research and training. *Anesthesiology, 69,* 387-394.

Gaba, D.M., & Raemer, D. (2007). The tide is turning: Organizational structures to embed simulation in the fabric of healthcare. *Simulation in Healthcare, 2*(1)*,* 1-3.

Gaumard. (2012). Our history of innovation. Retrieved from http:// gaumardscientific.mybigcommerce.com/our-history/

Gordon, M.S., & Messmore, F. (1972). *U.S. Patent No. 3,662,076.* Washington, DC: U.S. Patent and Trademark Office.

Gore, T., & Schuessler, J.B. (2013). Simulation policy development: Lessons learned. *Clinical Simulation in Nursing, 9*, e319-e322. doi:10.1016/j.ecns. 2012.04.005

Gore, T., & Thomson, W. (2016). Use of simulation in undergraduate and graduate Education. *AACN Advanced Critical Care, 27*(1), 86-95 10p. doi:10.4037/aacnacc2016329

Gore, T., Van Gele, P., Ravert, P., & Mabire, C. (2012). A 2010 survey of the INACSL membership about simulation use. *Clinical Simulation in Nursing, 8*, e125-e133. doi:10.1016.j.ecns.2012.01.002

Gravenstein, J.S. (1988). Training devices and simulators. *Anesthesiology, 69,* 295-297.

Greeneyer, F. (2008). A history of simulation: Part II-early days. Military and Simulation Training Magazine, Issue 5. Retrieved from http://halldale.com/insidesnt/history-simulation-part-ii-early-days#. VvxowlISsdc

Grenvik, A. & Shaefer, J. (2004). From Resusci-Anne to Sim-Man: The evolution of simulators in medicine. *Critical Care Medicine, 32,* 56-57.

Greeneyer, F. (2008). A history of simulation: Part III-preparing-for war. *Military and Simulation Training Magazine,* Issue 6. Retrieved from http://halldale.com/insidesnt/history-simulation-part-iii-preparing-war#.VvA86VISsdc

Guilbert, J.J. (2003). Making a difference. An interview with Dr. Stephen Abrahamson. *Education for Health, 16*: 378-384.

Haase, P.T. (1990). *The origins and rise of associate degree nursing education.* Durham, NC: Duke University Press.

Hallmark, B.F., Thomas, C.M., & Gantt, L. (2014). The educational practices construct of the NLN/Jeffries simulation framework: State of the science. *Clinical Simulation in Nursing, 10*: 345-352. doi: 10.1016/j.ecns.2013.04.006

Hart, S. (1983). Premise-promise paradox. In V.O. Allen & N.A. Hoddick (Eds.), *Prescription for growth: Achievements and challenges in associate degree nursing* (pp. 45-49). Battle Creek, MI: Kellogg Foundation.

Hayden, J. (2010) Use of simulation in nursing education: National survey results. *Journal of Nursing Regulation, 1*(3), 52-57.

Hayden, J. K., Jeffries, P. J., Kardong-Edgren, S., & Spector, N. (2009). *The National Simulation Study: Evaluating simulated clinical experiences in nursing education. Unpublished research protocol*. National Council of State Boards of Nursing, Chicago, IL.

Hayden, J.K., Smiley, R.A., Alexander, M., Kardong-Edgren, S., & Jeffries, P.R. (2014). The NCSBN national simulation study: A longitudinal, randomized, controlled

study replacing clinical hours with simulation in pre-licensure nursing education. *Journal of Nursing Regulation, 5*(2), 1-66.

Hermann, E. K. (1981). Mrs. Chase: A noble and enduring figure. *American Journal of Nursing, 81*(10), 1836.

Hermann, E.K., (2008). Remembering Mrs. Chase. *NSNA Imprint,* 52-55. Retrieved from http://www.nsna.org/Portals/0/Skins/NSNA/pdf/Imprint_FebMar08_ Feat_MrsChase.pdf

Hoggett, R. (n.d.). A history of cybernetic animals and early robots. Retrieved from http://cyberneticzoo.com/?tag-stephen-abrahamson

Imel, S. (1998). *Transformative learning in adulthood*. Retrieved from http://www.ericdigests.org/1999-2/adulthood.htm

Institute of Medicine. (1999, November). *Too err is human: Building a safer health system.* Retrieved from http://www.iom.edu/~/media/Files/Report%20Files/ 1999/To-Err-isHuman/To%20Err%20is%20Human%201999% 20%20report%20brief.pdf

Institute of Medicine. (2003). *Health professionals education: A bridge to quality.* Washington D.C.: The National Academies Press.

Institute of Medicine. (2010). *The future of nursing: Leading change, advancing health*. Retrieved from http://books.nap.edu/openbook.php?record_id=12956&page=R1

International Nursing Association for Clinical Simulation and Learning. (2011). Standards of best practice: Simulation. *Clinical Simulation in Nursing, 7*(4), 1-19.

International Nursing Association for Clinical Simulation and Learning. (2013). Standards of best practice: Simulation^{SM}. *Clinical Simulation in Nursing, 9*, 1-34.

International Nursing Association for Clinical Simulation and Learning. (2015). *History.* Retrieved from http://www.inacsl.org/i4a/pages/index.cfm?pageid=3279

Interprofessional Education Collaborative Expert Panel. (2011). *Core competencies for interprofessional collaborative practice: Report of an expert panel*. Washington D.C.: Interprofessional Education Collaborative.

Jarzemsky, P., McCarthy, J., & Ellis, N. (2010). Incorporating quality and safety education for nurses' competencies in simulation scenario design. *Nurse Educator, 35*(2), 90-92 3p. doi:10.1097/NNE.0b013e3181d52f6e

Jeffries, P.R. (2005). A framework for designing, implementing, and evaluating simulations used as teaching strategies in nursing. *Nursing Education Perspectives, 26*(2), 28-35.

Jeffries, P.R., & Rogers, K.J. (2012). Theoretical framework for simulation design. In P.R. Jeffries (Ed.), *Simulation in nursing education from conceptualization to evaluation* (2nd ed.) (pp. 25-42). New York, NY: National League for Nursing.

Kardong-Edgren, S. (2015). Initial thoughts after the NCSBN national simulation study. *Clinical Simulation in Nursing, 11*(4), 201-202. doi: 10.1016/j.ecns.2015.02.005

Katz, G.B., Peifer, K.L., & Armstrong, G. (2010). Assessment of patient simulation use in selected baccalaureate nursing programs in the United States. *Simulation in Healthcare*, *5*(1), 46-51. doi: 10.1097/SIH.0b013e3181ba1f46

Kimball, K. (1984). The use of simulators in the military. In Committee on Military Nutrition Research, Food and Nutrition Board, Commission on Life Sciences, & National Research Council (Eds.). *Cognitive Testing Methodology.* Paper

presented at the Cognitive Testing Methodology Workshop*,* National Technical Information Service, Springfield, VA, 11-12, June (pp. 163-169). Washington D.C.: National Academy Press.

Knowles, M. S. (1968). Andragogy, not pedagogy. *Adult Leadership, 16*(10), 350-352, 386.

Kolb, D. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ : Prentice-Hall.

Kunkler, K. (2006). The role of medical simulation: An overview. *The International Journal of Medical Robotics and Computer Assisted Surgery, 2,* 203-210. doi 10.1002/rcs.101

Laerdal. (2012). *History: Laerdal yesterday and today*. Retrieved from http://ww.laerdal.com/us/doc/367/History

Lave, J. (1988). *Cognition in practice: Mind, mathematics and culture in everyday life*. New York, NY: Cambridge University Press.

Ledbetter, M.N. (1995). *CAE-link corporation in airlift tanker: History of U.S. airlift and tanker forces.* Paducah, KY: Turner Publishing.

Lees, F. (1874). *Handbook for hospital sisters.* London, UK: W. Ibister & Company

Leighton, K. (2014). Simulation in nursing. In A.I. Levine, S. Demaria, A.D. Schwartz, & A.J. Sim (Eds.), *The comprehensive textbook of healthcare simulation* (pp. 425-436). New York, NY: Springer.

Link, E.A. Jr (1931). *U.S. Patent No. 1,825, 462.* Washington, DC: U.S. Patent and Trademark Office.

Lioce, L., Meakim, C.H., Fey, M.K., Chmil, J.V., Mariani, B., & Alinier, G. (2015). Standards of best practice: Simulation standard IX: Simulation design. *Clinical Simulation in Nursing, 11*, 309-315.

Maciocia, G. (1982). History of acupuncture. *Journal of Chinese Medicine, 9*, 9-15.

Makery, M.A., & Daniel, M. (2016). Medical error: The third leading cause of death in the U.S. *British Medical Journal, 353*: i2139. doi: 10.1136/bmj.i2139

Markoviç¸ D., & Markoviç-Živkoviç¸ B. (2010) Development of anatomical models-chronology. *Acta Medica Medianae*, *49*: 56-62.

Massey, V.H., & Warblow, N.A. (2005). Using a clinical simulation to assess program outcomes. In M.H. Oermann & K.T. Heinrich (Eds.), *Annual review of nursing education: Vol. 3 strategies for teaching, assessment, and program planning* (pp. 95-105) New York, NY: Springer.

McCormick, E.J. (1964). *Human factors engineering* (2nd ed.). New York, NY: McGraw-Hill.

McDonald, J.H. (2014). *Handbook of biological statistics* (3rd ed.). Baltimore, MD: Sparky House Publishing.

Mezirow, J. (1997). Transformative learning: Theory to practice. In P. Cranton (Ed.), *Transformative learning in action: Insights from practice* (pp. 5-12). San Francisco, CA: Jossey-Bass.

Meyer, M., Connors, H., Hou, Q., & Gajewski, B. (2011). The effect of simulation on clinical performance: A junior nursing student clinical comparison study. *Simulation in Healthcare, 6*(5): 269-277. doi: 10.1097/SIH.0b013e318223a048

Mississippi Institution of Higher Learning. (2017, July 1). *Mississippi nursing degree programs accreditation standards procedure manual.* Retrieved from http://www.mississippi.edu/nursing/downloads/procedure_manual_2017.pdf

Montag, M.L., & Gotkin, L.G. (1959). *Community college education for nursing: An experiment in technical education for nursing: Report of the cooperative research project in junior community college education for nursing.* New York, NY: McGraw Hill.

National Council of State Boards of Nursing. (2015). *NCLEX-RN® test plan for the national council licensure examination for registered nurses: Effective April 2016.* Retrieved from https://www.ncsbn.org/RN_Test_Plan_2016_Final.pdf

National League for Nursing. (2016) *Biennial survey of schools of nursing, academic year 2015-2016*. Retrieved from http://www.nln.org/newsroom/nursing-education-statistics/biennial-survey-of-schools-of-nursing-academic-year-2015-2016

National Council of State Boards of Nursing. (2017). *2016 number of students taking NCLEX examination and percent passing, by type of candidate.* Retrieved from https://www.ncsbn.org/Table_of_Pass_Rates_2017.pdf

National Council of State Boards of Nursing. (2018). *2017 number of students taking NCLEX examination and percent passing, by type of candidate.* Retrieved from https://www.ncsbn.org/Table_of_Pass_Rates_2016.pdf

Nehring, W. M. (2010). History of simulation in nursing. In W. M. Nehring & F. R. Lashley (Eds.), *High-fidelity patient simulation in nursing education* (pp. 3–26). Sudbury, MA: Jones and Bartlett.

Nehring, W.M., Ellis, W.E., & Lashley, F.R. (2001). Human patient simulators in nursing education: An overview. *Simulation and Gaming, 32,* 194-204.

Nestel, D., & Bearman, M. (2015). Theory and simulation-based education: Definitions, world-views, and applications. *Clinical Simulation in Nursing, 11,* 349-354. doi.org/10.1016/j.ecns.2015.05.013.

Nickerson, M., & Pollard, M. (2010). Mrs. Chase and her descendants: A historical view of simulation. *Creative Nursing, 16*(3), 101-105.

OAC 4723-5-13. (2017). *Curriculum for a registered nursing education program.* Retrieved from http://codes.ohio.gov/oac/4723-5-13

Orsolini-Hain, L., & Waters, V. (2009). Education evolution: A historical perspective of associate degree nursing. *Journal of Nursing Education, 48*(5), 266-271.

Owen, H. (2012). Early use of simulation in medical education. *Simulation in Healthcare, 7*(2), 102-116. doi 10.1097/SIH.0b013e3182415a91

Page, J.B., & Daley, B.J. (2009). Situated cognition: A learning framework to support and guide high fidelity simulation. *Clinical Simulation in Nursing, 5,* e97-e103. doi:10.1016/j.ecns.2009.03.120

Parker, R., McNeill, J., & Howard, J. (2015). Comparing pediatric simulation and traditional clinical experience: Student perceptions, learning outcomes, and lessons for faculty. *Clinical Simulation in Nursing, 11*(3), 188-193: doi: http://dx.doi.org/10.1016/j.ecns.2015.01.002

Pauly-O'Neill, S., Prion, S., & Nguyen, H. (2013). Comparison of Quality and Safety Education for Nurses (QSEN)-related student experiences during pediatric clinical

and simulation rotations. *Journal of Nursing Education, 52*(9), 534-538 5p. doi:dx.doi.org/10.3928_01484834-20130819-02

Perla, P. (1990). *The art of wargaming*. Annapolis, MD: Naval Institute Press.

Pierce, E.C. (1996). The 34th Rovenstine lecture. 40 years behind the mask: safety revisited. *Anesthesiology, 84,* 965-975.

Polit, D.F., & Beck, C.T. (2012). *Nursing research: Generating and assessing evidence for nursing practice* (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Quality and Safety Education for Nurses (QSEN) Institute. (2013). *Project overview.* Retrieved from http://qsen.org/about-qsen/project-overview

Reedy, G.B. (2015). Using cognitive load theory to inform simulation design and practice. *Clinical Simulation in Nursing, 11,* 355-360. doi.org/10.1016/j. ecns.2015.05.004

Richardson, J., Goldsamt, L. A., Simmons, J., Gilmartin, M., & Jeffries, P. R. (2014). Increasing faculty capacity: Findings from an evaluation of simulation clinical teaching. *Nursing Education Perspectives, 35*(5), 308-314. doi: 10.5480/14-1384

Rosen, K. (2014). The history of simulation. In A.I. Levine, S. Demaria, A.D. Schwartz, & A.J. Sim (Eds.), *The comprehensive textbook of healthcare simulation* (pp. 5-49). New York, NY: Springer.

Rutherford-Hemming, T., Lioce, L., Kardong-Edgren, S., Jeffries, P. R., & Sittner, B. (2016). After the National Council of State Boards of Nursing simulation study—Recommendations and next steps. *Clinical Simulation in Nursing, 12*(1), 2-7 6p. doi:10.1016/j.ecns.2015.10.010

Schnorrenberger, C.C. (2008). Anatomical roots of Chinese medicine and acupuncture. *Journal of Chinese Medicine*, *19*: 35-63.

Schunk, D. H. (2008). Cognitive learning processes (pp. 183-233). *Learning theories: An educational perspective* (5th ed.). Upper Saddle River, NJ: Pearson Education.

Selanders, L. C., & Crane, P. C. (2012). The voice of Florence Nightingale on advocacy. *Online Journal of Issues in Nursing, 17*(1). doi:10.3912/OJIN. Vol17No01Man01

Shearer, R., & Davidhizar, R. (2003). Using role play to develop cultural competence. *Journal of Nursing Education, 42*(6), 273-276.

Smiley, R. (2019). Survey of simulation use in pre-licensure nursing programs: Changes and advancements. *Journal of Nursing Regulation, 9*(4), 48-61. doi: 10.1016?S2155-8256(19)30016-X

Smith, R. (2010). The long history of gaming in military training. *Simulation and Gaming, 41*(1): 6-19. doi:10.1177/1046878109334330

Soccio, D. (2017). Effectiveness of mental health simulation in replacing traditional clinical hours in Baccalaureate nursing education. *Journal of Psychosocial Nursing & Mental Health Services, 55*(11), 36-43. doi: 10.3928/02793695-20170905-03

Society for Simulation in Healthcare. (2017). *Accreditation FAQ*. Retrieved from http://www.ssih.org/Accreditation/FAQ

Tetzlaff, J. E. (2007). Assessment of competency in anesthesiology. *Anesthesiology, 106*(4), 812-825.

Texas Board of Nursing. (2015). *Texas Board of Nursing 3.8.6.a. education guideline: Simulation in pre-licensure nursing education.* Retrieved from https://www.bon.texas.gov/pdfs/education_pdfs/education_nursing_guidelines/3.8Clinical_Learning_Experiences/3-8-6-a.pdf

Tschetter, L., Lubeck, P., & Fahrenwald, N. (2013). Integrating QSEN and technology to address rural health care: Initial outcomes. *Clinical Simulation in Nursing, 9*(10), e469-75 1p. doi:10.1016/j.ecns.2012.09.005

Tunis, E. (1954). *Weapons: A pictorial history.* New York, NY: World Publishing.

Twelker, P.A. (1968). *Simulation: An overview*. 56p. mimeographed paper, Teaching Research, Monmouth, Oregon. Retrieved from http://eric.ed.gov/?id=ED025459

Van Merri€enboer, J. J. G., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review, 17*(2), 147-177. http://doi.org/10. 1007/s10648-005-3951-0.

Virginia Board of Nursing. (2013). *Guidance document 90-24.* Retrieved from https://www.dhp.virginia.gov/nursing/nursing_guidelines.htm

WAC 246-840-534. (2016). *Use of simulation for clinical experiences in LPN, RN, or RN to BSN nursing education programs located in Washington state.* Retrieved from http://apps.leg.wa.gov/WAC/default.aspx?cite=246- 840-534

Walker, L.O., & Avant, K.C. (2005). *Strategies for theory construction in nursing* (4th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Weiner (1959). *An introduction to war games.* Santa Monica, CA: Rand. Retrieved from http://www.rand.org/content/dam/rand/pubs/papers/2008/P1773.pdf

Wilson, A. (1993). The promise of situated cognition. In S. Merriam (Ed.), *An update on adult learning theory* (Vol. 57). San Francisco, CA: Jossey-Bass Publishers.

Zayyan, M. (2011). Objective structured clinical examination: the assessment of choice. *Oman Medical Journal, 26*(4), 219-222.