A QUANTITATIVE ANALYSIS OF THE EFFECT OF SIMULATION ON MEDICATION ADMINISTRATION IN NURSING STUDENTS

By

Casey Scudmore

A Dissertation Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Education Curriculum and Instruction

UNIVERSITY OF PHOENIX

September 2012
Copyright

The copyright information will be added after final quality review.
The Dissertation Committee for Casey Scudmore certifies that this is the approved version of the following dissertation:

A QUANTITATIVE ANALYSIS OF THE EFFECT OF SIMULATION ON MEDICATION ADMINISTRATION IN NURSING STUDENTS

Committee:

Karen Halvorson, EdD, Chair

Karen Cowell, PhD, Committee Member

Ruth Rucker, EdD, Committee Member

Karen Halvorson
Karen Cowell
Ruth Rucker

Jeremy Moreland, PhD
Executive Dean, School of Advanced Studies

Date Approved: June 6, 2013
Abstract

Medication errors are a leading cause of injury and death in health care, and nurses are the last line of defense for patient safety. Nursing educators must develop curriculum to effectively teach nursing students to prevent medication errors and protect the public. The purpose of this quantitative, quasi-experimental study was to determine if high-fidelity simulation was an effective learning strategy to train associate degree nursing (ADN) students to reduce medication errors. Kolb’s Experiential learning theory provided the framework of the study. ADN students applied past knowledge to an adult medical-surgical simulation and made errors when administering medication. The students participated in self-reflection during a debriefing session. The students applied new knowledge in a second simulation and made fewer errors. This study determined that the ADN students made fewer medication errors after participating in high-fidelity simulation (p<.05). This is the first study that addresses using simulation as a learning strategy to decrease medication errors in ADN students, filling a gap in the research.
Dedication

I would like to dedicate this work to my husband who has endured, listened, and supported me without question. I would like to thank my husband for encouraging me to pursue this lifelong dream and listening to me describe at length the research process, statistics, and simulation. My children are too young to understand, but they helped motivate me to complete this project and show them that they are capable of anything with hard work and perseverance. I would also like to dedicate my success to my mom who accepts me for who I am, loves me unconditionally, and someone I greatly respect and admire.

I would like to say that this doctoral journey would not have been possible without support from my Grandpa Ben and Grandma Peggy who taught me that I could do anything that I set my mind to and that I would do something great with my career, my Grandpa Eddie who always reminded me of how important and precious life was and my Aunt Andee, an incredible nurse and mentor, who I always wanted to be when I grew up!
Acknowledgements

This is my chance to express my deepest appreciation for those individuals who helped me complete this research study and accomplish a lifelong goal. Dr. Karen Halvorson stepped in when I had no dissertation chair and provided me with enduring guidance, patience, and positive enthusiasm for this work, and I will be forever grateful. Dr. Ruth Rucker also agreed to serve as a committee member and offered me quick and honest feedback to ensure my success. Dr. Karen Cowell provided me with support and helped me with the vital details I may have overlooked. I would also like to thank Dr. Pauly O’Neill who wrote the data collection tool for my study and graciously shared it, helping to inspire my research design.

Lyndi Vela, Kelsey David, and Elizabeth Sundberg were essential to my data collection and helped me stay organized during the data collection process. Lyndi was with me every day, and I am sincerely grateful for her assistance. I thank Wendy Carter, my student, mentee, colleague, and friend who helped inspire, motivate, and keep me going when times were stressful. Every time I spoke with her I gained a new perspective or new idea that helped me move forward.

I would like to thank my undergraduate teachers who helped me build a foundation of knowledge and love of learning that assisted my journey into education. Antelope Valley College was instrumental in allowing me to collect my data in a state of the art simulation laboratory. I must recognize my colleagues who provided me with unending support and positive words of encouragement at every turn. I genuinely thank Aeron Zentner for helping me wade through the statistics and for providing essential guidance in my data analysis process. I would like to extend my appreciation to my University of Phoenix residency
facilitators, especially Dr. Leona Lobell who taught me that feedback is a gift. Lastly, I would like to convey my appreciation and pride to my students who saw the value of participating in a study that would advance the profession of nursing.
# TABLE OF CONTENTS

| LIST OF TABLES | xi |
| LIST OF FIGURES | xii |
| **CHAPTER 1: INTRODUCTION** | 1 |
| Background of the Problem | 1 |
| Problem Statement | 3 |
| Purpose of the Study | 3 |
| Significance of the Study | 5 |
| Significance of the Study to Leadership | 5 |
| Nature of the Study | 6 |
| Theoretical Framework | 7 |
| Research Questions and Hypotheses | 9 |
| Definitions | 9 |
| Assumptions | 11 |
| Scope and Delimitations | 11 |
| Limitations | 11 |
| Summary | 12 |
| **CHAPTER 2: LITERATURE REVIEW** | 14 |
| Introduction | 14 |
| Literature Search | 15 |
| Historical Overview | 16 |
| Simulation | 17 |
| Learning Outcomes | 17 |
| Perception | 21 |
List of Tables

Table 1: Frequency of Medication Errors.................................................................64
Table 2: Paired t-test..............................................................................................65
Table 3: Power Analysis.........................................................................................68
List of Figures

Figure 1: Cycle of Learning.................................................................8

Figure 2: Pre and Post Mean Comparison........................................69
Chapter 1: Introduction

Medical errors are a major cause of injury and mortality in health care (Kohn, Corrigan, & Donaldson, 1999). Medication administration errors account for 1.5 million injuries annually (NLN, 2006). Factors leading to medication errors include distraction, workload, time of day, lack of experience at the associate degree level, transcription errors, increasing patient acuity, progressively more complex decision making requirements, and greater responsibility in nursing (Harding & Petrick, 2008; Jones, 2009; Sheu, Wei, Chen, Yu, & Tang, 2008; Tang, Sheu, Yu, Wei, & Chen, 2007). Through education, nurse leaders strive to find new and innovative ways to prepare associate degree nursing graduates for an increasingly complex healthcare environment (Harding & Petrick, 2008). This chapter presents an overview of the completed study focused on the effects of high fidelity simulation on medication errors in nursing students. The chapter will include the problem, purpose, significance, theoretical framework, research questions, scope, and limitations.

Background of the Problem

In 1999, the Institute of Medicine released its landmark study, To Err Is Human, revealing preventable medical errors that occur in hospitals, leading to 98,000 deaths annually (Kohn, Corrigan, & Donaldson, 1999). An analysis of errors in 2004 revealed that these errors had not decreased even after considerable funding and media coverage and a death rate increase to 290,000 deaths annually (Bogner, 2009). Balas, Scott, and Rogers (2004), found that medical errors were grossly underreported because nurses caught the majority of errors prior to patient receipt of the medication. It is essential when discussing medication administration errors that a systems approach is utilized. When discussing medical errors, the provider is not the sole person responsible for the error. There are many
processes in place to help protect the public, and many double checks occurred prior to medication administration to the patient. The nurse at the bedside is the last line of defense and the most important person in prevention of patient harm (Bogner, 2009).

The National Council of State Boards of Nursing (NCSBN) recommended in 2009 that educators in nursing alter curriculum development to address the changing complexities of health care delivery. Nursing schools were encouraged to use more technology to improve patient safety and prevent errors (NCSBN, 2009). The Quality and Safety Education for Nurses (QSEN) project developed guidelines for nursing schools based on the competencies outlined by the Institute of Medicine (IOM), as a way to standardize benchmarks taught in nursing schools with the goal of improving patient safety (QSEN, 2011). The QSEN competencies can be incorporated into nursing simulation scenarios. The QSEN competencies include the most important aspects of nursing such as evidence based practice, patient centered care, patient and environmental safety, teamwork and professional collaboration, and continuous quality improvement.

A report by Classen et al. (2011) stated that medication errors accounted for approximately one third of hospital admissions. Due to limited clinical experience, nursing students may be at higher risk for making mistakes (Wolf, Hicks, & Serembus, 2006). According to the National Council for Medication Error Reporting (2001) from 1999 to 2003, 1305 errors were reported by nursing students. Over half of those errors required additional monitoring or caused injury to a patient.

Medication errors pose a serious threat to national patient safety (Kohn, Corrigan, & Donaldson, 1999). Nursing students must be taught with effective strategies to prevent these errors when they become registered nurses. Simulation is a teaching strategy used in nursing
education to allow nursing students to practice learned skills in a safe and realistic environment on a computerized mannequin, without risk of harm to a patient. Previous studies have shown support for the ability of simulation education to decrease medication errors in novice nurses (Ford, Seybert, Smithburger, Kobulinsky, Samosky, & Kane-Gill, 2010; Sears, Goldsworthy, & Goodman, 2010).

**Problem Statement**

The general problem is the increased rate of medication errors in health care (Kohn, Corrigan, & Donaldson, 1999). Medication errors are a leading cause of injury and death in health care (NLN, 2006). Nursing educators must find innovative ways to teach nursing students how to prevent medication errors as a way of protecting the public and in response to the NCSBN. The specific problem is how to structure educational training effectively to reduce medication errors in nursing students. The quantitative, quasi-experimental study focused on the application of high fidelity simulation to associate degree nursing (ADN) students to determine the effect on medication errors. The study took place in an ADN program at a two-year community college in Southern California.

**Purpose of the Study**

The purpose of this quantitative, quasi-experimental study was to examine the use of simulation as a learning strategy to decrease medication errors. A quasi-experimental study was appropriate because it was impossible to control all of the variables in the experiment. The dependent variable was the number of medication errors and the independent variable was the high-fidelity simulation experience. There are many systems and individuals involved in the process of patient care where errors commonly occur and the study concentrated on medication administration in nursing (Anthony, Wiencek, Bauer, Daly,
& Anthony, 2010). The sample was taken from students who had completed first semester, medical-surgical nursing fundamentals and the intravenous (IV) module at a community college in Lancaster, California. Students who had completed the first semester of the nursing program and the intravenous medication module are able to administer all types and routes of medication except for intravenous push. A convenience sample of approximately 60 students was desired to gather data regarding reduction in medication error rates using simulation.

High fidelity simulation incorporates the highest level of realism by incorporating a robotic mannequin with many human-like attributes (Durham & Alden, 2008). The simulation process starts with orientation to the equipment and expectations of the students and faculty involved. The students are given objectives that are the focus of the simulation scenario and related to previously learned content. The students are usually in groups of three to five and sometimes more if observing. The students have a scenario with all of the patient information necessary to participate in simulation. The students must assess the patient and gather data like laboratory values, cardiac rhythm, lung sounds, and anything else pertinent to the care of the robotic patient. The students must make decisions about how to care for the patient, and the faculty member using the computer makes the mannequin respond as closely as possible to what a real person would do in the clinical environment. The students reevaluate and make new plans. After the objectives of the scenario are met, the faculty member stops the simulation and the group enters the debriefing session. During the debriefing the students reflect on their actions (Jeffries & Rizzolo, 2006).

Studies have examined the factors involved that have an influence on nursing student medication administration errors in nursing students (Wolf, Hicks, & Serembas, 2006,
Harding & Petrick, 2008; Reid-Searl, Moxham, Walker, & Happell, 2008; Reid-Searl, Moxham, Happell, 2010). Three studies have explored the use of simulation to reduce medication errors in nursing students. Two of these studies focused on BSN students (Gantt & Webb-Corbett, 2010; Pauly-O’Neill, 2009). Sears, Goldsworthy, and Goodman (2010) examined senior nursing students and the use of simulation to decrease medication errors and general patient safety measures. The gap in the research is the lack of knowledge about the effects of high-fidelity simulation and medication administration in ADN students.

**Significance of the Study**

The significance of the study is evident in the reduction in medication errors and the protection of the public. The study may help to determine if medication errors are prevented through learning strategies such as simulation and may help inform best practices of curriculum integration of simulation in ADN programs. Several studies show medication errors are a serious problem with nursing students. Wolf, Hicks, and Serembus (2006) observed 1,305 medication errors over a five-year period. Reid-Searl, Moxham, Walker, and Happell (2008) found 32% of students interviewed admitted to making at least one medication error. Pauly-O’Neill (2009) found only 22% accuracy in nursing students’ abilities to correctly administer intravenous (IV) medications to pediatric patients.

**Significance of the Study to Leadership**

There is a significant impact on leadership in nursing education as a result of the study. This study may help nursing faculty members determine where simulation will provide the most influence and may identify if it is a viable teaching strategy when attempting to reduce medication administration errors. Hospital leadership will also be affected because of their interests in patient safety and reducing medication errors in the
hospital setting. Nursing students practice in the hospital environment and are the future workforce. If simulation provides medication administration error reduction, it may be a strategy worth adopting for use with the education of hospital staff nurses.

**Nature of the Study**

The quantitative, quasi-experimental study occurred in a nursing simulation laboratory in a public community college in Lancaster, California. Quantitative research was the appropriate method due to the format of the research questions and hypothesis. Quantitative methods were appropriate for this study because of the narrow nature of the problem and the ability to observe and measure data in an effort to reject a hypothesis or fail to reject a hypothesis (Creswell, 2009). The quasi-experimental design is the preferred way to determine if a change occurs after an intervention is applied. A true experimental design was not plausible because the study involved too many variables that could not be completely controlled (Black, 2005).

The sample consisted of students currently enrolled in the nursing program and had completed first semester and the intravenous module. Each group consisted of three students. A power analysis helped to determine the strength of the sample size. The students participated in one simulation scenario including medication administration and the medication errors were marked on a checklist. The students participated in a debriefing session with discussion about what errors were made and how they could have been avoided or corrected. The students participated in a slightly different second scenario, but utilized the same skills as the first scenario. The medication administration errors were marked during this time using the same checklist. The data was input into a Microsoft Excel spreadsheet and SPSS software was used to collate and analyze the data. The data was analyzed to
determine if there was a reduction in medication errors after participation in the simulation and debriefing. Qualitative research methods could not be employed in this study because it was not a broad concept, did not involve describing the simulation experience, and did not use textual data for analysis (Creswell, 2009).

**Theoretical Framework**

Kolb’s experiential learning theory provided the framework for the study. Experiential learning theory entails using the information learned from the textbook in a real life situation to build on previous learning. In simulation, nursing students have the opportunity to use abstract knowledge actively in a realistic and meaningful way. Students experience simulated patient responses to the student’s actions and create meaningful connections in the student’s brain between the actions taken and the patient response. After experiencing this phenomenon, students have the opportunity to reflect upon their behavior and patient response to their nursing intervention. Students determine what they did incorrectly and what they would try next time. The final step in Kolb’s learning theory is the ability to implement these reflexive behaviors to determine their effectiveness (Kolb, 1984).

In this study, the students participated in the first simulation scenario involving administration of medication. This first simulation experience was the concrete experience in Kolb’s experiential learning theory. This was the time when the student tried to apply knowledge from experience and coursework to a realistic situation with a robotic mannequin. After the simulation experience, the student participated in a debriefing session with all participants and observers. During the debriefing period, the student reflected upon behavior, response of the patient and areas for improvement and success (Durham & Alden, 2008). This was the self-reflection portion of Kolb’s theory. The expectation was that the
student would find meaning in the reflective portion and commit the new information to memory. Finally, the student had the opportunity to participate in a second simulation. The second simulation scenario was similar with minor changes and the same skill requirement as the first simulation. The student attempted to apply the new knowledge to this situation, completing the cycle of experiential learning (Kolb, 1984). A visual schema illustrating the study related to the cycle of learning is provided below.

Figure 1. Cycle of Learning

Figure 1. The cycle of learning derived from Kolb’s Experiential Learning Theory. The student participates in the simulation and obtains hands-on experience. The student participates in a debriefing and self-reflection of analyzes areas of improvement. The student learns from mistakes and makes a plan for future experiences. The student participates in a second simulation and applies the new learning in a hands-on environment.
**Research Question and Hypothesis**

The following question guided the study:

Research Question 1: How does simulation affect medication administration errors in nursing students?

H0: There is no significant change in number of medication administration errors, between the first and second simulation sessions.

HA1: There is a significant decrease in number of medication administration errors between the first and second simulation sessions.

HA2: There is a significant increase in number of medication administration errors between the first and second simulation sessions.

**Definitions**

**High fidelity simulation:** High fidelity simulation refers to a realistic environment in which students practice nursing skills without risk of harm to the patient. Realism is developed by using a robotic mannequin with many human-like characteristics with the appropriate physiological response to nursing interventions (Ironside, Jeffries, & Martin, 2009).

**Debriefing:** Debriefing is the time after the simulation scenario when students take time to reflect upon each student's actions, patient responses, events that were successful, and events that should have been handled with different actions. The facilitator or instructor helps direct the debriefing by asking questions about the events in the scenario, the objectives, and critical points of which students need to be aware. For example during a simulation involving medication administration, the facilitator has the students discuss the steps taken to administer the medication, communication involved in the medication administration, and
patient response. The facilitator also ensures that students are aware of any errors or adverse reaction by the robotic patient (Ironside, Jeffries, & Martin, 2009).

**Human patient simulator:** SimMan3G by Laerdal will be the robotic mannequin in the simulation scenarios. SimMan3G is wireless and has lung, heart, bowel sounds, electrocardiogram, blood pressure, as well as tactile features like pulses. The faculty member can speak through the mannequin and can cause response from the mannequin with bodily fluids such as bleeding, sweating, or tears (Durham & Alden, 2008).

**Medication administration:** The act of giving medication to a patient by various methods: IV, intramuscular, by mouth, or rectally. The student must verify the medication with the physician order and determine if the medication is the correct dose for the patient and review side effects and contraindications. The student must review the medication administration record to determine when the last dose of medication was given and if it is safe to administer at the scheduled time. The student must then verify the correct patient by using two identifiers such as birthday and hospital identification number. The student must ask the patient to state their full name and birthday and compare the medication record with the patient identification armband. The student must also verify patient allergies and correct route of the medication. After the patient has received the medication, the student must assess for any reaction or effectiveness of the medication. The student must also document the medication in the chart (Hughes & Blegen, 2008).

**Medication error:** Deviation from the six rights of medication administration of nursing: right patient, right drug, right time, right route, right dose, and right documentation (Hughes & Blegen, 2008).
**Assumptions**

Many assumptions existed in the development of the study. Nursing students would buy-in to the simulation environment as realistic and act professionally. Nursing students would attempt to administer medication in the simulation lab exactly as they would in the hospital setting. Nursing students would make medication errors. Nursing students may have had increased anxiety approaching performing in the simulation lab because of fear of a low grade or knowing they were observed. To negate these effects, students were informed prior to the simulation experience that they were not being graded on performance. The students received an orientation at the beginning of the program to high fidelity simulation and signed a confidentiality waiver.

**Scope and Delimitations**

The scope of this study included ADN students with the hopes that the results would be generalizable to other groups of students. The students in the Antelope Valley College associate degree nursing program were a diverse group in a Board of Registered Nursing approved program (AVC, 2012). The delimitation included only those students who had completed first semester fundamentals because of the training in similar medication administration methods and pathophysiology in an effort to provide consistency. Students in first semester did not have all of the competencies to administer medication by all routes and the students in all other semesters were taking specialty content that varies in the amount and type of medications.

**Limitations**

Limitations to this study included lack of funding for additional personnel to assist with data collection. Various faculty members had expressed interest in improving the
nursing program, and willing to assist in data collection. Sample size may not have been adequate for statistical significance and a power analysis was conducted for determination of statistical strength. The realism of the simulation scenario was vital to the learning process of the student (Jeffries & Rizzolo, 2006). Technological issues could have occurred and prior to the simulation experience, the computers and mannequins were routinely tested for hardware and software functioning. Students were asked to volunteer in simulation outside of class time and the study may have been limited if only the students with the highest grades or motivation agreed to participate.

**Summary**

Medication errors in nursing are a safety hazard to the public and nurse educators must identify and use teaching strategies effectively to prevent registered nurses from making these errors. Nursing students have a lack of experience in the clinical setting and could be at a higher risk of making errors. Simulation is a teaching strategy that research shows is beneficial in many aspects of nursing education. The study may provide information about how effective simulation is in reducing medication administration errors in associate degree nursing students.

Chapter 2 contains a review of the literature surrounding the proposed study to illustrate the gap in knowledge related to simulation and medication errors starting with a discussion of the process of literature review. The literature review is divided into two major categories: studies related to simulation and studies related to medication administration in a historical and current perspective. The simulation literature review is further divided into the specific areas that have been researched including: learning outcomes, student perception, skill development, critical thinking, confidence, emergency preparedness, and care of
multiple patients. The medication administration section is divided into types and causes of errors and teaching strategies for improvement.
Chapter 2: Review of the Literature

The principal objective of an associate degree nursing program is to produce nursing graduates capable of providing safe, competent care to the public (Failla, Maher, & Duffy, 1999). Simulation is one teaching strategy that has shown to achieve beneficial outcomes in nursing students. Studies have shown simulation improved confidence, critical thinking skills, leadership skills, communication, teamwork, and the exposure of students to patient care scenarios not accessible to students while in clinical settings (Jeffries & Rizzolo, 2006; Lewis & Ciak, 2011; Gudhe, 2010). The purpose of this quantitative, quasi-experimental study was to examine the use of simulation as a learning strategy to decrease medication errors. This chapter contains a review of the relevant literature related to simulation in nursing and medication administration. Research will be discussed that supports the need for the proposed study from a historical and current perspective. This chapter will include the literature search, historical overview and current findings.

First is a discussion of how the literature search was conducted, followed by a review of the historical literature conducted prior to 2007. The historical review will include research conducted using simulation focusing on learning outcomes and perception of nursing students. A historical review of medication errors including the types of errors made by registered nurses and nursing students. Current findings will review simulation studies focusing on skill and knowledge development, perception of nursing students, critical thinking, self-confidence, emergency preparedness, care of multiple patients, and inconclusive findings. Current research related to medication administration errors will be discussed focusing on learning strategies for improvement of medication errors, causes of medication errors in registered nurses and nursing students and inconclusive findings.
Literature Search

A comprehensive literature review was conducted using electronic and manual resources. The in-depth search included electronic databases such as EBSCOhost, ProQuest, Gale PowerSearch, PubMed, Medline, Google scholar, national organization websites, and their publications such as the International Nursing Association Clinical Simulation Learning, National League for Nursing, and the Institute of Medicine of the National Academies (IOM). Multiple search terms were used including the following: simulation, simulation and nursing, medication errors, nursing and medication administration, adverse drug events, simulation and education, associate degree nursing students and simulation, nursing curriculum integration, and technology in nursing. A search was also conducted to determine appropriate frameworks and theories for simulation and learning. The keyword search included peer-reviewed articles, research studies and relevant books (see Appendix A).

Due to the volume of literature related to simulation and medication administration in healthcare, inclusion and exclusion criteria were developed to consider data relevant to the current study. Studies conducted prior to 2007 were considered historical. Studies conducted in 2007 and after when simulation was used routinely in nursing programs, were considered current. Excluded studies included studies that emphasized faculty professional development, simulation design, mathematical abilities of nursing students and nurses, and any research performed outside of the discipline of nursing. Research that included medication administration and nurses, medication administration and nursing students, and studies that discussed simulation as a teaching strategy and effectiveness were analyzed for relevance. Of the 208 studies, 59 studies were found to meet the inclusion criteria and
therefore were included as part of the literature review below. A comprehensive literature map of sources is included (see Appendix B).

**Historical Overview**

Associate degree nursing programs were developed out of a necessity for qualified professional nurses who had studied the vast knowledge of medicine and health care since the 1920s (Sullivan, 2010). Nursing curriculum has evolved a great deal and has developed out of necessity in response to increasingly complex illnesses of patients, increasing technological advances in health care, and increasing nursing responsibility and accountability at the bedside (Orsolini-Hain & Waters, 2009).

Nursing students are expected to perform at an entry level after completing an associate degree nursing program. They must learn and practice fundamental nursing skills in a safe setting before they can implement these skills in the hospital where there is a risk of harm to patients. Nursing schools have incorporated skills laboratories with equipment similar to the machines and devices used in the clinical setting. The skills laboratory is a place where nursing students learn how to perform vital signs, aseptic technique and infection prevention, patient hygiene, mobility assistance, medication administration, and invasive procedures. Although learning the fundamental skills in the laboratory was beneficial, educators found that students were still lacking critical thinking skills and the ability to apply fundamental skills to a realistic environment. Simulation was a possible solution for this problem (Jeffries, Rew, & Cramer, 2002).

High fidelity simulation utilizing advanced technology became popular in 2006 and 2007. Simulation in nursing education became prevalent and necessary because of the competition for clinical sites among nursing schools, the increasing complexity in patient
care, the need for nursing students to care for a patient with a specific disease process, and the need for nursing students to have the opportunity to care for high-risk patients without the risk of injury to the patient (Jeffries & Rizzolo, 2006). Prior to 2007, simulation was used to enhance learning and studies focused on the effect on learning outcomes and the perception of students. The following section is used to demonstrate the historical perspective prior to simulation being used routinely in nursing education. Medication error studies prior to 2007 measured the types and number of errors made by nurses and nursing students (Balas, Scott, & Rogers, 2004; Hereout & Erstad, 2004). Studies that offer a different view of simulation or inconclusive evidence are also discussed to demonstrate due diligence.

Simulation

Learning outcomes. Alinier, Hunt, and Gordon (2004) conducted a study of over three years in the United Kingdom using a three adult bed intensive care unit and simulation. The sample consisted of 67 second-year undergraduate nursing students. A quantitative, experimental design was used with a randomly selected control and experimental group. All of the students were given an examination to obtain baseline information about knowledge and skills. The experimental group participated in two simulation sessions. A second examination was given to all students, along with a confidence questionnaire related to using technology as a learning modality. Students from both the control and experimental group demonstrated similar confidence at the beginning of the study and the experimental group showed an increase in competence after participating in the simulation sessions. An independent t-test was used to examine the differences in improvement between the two groups and was found to be significant (p <0.05).
Learning outcomes were a major focus of simulation use. Bachelors of Science in nursing (BSN) students were used to examine the use of simulation and the ability to improve learning and critical thinking skills. Lasater (2005) conducted a mixed method study for a dissertation in 2005 with 48 BSN students and found simulation aided in the integration of learning and students learned better when actively engaged. Using descriptive statistics and ANOVA Lasater stated that the quantitative findings did not yield statistical power because of the sample size. Many themes were found qualitatively including the desire for more specific feedback and alternative outcomes based on different nursing behaviors that could have been exhibited by the students, a better understanding of the importance of collaboration among nurses, and the opportunity to reflect during the debriefing session allowed for feedback from other students and time to examine other perspectives of priorities of care.

Jamison, Hovancsek, and Clochesy (2006) determined that simulation provided significant improvement in a quantitative study with 19 BSN students related to skill acquisition. Pre-and post-test data was compared with two groups of students learning how to insert IV catheters. One group used a static mannequin arm and one used a computerized IV cannulation device with the ability to provide feedback to the student. The traditional mannequin arm group demonstrated no improvement, while the computerized IV group demonstrated improvement (p<.05) using a paired t-test. Students expressed that the ability to receive feedback from the computerized device was a very important aspect of the learning process. A limitation to this study was using only a small, single, convenience sample.

In a project sponsored by Laerdal, a major simulation equipment provider, and the National League of Nursing (2006), quantitative analysis revealed simulation helped to
promote active and diverse learning, with feedback being paramount to success. The study by Jeffries and Rizzolo (2006) consisted of four phases. The first two phases focused on design of the simulation experience. Phase three included 403 participants, 62% BSN students and 38% ADN students, with a pre and post-test design. The students completed a pre-test prior to watching a 38 minute video by a master lecturer on post-operative patient care, and then completed a post-test. The students were divided into three groups with different types of simulation. One group completed a paper/pencil case study, another group took part in a simulation using a static mannequin, and the third group participated in high-fidelity simulation with a robotic mannequin. All three of these methods were implemented with specific controls: groups of four, same patient scenario requiring post-operative nursing care, twenty minute completion time, and a twenty minute debriefing session. The facilitator observing each simulation led the debriefing session using specific scripted questions. Students were provided with an opportunity to participate in any of the three types of simulation before completion of the study and no students took this opportunity. The researchers identified a limitation of this phase as the experience of the students was limited to the learning context or the type of simulation. In the fourth phase, 110 participants from the original sample were divided in half and participated in a paper/pencil case study and high-fidelity simulation with a robotic mannequin. The findings were similar for phase three and four. Researchers found that the educational practice embedded in simulation was collaboration and that the most important design feature was the debriefing with feedback immediately after the scenario. Students participating in simulation using a robotic mannequin reported increased confidence and satisfaction with learning and an increased desire to receive feedback. Researchers found no effect on results based on role-assignment.
The students participating in the paper/pencil case study reported perceived higher expectations for performance, but little need for feedback. The knowledge gain for all students had no statistical power to support any of the three methods of learning as superior. This is an important finding because simulation was expected to produce a greater knowledge gain. Researchers also found feedback during the debriefing session improved opportunities for decision-making and problem solving development (Jeffries & Rizzolo, 2006).

Larew, Lessans, Spunt, Foster, and Covington (2006) reviewed simulation for effectiveness related to levels of prompting appropriate student level. Adult health nursing students (n=192) were observed in simulation and provided with different levels of prompting based on prior learning. If students were participating in the simulation scenario and were missing critical information or not performing a vital intervention, they were given escalating cues by the facilitator to guide them to the appropriate behavior. The cues started out very subtle and then increased in increments until the behavior was plainly stated. The more advanced student performed better with more subtle cues during the simulation scenario. This study provides information to educators when designing and implementing simulation creating a more effective learning experience for when to provide cues most effectively in simulation scenarios related to the student level. No statistical data or results were discussed in the study.

Alinier, Gordon, Hunt, and Harwood (2006) examined the use of simulation on nursing skills and competence in the United Kingdom. A quantitative pre-test and post-test design was used with a group of 99 undergraduate nursing students in a randomized control and experimental group. Students completed a test prior to the simulation exposure and
retested after a 6 month period of time elapsed. The control group did not participate in the simulation. The experimental group was divided into groups of 2 students and each participated in 2 simulations and observed 2 additional simulations. The researchers' results included better scores on the part of the experimental group (p<.001).

**Perception.** Researchers sought to discover the perception and attitudes toward simulation of nursing students to determine if it was worthwhile and aided in the process of adult learning (Bremner, Aduddell, Bennett, & Vangeest, 2006; Rhodes & Curran, 2005). Simulation has been described as a positive experience, and students and faculty have expressed the need for simulation to be a mandatory learning activity (Feingold, Callaluce, & Kallen, 2004; Rhodes & Curran, 2005; Bremner, Aduddell, Bennett, & Vangeest, 2006).

Feingold, Callaluce, and Kallen (2004) performed a study to determine the realism of simulation, the ability of students to transfer knowledge from the simulation lab to real clinical experience, and the perception of the value of the learning experience. BSN students (n=97) participated in two simulations, one scenario at the beginning of the semester and another scenario at the end of the semester. The students then completed a satisfaction survey regarding the learning experience. The researchers focused on three aspects of simulation including, realism, transferability to clinical practice, and value of learning. A confidence level of .05 was used for the statistical tests: ANOVA and t-test. Greater than 60% of the sample population rated simulation as realistic, an adequate test of nursing skill achievement, and a valuable component of learning. Unexpected results included less than 50% of the sample population expressed an increase in confidence and competence levels, and 54% believed simulation would help prepare them for providing nursing care in clinic. The t-test revealed a difference between grade-point average (GPA) groups on the element of
the perceived value of technical skills learning. Students in the GPA group of greater than 3.6 rated the value of technical skills taught to be lower than the GPA group less than 3.6, suggesting simulation might be a useful tool for struggling students. The ANOVA statistical test revealed differences related to the pace of clinical simulation being a reflection of an actual clinical setting. Those students that were younger than 22 years old rated the simulation experience more like an actual clinical setting than the older students (Feingold, Callaluce, & Kallen, 2004).

Rhodes and Curran (2005) developed a pilot simulation program for senior level undergraduate nursing students in an effort to increase critical thinking skills. Twenty-one students participated in the project in a scenario related to hemorrhagic shock. The students were provided with an orientation and learning objectives. The students participated in each simulation in groups of four and each scenario was videotaped for student and faculty review. After each scenario the observing faculty and students participated in a debriefing session. During debriefing students received immediate feedback, which included viewing their videotaped performance to review their actions during the simulation with guidance and rationale from the instructors. The feedback provided allowed the students to identify areas of strength and areas that required improvement. Students completed a survey related to their perceptions of the simulation experience. Survey results revealed students felt the experience was positive that they were provided the opportunity to use critical thinking skills in a safe environment. Students did note that sometimes it was difficult to treat a robotic mannequin as a real patient. No statistical data was offered in the researchers’ review of the study (Rhodes & Curran, 2005).
Bremner, Aduddell, Bennett, and Vangeest (2006), explored the usefulness of patient simulation as a teaching modality with novice nursing students. The researchers focused on the teaching and learning application, the realism, limitations, and student confidence when using simulation to practice nursing skills. Fifty-six BSN students participated in a head to toe assessment simulation of a high fidelity mannequin. Forty-one of the students completed a questionnaire asking about their experiences: 95% of the students rated the simulation at a level of good or higher, and 68% indicated that simulation should be mandatory. Most comments in the qualitative section of the questionnaire were positive with one student referencing the realism as inadequate due to caring for a dummy. One student discussed the inability of simulation to decrease the student's anxiety when going to an actual clinical setting.

A study conducted by Ker, Mole, and Bradley (2003) examined the perception of health professionals in the UK who participated in inter-professional simulation. The researchers focused on determining when the best time to train professionals of different disciplines on how to improve communication and interaction between various groups. Medical (n=92) and nursing (n=59) students were chosen for the study at a time when the curriculum overlapped and each group had received similar content and specific skills. A semi-structured evaluation questionnaire was completed with a response rate of 94%. The findings included positive comments related to the realistic environment, valuable to learning, learning through mistakes, sharing responsibilities, and observing each other’s roles.

Historically very few studies had been performed to examine the use of simulation in nursing education. The results demonstrated the students and faculty like simulation and that
there is a positive effect on learning outcomes. Future studies are needed to determine the areas of learning that were most affected by the use of simulation, as well as how to integrate this learning strategy into the curriculum most effectively. The next section will provide an overview of studies related to medication errors and nurses from a historical perspective.

**Medication Errors**

**Types of nursing errors.** Prior to 2007, the majority of studies related to medication errors were used to examine the types of errors made in nursing. The researchers were trying to determine causes and types of errors in the hopes that solutions could be found (Balas, Scott, & Rogers, 2004; Rothschild, Landrigan, Cronin, Kaushal, Lockley, Burdick, Stone, Lilly, Katz, Czeisler, & Bates, 2005).

The Agency for Healthcare Research and Quality (AHRQ) is a branch of the Department of Health and Human Services, a federal group that strives to improve healthcare for Americans through research and policies. According to the AHRQ (2012), medical errors are considered unintentional, preventable undesirable events due to care whether harmful or not to the patient. These types of errors are different than the medication administration errors discussed in the proposed study. Medication administration errors are adverse events that may or may not harm the patient and are directly related to the process of administering medications by the nurse (Lisby, Nielsen, Brock, & Mainz, 2010).

In 1995 Donchin studied 554 medication errors in the intensive care unit over a four month period. The authors discovered each nurse made approximately 1.7 errors per patient per day. The severity of the rating demonstrated 29% that could cause potentially critical harm to a patient and leading to decomposition of the patient's health and even death. Most of the errors were made during the day (p<.002). Physicians (46%) and nurses (54%) were
equally responsible for making medication errors regardless of the workload; physicians only
carried out 4.7% of the orders and nurses carried out 87% of the orders. Communication
was the number one cause of medication errors. This study demonstrates that strategies for
improvement must include communication.

In 1999, the landmark report published by the Institute of Medicine (IOM), *To Err is
Human: Building a Safer Healthcare System*, highlighted the severity and number of medical
errors that were occurring in the United States healthcare systems. This prompted many
national organizations to review the issue of medication administration at all levels and
search for ways to efficiently report medication errors and how to prevent them in the future
(Kohn, Corrigan, & Donaldson, 1999). A follow-up study by Leape and Berwick (2005)
revealed an increase in the number of medication errors and resulting deaths since the
original landmark report. One recommendation made in this follow-up study included a need
for better training in the reduction of errors.

Balas, Scott, and Rogers conducted a study in 2004 to determine the relationship
between staff nurse fatigue and patient safety. Staff nurses (n=393) participated in a
prospective national study using logbooks to record medication administration errors and
surrounding circumstances. Using descriptive statistics, the authors found that one-third of
the nurses made an error at least every 28 days. The reasons reported by the nurses for the
errors included variance from the standard of care, distraction during the medication pass,
patient technology interface requiring an increased amount of attention, communication
breakdown, and staff to patient ratio. Limitations that were discussed included
underreporting of medication errors and the inability to identify all actual errors and near
misses which continue to provide a vague picture of the actual number of errors and potential errors nurses make.

Hereout and Erstad (2004) studied medication errors related to IV infusions with a sample of 202 nurses in a critical care unit. Data was collected through direct observation of IV medication administration with a frequency distribution demonstrating 94% of doses were administered correctly. Medication errors discussed included incorrect weight documentation, incorrect IV fluid rate of administration, and inadequate math skills when calculating dosages. Using direct observation as the method of data collection could have influenced the actions of the nurses if they understood they were being monitored and errors were being documented.

Cousins, Sabatier, Begue, Schmitt, and Hoppe-Tichy, (2005) conducted a study in the United Kingdom, Germany, and France with a focus on medication errors and IV medications. Nurses were observed preparing and administering IV medications in hospitals in 3 respective countries. The observers watched 824 medications prepared and 798 medications administered over a 6 week to 3 month period. Errors found were related to incomplete labeling (n=559), wrong dose (n=13), wrong diluents (n=228), wrong rate (n=171), lack of hand-washing (n=412), not swabbing a medication vial during preparation (n=544), and non-clean preparation area (n=426). The results of this study demonstrate the significant number of errors based on a large number of observations and the need for improvement strategies.

Rothschild, et al (2005) conducted an observational study to explore the nature and incidence of errors in a critical care unit. Three-hundred ninety one patients were observed during a course of 1490 patient days with the percentage of errors reported. Out of 223
observed errors, 55% of errors were non-preventable, 45% were preventable, 61% were medication errors, and 20.2% resulted in adverse events. A non-preventable error occurred when a patient was injured even though the appropriate medical care was provided. A preventable error occurred when a patient suffered an injury due to medical treatment and the error was not interrupted by healthcare professionals. Both types of errors result in patient injury, but preventable errors can be avoided by consistently following the standards of care, including the six rights of medication administration. An adverse event was classified as any injury to a patient that was caused by medical treatment and not an underlying disease process such as a hospital acquired infection or a blood clot because of a medication error. Medication errors accounted for 78% of the errors observed in the critical care unit. Medication errors were most often due to a wrong dosage, but were also associated with lack of administration of preventative medications.

**Types of nursing student errors.** Only two studies were published prior to 2007 that examined errors in nursing students. The assumption existed that nursing students were supposed to make mistakes and that the mistakes would be caught prior to patient injury and was not a major focus in the research (Konkloski, Wright, & Hammett, 2001). A study conducted by Konkloski, Wright, and Hammett (2001) focused on 27 nursing students and the medication errors made related to the amount of supervision they received. The data was collected through direct observation of medication administration and analyzed quantitatively, using an ANOVA technique. The researchers found supervision as the key to preventing errors in nursing students. The percentage of errors made by nursing students was found to be less than the national average.
Wolf, Hicks, and Serembus (2006) performed a retrospective study on 1305 medication errors to determine the contribution by nursing students. Descriptive statistics were used to report that one-third of the errors were based on omission of the dose or the wrong dose of medication by nursing students. The primary causes of the medication errors were inexperience and distractions.

From a historical perspective, medication errors were not a major subject of focus until 1999 with the landmark publication by the IOM (Kohn, Corrigan, & Donaldson, 1999). A gap exists in the literature related to nursing students and medication errors. Only two studies were performed and only focused on the amount and type of medication administration errors. There was no research prior to 2007 that attempted to utilize learning strategies to decrease medication errors in nursing students.

**Current Findings**

Current simulation studies conducted since 2007 examined here focused on skill and knowledge development, perception of simulation as a learning strategy, critical thinking skills, self-confidence, emergency preparedness, and caring for multiple patients. Medication error studies since 2007 focused on causes of errors, types of errors, and the effect of simulation on medication administration skills. Research has demonstrated an increase in knowledge of theory, the understanding that assessment is not only a task, but also, a high level skill that requires critical thinking, and an increase in understanding of professional roles (Lasater, 2007; Campbell, Themessl-Huber, Mole, & Scarlett, 2007).

**Skill and knowledge development.** Simulation was used as a teaching or learning strategy for improving skill acquisition and knowledge. Researchers thought that students
would learn better through experiential learning, ability to safely make mistakes, and multisensory environments (Alinier, 2007; Brannan, White, & Bezanson, 2008).

An increase in skill development was demonstrated in several studies using BSN students as participants. Simulation was performed with pre and post-test data to determine changes in skill and knowledge. Brannan, White, and Bezanson (2008) compared traditional classroom lecture and simulation with 107 BSN students participating in a simulation study related to acute myocardial infarction. The first group of students participated in a two-hour lecture with the opportunity for questions and discussion with instructors. The second group of students did not receive the lecture and instead rotated through five different simulation stations during the same two-hour timeframe. The stations included case studies with critical thinking type questions, objectives to be completed at each station and one station that included an interactive experience with a mannequin. After each simulation experience, an instructor spent 10 minutes in a debriefing session with the students, providing feedback and asking questions about performance. A significance level was set at .05 and a t-test was performed using pre-and posttest data. The researchers found posttest scores in the simulation group to be higher than that of the lecture group. Changes in confidence level between the two groups did not reach statistical significance.

Endacott, Scholes, Buykx, Cooper, Kinsman, and McConnell-Henry (2010) designed a study to investigate how nursing students recognize subtle changes and the need for cues by facilitators during simulation. Nursing students in their final year of nursing school in Australia (n=52) were immersed in simulation scenarios with a deteriorating patient. Students were allowed to make decisions regarding the care of the high-fidelity mannequin and were given subtle cues if critical actions were not being met. The researchers found that
many times changes in vital signs were only cause for student concern when an alarm sounded and some did not react at all. Many of the cues provided to the students were not recognized, suggesting that discussion of these early cues in addition to how to identify them is a vital part of the learning process. Students also did not perform normal assessments when they suspected a specific problem, leading to the possibility of missing further cues. Students did not recognize that assessment of a patient is an ongoing task and not specified by a finite time frame.

Researchers in Canada examined the effects of using a virtual IV pump as a teaching strategy to help train nursing students in error prevention related to the skill of programming and troubleshooting real IV pumps in the hospital. Third year nursing students (n=43) participated in the use of a computer simulated IV pump with relation to a patient scenario and learning module. Students completed surveys focused on self-confidence, satisfaction and an observational checklist was used to evaluate student performance. The researchers found the experimental group who used the virtual IV to have higher self-confidence but without significant statistical data (p=.511). The mean satisfaction score was 39 out of 55 without qualitative data to support. The performance observations revealed higher scores in the experimental group (p=.287). Those students with higher performance scores also took longer to perform tasks than the control group. Very few correlations were made between satisfaction and performance (Lucktar-Flude, Pulling, & Larocque, 2010). This study provides data that suggests further studies are needed related to nursing skills and virtual format because of possible positive future results.

Shepherd, McCunnis, Brown, and Hair (2010) investigated the differences between automated and role-play simulation in the United Kingdom. Pre-registration nursing students
(n=28) participated in a longitudinal, quasi-experimental study. All students were assessed for their ability to perform vital signs as a baseline for knowledge and skills. Students at the first site (n=18) then performed a simulation including vital signs on an actor, trained to play a role. The students at the second location (n=10) performed the same simulation with a high-fidelity mannequin. All students were assessed after their simulation and in six months’ time. An independent t-test revealed no important differences between the real person and the mannequin. The qualitative portion of the study revealed that the least anxious students before the test had the greatest increase in anxiety after the simulation (p<.01). It is difficult to make any conclusions about the study with the small sample sizes.

In a study conducted at the University of Pittsburgh, School of Nursing in 2010, 125 first-year BSN students participated in a simulation study related to problem solving and critical thinking skills. All participants received a two-hour lecture on nursing process. Nursing process is a decision-making tool used as a foundation for most nursing programs that includes assessment, diagnosis, planning, intervention, and evaluation. The researchers equated the nursing process as a method for critically thinking about a problem. Graduate nursing students helped guide the first-year nursing participants through the simulation process. After each scenario, the students participated in a debriefing with a faculty member and discussed use of the nursing process and areas of strength and areas that needed improvement. A t-test was completed on the pre-and posttest data revealing that knowledge acquisition and improvement of critical thinking skills occurred with simulation as an addition to traditional lecture with a p < .001 at a 95% confidence interval. Limitations included no control group and no specific comparison between each assessment that occurred
during the simulation. Lack of simulation exposure might have affected the results by increasing anxiety in first time students (Burns, O'Donnell, & Artman, 2010).

A study of U.S. Army licensed practical nursing (LPN) students was conducted and focused on treating combat injuries. The students who used simulation demonstrated higher scores than the group that used a CD-ROM for training. Thirty-five nursing students participated in simulations on a realistic looking battlefield using high-fidelity mannequins. Each scenario took thirty minutes with a total of 90 minutes of simulation. Forty-five students used the CD-ROM which included the same injuries and timeframe as the simulation experience, without the ability to interact with the patient. Thirty-nine students served as a control group. All of the students completed a multiple choice exam. A multivariate analysis was performed with an alpha of .05. The simulation group had higher scores than the CD-ROM and control groups (p=.001) and the CD-ROM group had higher scores than the control group (p=.06). There were no differences found in critical thinking. Limitations of the study were not discussed (Johnson, Ramos-Alarilla, Harilal, Case, & Dillon, 2011).

Radhakrishnan, Roche, and Cunningham (2007) performed a quasi-experimental study with twelve senior BSN students. The control group (n=6) participated in clinic without simulation practice throughout the semester. The treatment group (n=6) participated in clinic, but also practiced caring for two robotic patients in the simulation lab prior to the clinical experience. At the end of the semester, both groups were observed caring for two complex patients in the simulation lab. The focus of the study included five aspects of nursing: safety, assessment, prioritization, delegation, and communication. The researchers determined that with simulation, students increased verification of patient identification and
focused more on the assessment and importance of vital signs. In the area of safety and basic assessment the students in the intervention group scored higher (p=.001). This study was limited by the sample size and the students in the treatment group received more practice caring for patients, which could have affected their performance. The treatment group was familiar with the simulated environment as opposed to the control group who experienced this for the first time at the end of the semester. This is one of the only studies to evaluate students in a complex patient environment in simulation.

McKeon, Norris, Cardell, and Britt (2009) explored two types of simulation: traditional patient simulation and computer-based simulation with a focus on QSEN competencies. The computer-based simulation focused on non-skill oriented concepts like conflict resolution, patient consent, assessment of patient decision making abilities, and creating a plan of care. The computer simulation consisted of a software program that uses images, character interaction, and the opportunity to make decisions based on a scenario. A pre-test, post-test design was used with BSN students (n=53). Both groups demonstrated improvement on the post-test; more improvement by the patient simulation group (p<.001). The researchers did not report the significance level used, but showed that the use of technology as a teaching strategy was effective. The purpose of the study was aimed at comparing the use of computer software with traditional patient simulation, but the researchers also helped show support for patient simulation as a learning tool. The researchers discussed the increased amount of hours required for administering the traditional simulation compared to the software program. The researchers also reported a considerable learning curve for faculty who had not performed either type of simulation. It was also reported that other factors could have affected the outcome on the post-test such as the lag-
time after the pre-test and student experiences and content lecture prior to taking the post-test.

An experimental, quantitative study with 84 pre-licensure nursing students was conducted to explore learning retention with simulation. The students were given content exam questions for the pre-test and not provided the answers. After the simulation that involved the same content as the pre-test questions, the same questions were provided as a post-test. A final examination was also given at the end of the semester with the specific length of time not mentioned. The final examination included similar content questions to the pre and post-test to determine retention of information from the simulation activity. The content varied and the researchers did not state if there was a selection process for a particular type of content matched with certain students. The content described in the report included a mastectomy question, congestive heart failure and a respiratory distress question. With a p-value of less than .001, the researchers determined that simulation caused an increase in knowledge with only fifty percent retention. The researchers found one simulation that resulted in a decrease in performance post-simulation. Prior to the scenario, the faculty member placed emphasis on correct placement of the cardiac leads and this may have led to a change in student judgment. A secondary finding that came from the results was the second year students demonstrated more improvement than the third year nursing students (Elfrink, Kirkpatrick, Nininger, & Schubert, 2010).

Lewis and Ciak (2011) examined the effects of simulation on critical thinking, satisfaction, confidence, and cognitive learning. A pre and post-test design incorporating the Student Satisfaction and Self-Confidence in Learning tool by the National League for Nursing with a Likert type scale was used. A standardized test was also given to determine
changes in knowledge and critical thinking. Students were provided with PowerPoint slides related to the theory incorporated in the simulation scenarios. After completing a pre-test, the students (n=63) participated in four pediatric simulation scenarios and four maternal-newborn scenarios. Students completed a post-test immediately following the simulation experience. Data was analyzed using a quantitative design revealing a t-test with a p-value of less .005; the students demonstrated positive satisfaction, confidence, and an increase in knowledge. No definitive inferences could be determined about changes in critical thinking skills due to conflicting data; some of the answers showed improvement and some did not when comparing the pre-test and post-test. The researchers found an unexpected result that students answered medication questions more accurately when they had the opportunity to manipulate the medication in the simulation scenario.

Sportsman, Schumacker, and Hamilton (2011) explored the impact of simulation on competence, GPA, exit examination scores, in addition to attitudes and motivation to learn. Eight-hundred ninety-five ADN and BSN students participated in a quantitative study over a period of 34 months. The number of simulations was not provided, only the number of semesters the students were exposed to simulation including two to five semesters. The amount of simulation experience depended upon the progression of enrollment of each student at the time of data collection. The senior students only participated in one semester prior to graduation and the freshmen students had the opportunity to participate in five semesters of simulation. The content of simulations was not identified. Despite finding no difference in GPA or exit exam scores for the entire group, junior nursing students demonstrated an increase in competence and the senior nursing students demonstrated an increase in leadership with a p-value of less than .001. The researchers found the anxiety
level increased over the data collection period. No possible reasons for anxiety were stated in the report. One weakness to the study included the increase in staffing, faculty expertise, and improved processes at the simulation center which may have impacted the quality and complexity of the simulation experiences over time.

**Perception.** Studies have demonstrated that students found the simulation experience to be positive and created an increase in clinical decision making skills or nursing judgment. Nursing judgment is the ability to assess the patient and situation and make decisions based on experience and theory content. Students have expressed that the use of simulation was an effective way to improve teamwork and understanding of the professional roles of the nurse (Campbell, Themessl-Huber, Mole, & Scarlett, 2007; Dillard, Sideras, Ryan, Lasater, & Siktberg, 2009).

**Critical thinking.** Critical thinking is a difficult skill to measure in nursing students and multiple studies have been conducted to determine if simulation improved clinical judgment and critical thinking. Critical thinking is an essential skill of a nurse including the ability to collect information related to a patient and make clinical decisions based on theory, evidence, and experience. Many studies have focused on critical thinking and clinical judgment due to the implications for patient safety. The following studies were conducted to determine if simulation could be used to improve critical thinking skills in nursing students (Guhde, 2010; Lasater, 2007).

Guhde (2010) conducted a quantitative study using 80 BSN students to compare simulation and critical thinking skills. In the week prior to the simulation, the students participated in online discussion related to a case study that included the content for the upcoming simulation. The students had the opportunity to determine the patient’s problems
and possible nursing actions they would implement. The students participated in a simulation and debriefing involving the patient they had been discussing online. The debriefing included reflection by the students of areas of strength and weakness and then their thought processes. The students discussed how they came to a decision and the thought process behind it. The students also wrote a two paragraph self-reflection including activities in the simulation that correctly led to the appropriate intervention and activities that led them astray to an incorrect thought process. Through a post simulation survey, Guhde found an increased awareness of how to use critical thinking skills and the process of what patient information to consider and possible outcomes of any decisions made. A weakness of the study included student difficulty with the reflection portion of the experience and responses were minimal. The problem with this study is not being able to determine if the improvement in using critical thinking skills was caused by simulation or the online discussion and preparation for the simulated experience. The only statistical information provided was obtained from the 5-point Likert-type survey on student perception of the value of their learning experience. Mean numbers were provided such as a 4.7 for utilization of critical thinking skills, 4.8 for increased awareness of assessment, and 4.7 on the importance of simulation in the nursing program. These results are perception and opinion of the student and no statistical significance information was provided.

In 2007, Lasater conducted two different studies in simulation focused on critical thinking and clinical judgment of nursing students. Lasater focused on acute medical surgical nursing students and determined through qualitative means that simulation helped the students to integrate learning, practice in a variety of experiences, and demonstrate increased clinical judgment. This information was anecdotal and provided by the students.
In a second study, Lasater developed a rubric to measure the development of clinical judgment in a quantitative manner. Cato, Lasater, and Peeples (2009) also explored the effectiveness of a clinical judgment rubric using a qualitative method with 48 junior nursing students. The results of Cato, Lasater, and Peeples' study determined that the rubric was helpful in assisting students to learn how to practice self-assessment.

**Self-confidence.** BSN students in three studies expressed an increase in self-confidence after participating in simulation (Bambini, Washburn, & Perkins, 2009; Brown & Chronister, 2009; Blum, Borglund, & Parcells, 2010). Bambini, Washburn, and Perkins, (2009) conducted a mixed method study with 112 BSN students. The simulation activities were based on obstetrical nursing and consisted of eight different stations. The stations varied from low to high fidelity, skills such as listening to fetal heart tones, and performing measurements on infant manikins. Debriefing occurred between students and faculty members at station five to provide the students with the ability to ask questions and clarify concepts. Participating students were given the option of completing a pretest and posttest regarding self-efficacy and the simulation learning stations. The researchers received a 50% response rate. Statistical analysis using a t-test was performed and revealed an increase in confidence (p<.01). Qualitative information included gaining an understanding of the importance of communication, improved confidence, and understanding how to better prioritize skills and how to intervene when problems occur with the patient. Limitations in the study included self-reported data, no control over who participated, and due to group dynamics and a variety of questions asked by students, each scenario varied slightly (Bambini, Washburn, & Perkins, 2009).
Blum, Borgland, and Parcell’s (2010) study aimed to find relationships between self-confidence of BSN students and clinical competence of BSN students using simulation with a quasi-experimental, quantitative design. The control group (n=16) performed skill demonstrations on a task trainer. A task trainer is a part of a mannequin that can be used to practice specific skills such as a plastic arm to practice IV insertion. The experimental group (n=37) performed skill demonstrations using the Laerdal SimMan high fidelity robotic mannequin with a simulation scenario. After each scenario, the students participated in a debriefing session and alternated roles for each simulation. The specific number of simulation scenarios performed was not offered in the report. Students and faculty completed the Lasater clinical judgment rubric in the middle and at the end of the study. Students were asked about self-confidence and faculty were asked about observations of clinical competence. With a confidence level of .05, a statistical t-test was performed and revealed an increase in self-confidence by students and an increase in the faculty perception of clinical competence. A correlation study was also performed and revealed a positive correlation between simulation and increasing confidence and competence.

Brown and Chronister (2009) studied 140 BSN students to determine the correlation between the timing of simulation on critical thinking and self-confidence specifically related to interpretation of ECG strips. Part of the group performed simulations weekly and the other group performed simulation at the end of the course. After completing a two sample t-test, the researchers found no significant difference in test scores on the ECG SimTest. There was a reported increase in self-confidence for students who participated in the weekly simulations compared to those who did the simulation at the end of the course. This study helps to inform curriculum integration practices and placement of simulation within a course.
Prescott & Garside (2009) conducted a mixed-method study with 45 diploma nursing students to evaluate simulation strategies in nursing education. The students completed a questionnaire before and after participating in simulation. The majority of students (n=32) had never experienced simulation prior to this study. Before the simulation, 12 of the students stated that their knowledge and skill level was poor and afterwards 26 students rated their level of skill as improved. The researchers found that simulation had a positive influence on the confidence and competence of the nursing students. No statistical data are presented in this study, but the study suggests that future research is needed because of the positive outcome.

**Emergency preparedness.** One reason for the necessity of simulation in nursing education includes the ability to re-create a realistic patient scenario that would otherwise be unavailable to a nursing student. Patients who are being defibrillated in a code situation or have suffered trauma would not be assigned to nursing students because of the risk to patient safety. In a simulated environment, nursing faculty can allow nursing students to care for any type of patient at any level of illness to improve learning (Jeffries, 2005).

Dillon, Noble, and Kaplan (2009) studied 68, 4th year BSN students and 14, 3rd year medical students in a mixed method study to identify the usefulness of an interdisciplinary approach to a code situation and the effects on clinical decision making skills. Using the ANOVA statistical analysis method, the researchers found that prior to the simulation; the nursing students had better scores on a pre-test than the medical students. After the simulation experience, the medical students had improved post-test scores. In the qualitative portion, the medical students expressed an increased realization of the importance of the nursing role. The nursing students expressed an increased understanding of the team role.
Hutchinson, Haynes, Parker, Dennis, McLin, and Welldaregay (2011) identified that nursing students were not prepared to perform in emergency situations. The researchers attempted to use simulation as a teaching strategy for improvement. In a quantitative experiment, 81 undergraduate students participated in emergency preparedness simulation scenarios. Using an ANOVA test with a p-value of .05, the students exhibited increased knowledge after simulation. A secondary finding was the sophomore students demonstrated more improvement than the senior and junior students. The authors attributed this finding to possible life experience and different faculty experiences in the nursing program.

**Multiple patients.** Radhakrishnan, Roche, and Cunningham (2007) conducted a study of BSN students and the effects of simulation on the nursing process. The study involved complex two-patient assignments. The students were required to prioritize multiple tasks, analyze multiple data sets, assess both patients, and perform safe nursing care including delegation, medication administration, and intervention. The results revealed improvements in specific areas, the majority of aspects studied were the same for the group with and without simulation. The areas that demonstrated improvement when using simulation included assessment, vital signs, and patient identification.

In a study with 24 BSN students, Gore, Hunt, and Raines (2008) examined the use of simulation with four patients per nursing student in an effort to provide the students with a more realistic view of patient to staff ratio after graduation. Gore, Hunt, and Raines also examined the level of safe care provided. The findings resulted in positive feedback from instructors and students with little information regarding the analysis or data collection methods. No negative feedback was discussed. The only disadvantage mentioned regarding simulation was an increase in faculty workload.
A study was conducted by Ironside, Jeffries, and Martin (2009) to determine the effects of multiple-patient simulation on patient safety competencies nursing students. The students were in their final semester of a nursing program and included BSN and ADN students. The sample was purposeful and included final semester students, with a mean age of 29, a majority of females, and a GPA of at least 3.4. During the simulation, a faculty member observed and collected data related to adherence to patient safety competencies using a checklist. Interrater reliability was insured by the use of a designated faculty observer. The students participated in two different simulations followed by a twenty minute debriefing session. Statistical analysis included a paired t-test to compare behavior between the two simulation experiences. The researchers were able to demonstrate that multiple-patient simulation lead to improvement of patient safety competencies with a p-value of less than .0002.

Inconclusive findings. Kardong-Edgren, Anderson, and Michaels (2007) organized a quantitative research study to determine the effect different levels of simulation fidelity had on test scores. Fourteen nursing students participated in the study and an ANCOVA analysis demonstrated no significant differences between levels of fidelity. The sample size was identified as a convenience sample chosen from three hundred nursing students. The authors did not state why they chose such a small sample, a major weakness of the study.

Kinney and Henderson (2008) compared the effectiveness of low-fidelity simulation with traditional lecture and medication administration in a quantitative, experimental test involving 42 ADN students. The researchers provided a post-test directly after the simulation and four months later to look at retention of information. The findings revealed
no significant differences on retention of knowledge, suggesting the low-fidelity simulation and traditional lecture had the same effects on retention of the content.

Kuiper (2008) compared the outcomes of experiential learning to real-world application in clinical. The researchers also wanted to determine the effectiveness of the Outcome Present State Test Model (OPT). OPT is a model that helps to outline effective methods of using clinical reasoning to make decisions. The OPT model also includes worksheets students can fill out to aid in reflection of decision-making. A mixed method study was conducted with 44 students and data was analyzed using a t-test. Students were provided with a patient scenario and four hours of simulation. The participants completed an OPT worksheet before and after the simulation experience. No differences were found related to the use of clinical reasoning between the simulation and traditional clinical experience.

Kardong-Edgren, Starkweather, and Ward (2009) studied sixty-five BSN students in an experimental setting to determine what type of simulation results in the greatest improvement of learning. Three groups were used to compare the VitalSim mannequin, SimMan mannequin, and no mannequin learning methods. The VitalSim is a less sophisticated mannequin than SimMan but has the instructor ability to show different vital signs on a monitor for the students. The students were provided with a study packet at the beginning of the study, focusing on acute coronary syndromes. All participants attended a fifty minute lecture, the VitalSim and SimMan groups also participated in a fifteen minute simulation with the VitalSim or SimMan mannequins, followed by a fifteen minute debriefing. An ANOVA statistical analysis was performed and no differences were found between the three groups.
Adamson (2011) examined the effectiveness of simulation on teaching affective, cognitive, and psychomotor domains in a simulation environment compared with a case study format. The affective domain was measured using the Student Satisfaction and Self-Confidence tool designed by the NLN. The cognitive domain was examined using a content related test developed by Elsevier. The psychomotor domain was tested in the simulation lab using the Clark Simulation Evaluation Tool. This tool helps an observer to identify specific nursing behaviors that are appropriate to the patient in the simulation exercise. Using 14 participants in a quasi-experimental, quantitative study, no significant differences were found. Adamson (2011) stated that the results were directly related to the small sample size.

Ross (2011) compared teaching strategies used for the skill of intramuscular (IM) injection administration in 55 BSN students. One group of students participated in simulation and the second group used traditional clinical skills practice to learn how to administer medication via the IM route. The students were tested in a flu clinic and in the skills lab to identify if the skills learned in simulation or traditional laboratory transferred to a patient care setting. An ANCOVA analysis revealed no statistically significant changes in student performance between the two groups.

The previous studies have shown the success and usefulness of simulation in nursing and the various ways nursing students can benefit from this teaching modality. Researchers have started to consider simulation as a way to improve patient safety behaviors in nursing students by using simulation to practice these skills and illustrate the importance of following the standard of practice. The following section illustrates the studies that have been conducted to determine the success of simulation as a way to reduce medication errors.
Medication Administration Errors

This section will include a discussion of the current studies that have been performed on medication administration skills of nursing students. These studies are also used to demonstrate the gap in literature related to the use of simulation as a method to reduce medication errors in associate degree nursing students.

Strategies for improvement. Pauly-O’Neill (2009) conducted an in-depth study related to medication errors and nursing students in a pediatric setting. The study included the observation of 20 medication administrations in pre-licensure master's degree entry-level students. The students were observed administering medication in a simulation environment and medication administration errors were tabulated and categorized by type on a validated checklist (see Appendix C). In the pre-intervention period, the nursing students only administered medication correctly 22% of the time. The areas that were found to be inadequate include dilution of medication, calculating the correct IV rate, selecting appropriate needle length and gauge, and administering medication through the correct IV port. Students only chose the correct medication 30% of the time and diluted correctly 29% of the time. Students correctly identified the patient 95% of the time, administered the medication at the correct hour 90% of the time, and chose the right route 88% of the time. The students took part in the intervention which included time to practice, lecture, available resources, role modeling in the simulation lab, treating each medication administration in the simulation lab as authentic, and a zero error in simulation policy. After the intervention, 30 medication administration observations were made. Students demonstrated identifying the right patient and the right route 100% of the time. Students also increased administering the right dose of medication from 30% to 93% of the time. The significance of the study
conducted by Pauly-O’Neill (2009) is the illustration of medication errors beginning in nursing school. Problems with this study include a small number of medication administration observations of 20 to 30 and the post-intervention consisted of more observations than the pre-intervention.

**Causes of medication errors in nurses.** Kazaoka (2007) sought to find out the problems with communication and teamwork that surrounded medication administration in nursing. Third year nursing students (n=100) and nurses (n=163) worked together to administer medications. The researchers found that as nurses gained more experience, they were less inclined to have other nurses confirm that medications were correctly prepared. Errors occurred because nurses were not consistently preparing their own medications for administration and were relying on others without verifying accuracy. The evidence supported the importance of the administering nurse also preparing his or her own medications.

Sheu (2008) used a questionnaire to determine the types of medication administration errors being made with 85 nurses. Using descriptive statistics, the researchers found 328 errors mostly on day shift by nurses with less than 2 years of experience. One-third of the errors were the wrong drug or dose. Near misses that were caught prior to administration were found during a confirmation of the medication by a second nurse.

Tang (2007) examined causes of medication errors in nursing by using a qualitative questionnaire format. 72 RNs participated in the study and responses were analyzed using descriptive statistics. Themes for the top reasons for errors included: personal neglect, heavy workload, new staff, wrong dose, wrong drug and 76% of errors were multi-factorial.
Ford, Seybert, Smithburger, Kobulinsky, Samosky, and Kane-Gill (2010) studied 24 nurses to look at medication error rates after traditional lecture or simulation. Using a chi-square, fisher’s exact, and Mann-Whitney U statistical analysis, the researchers found that simulation helped decrease medication errors from 30% to 4%. No significant difference was noted after only traditional lecture, suggesting that simulation was an effective teaching strategy for reducing medication errors in nurses.

**Causes of medication errors in nursing students.** Harding and Petrick (2008) performed a retrospective review of medication errors by BSN students in Canada. The review encompassed a three-year period of time where 77 errors were made. Omission errors accounted for 34% of the reported errors where students had not given a medication. The researchers found that medications were often omitted because of a problem with the medication administration record or the student’s interpretation of the record. The majority of the medication errors occurred when a student gave the wrong medication or the wrong dosage of the medication. Factors contributing to these types of errors included not checking the physician order, unfamiliarity with the system at different clinical facilities, and double checking medications with another RN such as insulin or heparin. No specific statistical information was provided in the study. The results of this review demonstrate the need for realistic practice administering medications by nursing students.

Reid-Searl, Moxham, Walker, and Happell (2008) examined medication errors and nursing students using a grounded theory approach in Australia. A sample of twenty-eight final year nursing students participated in in-depth interviews to determine the experience of medication errors from the perspective of nursing students. The results revealed that medication errors occurred when the amount of supervision by the nursing instructor or RN
was decreased (Reid-Searl, Moxham, Walker, & Happell, 2008; Reid-Searl, Moxham, Walker, & Happell, 2010). This study suggests that direct supervision of nursing students is essential to protecting the well-being of patients.

**Number of nursing student errors.** A study conducted in Iran focused on barriers to reporting medication errors by nursing students. Koohestani and Baghcheghi (2009) used a questionnaire to determine the rate of medication error reporting by nursing students and influencing reasons for this behavior. Statistical analysis was conducted using independent t-tests, Pearson correlation, and ANOVA methods. All of the nursing students (n=240) across the program responded to the survey. The data revealed that 80% of errors were reported to the nursing instructor, revealing that medication errors in nursing students are underreported. The two barriers that were most prevalent were fear of lower grade and administrative barriers such as negative feedback from the instructor or punitive response (p<.05). This study reveals that students must learn about medication administration errors in a more productive way and the importance of reporting to improve the system process.

**Inconclusive findings.** Gantt and Webb-Corbett (2010) conducted a study with 194 nursing students to determine how simulation affects the students’ ability to protect patient safety specifically related to hand washing and patient identification. Students participated in simulation scenarios involving blood administration, tracheostomy suctioning, and intravenous therapy. Skills checklists were used to identify when students performed the appropriate and expected behaviors. After the simulation scenario, the students participated in debriefing and the checklists were used to help students identify areas for improvement. The researchers found that 61% of students performed inadequate hand washing, while 25% of students performed both inadequate hand washing and patient identification. The study
was repeated a semester later and the results indicated 48% had performed inadequate hand washing or patient identification. These results showed no improvement in skills acquisition after simulation. Detailed statistical information was not reported by the authors in the report.

**Gaps in the literature.** The gaps in the literature include the lack of studies on medication administration and associate degree nursing students. Two studies prior to 2007 identified reasons nursing students make errors as related to supervision, omission of medication, inexperience, and distraction (Konkloski, Wright, & Hammett, 2001; Wolf, Hicks, & Serembus, 2006). Reid-Searl, Moxham, Walker and Happell, (2008) demonstrated that medication errors were reduced with increased supervision by the instructor. Pauly-O’Neill (2009) studied medication errors in nursing students at the master's degree level and determined that medication errors were largely related to IV administration and mathematical ability. She revealed that simulation improved the ability of nursing students to give medication with improved safety after simulation. Ford, Seybert, Smithburger, Kobulinsky, Samosky, and Kane-Gill (2010) showed that simulation could help reduce medication errors using simulation with registered nurses. None of these studies examined the use of high fidelity simulation and medication errors in associate degree nursing students. The proposed study may fill that gap in the literature (see Appendix B).

**Summary**

Chapter 2 presented literature related to simulation in nursing education and the impact simulation made on nursing students’ self-confidence, clinical-decision making, clinic preparation, and reduction of medication errors. The literature review revealed a gap in quantitative research of medication errors and associate degree nursing students and use of
simulation for improvement. Out of forty studies related to simulation and nursing, only twelve did not use BSN students and only four clearly utilized ADN students as participants (Sportsman, Schumacker, & Hamilton, 2011; Rhodes & Curran, 2005; Kinney & Henderson, 2008; Hutchinson, Haynes, Parker, Dennis, McLin, & Welldaregay, 2011). Only one study used simulation as a strategy to reduce medication errors and unlike the completed study, MSN students were used with a large focus on medication calculation (Pauly O’Neill, 2009). The completed study may add to the knowledge related to the effects of patient simulation on the reduction of medication administration errors and incorporate a new sample of ADN students.

The literature revealed the strengths of simulation as providing a positive experience that students enjoy and can practice skills that are inaccessible to them with human patients (Bremner, Aduddell, Bennett, & VanGeest, 2006; Jeffries, 2005). The use of simulation demonstrated improvements in skill acquisition in nursing students (Brannan, White, & Bezanson, 2008). Nursing students demonstrated increased knowledge, without retention (Elfrink, Kirkpatrick, Nininger, & Schubert, 2010; Hutchinson, Haynes, Parker, Dennis, McLin, & Welldaregay, 2011). Students expressed an increase in confidence which can lead to an increased motivation to learn (Blum, Borgland, & Parcell, 2010; Brown & Chronister, 2009). The completed study is valuable because simulation has been shown as an effective learning strategy for nursing students.

The literature supported the knowledge that medication administration errors in nursing is a serious problem and needs to be addressed in nursing school (Kohn, Corrigan, & Donaldson, 1999). Medication errors are highly preventable and in the study by Rothschild et al. (2005), 45% of the errors made by nursing students could have been prevented. Wolf,
Hicks, and Serembus (2006) found that the major causes of medication errors made by nursing students are caused by inexperience. The one study using simulation as a method to reduce medication errors was successful using master’s degree nursing candidates as participants (Pauly O’Neill, 2009).

The research discussed in the preceding literature review identified areas of weakness such as small sample size, lack of realism, underreporting of errors, faculty influence, and learning curve of faculty in simulation design and implementation (Jamison, Hovancsek, & Clochesy, 2006; Bremner, Aduddell, Bennett, & VanGeest, 2006; Rhodes & Curran, 2005; Balas, Scott, & Rogers, 2004; Elfrink, Kirkpatrick, Nininger, & Schubert, 2010; McKeon, Norris, Cardell, & Britt, 2009). The completed study may avoid the small sample size by using students from two different semesters, increasing the population pool. The completed study used an advanced wireless, robotic mannequin in a realistic hospital room in the simulation lab at Antelope Valley College and ensured that all realistic equipment was available and operational prior to data collection. Underreporting of errors was prevented by using observation and by the researcher of the simulation scenarios. The faculty members were instructed not to provide additional clues to the students prior to the scenario to attempt to create consistency between simulation scenarios. The faculty using the simulation lab during the data collection period have all used the simulation equipment for a minimum of three years and all understand the functioning of the mannequin. Chapter 3 will describe the details and appropriateness of the research method and design, population and sampling, instrumentation, data collection and analysis, validity of the completed study, informed consent, confidentiality, and geographic location.
Chapter 3: Methodology

The purpose of this quantitative, quasi-experimental study was to examine the use of simulation as a learning strategy to decrease medication errors in associate degree nursing students. This study addressed the research questions related to how simulation affects medication administration errors in associate degree nursing students. This chapter will present the process and appropriateness of the research method and design of the completed study, population and sampling, instrumentation, data collection and analysis, validity, informed consent, confidentiality, and geographic location.

The research method used was quantitative, quasi-experimental, and utilized associate degree nursing students who had completed the first semester fundamentals course and the IV module. The sample was gathered from the students enrolled in the nursing program during the data collection period. The data collection instrument used has been tested for validity and reliability in a previous study and permission has been obtained by the author (see Appendix D) (Pauly-O’Neill, 2009). Data collection occurred in the simulation laboratory at Antelope Valley College during the spring semester of 2013. The data was analyzed using SPSS statistical software using a paired t-test analysis to compare medication administration performance of each nursing student participating in the simulations. This chapter presents the research methodology, design appropriateness, research questions, hypotheses, description of data collection, and data analysis.

Research Question and Hypothesis

The study was guided by the following question:

Research Question 1: How does simulation affect medication administration errors in associate degree nursing students?
H0: There is no significant change in number of medication administration errors, between the first and second simulation sessions.

HA1: There is a significant decrease in number of medication administration errors, between the first and second simulation sessions.

HA2: There is a significant increase in number of medication administration errors, between the first and second simulation sessions.

**Research Method and Design**

A quantitative, quasi-experimental method was used. This method was appropriate because of the use of a hypothesis and the degree of control desired by the researcher. The study proposed a problem with a solution and was very closely related to a causality type study (Black, 2005). The nursing students who participated in the study were not a random sample. The students had completed first semester, were registered in nursing courses, and were participating in these simulations as part of the established curriculum. When the sample group is not exclusively random and may reduce generalizability of the results, a quasi-experimental approach is most appropriate. Quasi-experimental was used instead of experimental because it would be unethical to withhold a learning strategy that has strong evidence for a positive outcome in a control group (Jeffries & Rizzolo, 2006).

A quantitative design was the most appropriate and was chosen because of the type of data collected. The study aimed at finding the number of medication errors and comparing it to the number of medication errors after the intervention of simulation and debriefing. When the raw data is in a numerical format, quantitative is the most suitable method for analysis. Current studies that utilize quantitative methodology use data collection tools that consist of tests, rubrics, or Likert-type surveys (Brown, 2009; Blum, 2010, Lewis & Ciak, 2011). The
The completed study utilized a checklist to gather the number of medication errors made during simulation. The Likert-type survey was not appropriate because the study was not searching for insight from the participants. A knowledge test was not adequate because the study was not being used to determine change in knowledge due to simulation experiences. A rubric would be suitable if different behaviors were being observed during the simulation.

A qualitative design would not be appropriate because the data collected will include numerical measurements of medication errors and the purpose of the study includes the desire to compare groups of students who have participated in similar situations and learning strategies (Black, 2005). A qualitative study aims at discovering perceptions, attitudes, and experiences of the study participants. This has been performed in simulation studies to determine effects of simulation on confidence level and attitude (Campbell, Themessl-Huber, Mole, & Scarlett, 2007; Dillard, Sideras, Ryan, Lasater, & Siktberg, 2009).

A mixed-method study was another design considered for study. A mixed-method design incorporates a quantitative and qualitative portion to capture a more comprehensive analysis of a phenomenon. Bambini, Washburn, and Perkins (2009) performed a mixed-method study to find out the effects of simulation on nursing student confidence and the depth of learning that occurred. One problem with the qualitative portion of the study was the aspect that students asked different questions in each group and decreased the control the researcher had over the sample. The completed study had a specific list of questions for the facilitator of the debriefing session to attempt to minimize this problem. Bremner, Aduddell, Bennett, and VanGeest (2006) also designed a mixed-method study because the researchers wanted to know the value of simulation as a learning experience. One problem with the study was the lack of data to support that learning occurred. The data was based exclusively on the
perception of the students. The proposed study will use data observed by a faculty member to attempt to collect data that are more objective. The purpose of the completed study was to focus on medication errors and how they were affected by simulation experience, which did not require a qualitative examination of the reasons for the errors or the nursing students’ perception of the errors (Black, 2005).

**Population and Sampling**

The population consisted of associate degree nursing students currently enrolled in a community college in southern California. A convenience sample was drawn from nursing students who had completed first semester, successfully completed the IV module, and were enrolled in the nursing program. All students enrolled in the nursing program and had completed first semester and the intravenous module were eligible for inclusion in this study. Students were invited to participate with an anticipation of approximately 60 students because of the estimated number of students enrolled during the data collection period of spring semester 2013. There was a potential that two-thirds of the sample would be current or past students of the researcher. The participants were encouraged to discuss any concerns about confidentiality, fears related to performance in the study and a reflection in their grades, and any anxiety related to participating in the study. The informed consent clearly stated that the study was completely separate from the college and the grade would not be affected by any performance or errors that occurred during data collection. The students were also informed that they could withdraw from the study at any time. The participants had the opportunity to ask questions of the researcher at any time and contact information was listed on the informed consent. The population of students in the nursing program is generally diverse with the exception of male to female ratio. Students who had completed
first semester and the intravenous module focus equally on medication administration and can administer medications via several routes including intravenous (IV) subcutaneous (SQ), intramuscular (IM), and by mouth (PO).

**Instrumentation**

The data collection administration tool was titled the *Skills Validation Checklist* and was used in a study by Dr. Pauly O’Neill (2009). The checklist collection tool was created as a Microsoft Word document for ease of use by the researcher (see Appendix C). The tool included the five rights of medication administration and the critical behaviors essential to the process of safe medication administration including, verifying the physician’s order, demonstration knowledge of the drug action and side effects, checking the medication for the expiration date, correct identification of the patient, administering the medication at the correct time, appropriate preparation of the medication, using the correct route, correctly calculating any dosage information, and explaining the medication to the patient and family. The observer checked the appropriate box as students administered medication in the simulation scenario. The data from the checklist was input into a Microsoft Excel spreadsheet for analysis.

**Data Collection**

As a regular process of simulation in the ADN program, participants signed a confidentiality agreement. The informed consent included all possible risks and benefits of the study and the promise of confidentiality (see Appendix E). The students were invited to participate in the simulation laboratory on four different days. To encourage participation, the students were provided the assurance that any mistakes made would not affect his or her grade. The students were promised a synopsis of the research that they participated in for
their resume upon completion of the study as an incentive. Each student was given a unique identifier, and the master list was locked in a file cabinet in the researcher’s office. The informed consent forms were collected only by the researcher and the student signed the form in front of the researcher at the time of collection. Data was collected using a checklist of appropriate and expected interventions related to medication administration, based on a medical surgical simulation scenario validated by the National League of Nursing. The scenarios were purchased by the college and permission for use is not necessary. A data collection instrument developed in 2009 by Dr. Pauly-O’Neill was used to record the number and types of medication administration errors that occurred. Permission has been granted by Dr. Pauly O’Neill to use the data collection tool and has been validated and considered reliable (see Appendix D).

The simulation lab consisted of a hospital bed with a robotic mannequin, medication cart, patient chart, bedside monitor for vital signs, and supplies students would have access to in a hospital setting. The students signed the informed consent and divided randomly into groups of three students. The students entered the simulation lab and received a bedside report by a faculty member. The students reviewed the patient chart with doctors’ orders, laboratory data, and any test results pertinent to the scenario. The students worked collaboratively to assess the patient and determine a course of action based on the patient’s needs. The students had a medication form with scheduled medications and they had the opportunity to call the doctor (a faculty member on the other phone) and ask for additional tests or medications as appropriate. During the simulation, the researcher used the skills checklist (see Appendix C) to mark when medication administration errors are made. To ensure interrater reliability, the researcher was the only one observing and using the
checklist. When the students had completed the objectives for the scenario, the faculty member stopped the simulation and the students moved to the debriefing room. During the debriefing, students reflected upon their actions during the simulation and determined what areas need improvement. The researcher made certain that the students understood any medication errors that were made through verbal feedback by the students. The students had to wait approximately twenty minutes between the debriefing session and the second simulation scenario for preparation of the simulation room and mannequin. After the debriefing, the students participated in a second simulation scenario similar to the first with some minor changes, such as different patient name or different intravenous fluid infusing; the basic content remained the same. The number of medication errors made in the first simulation scenario and the second simulation scenario was compared and analyzed for changes. The current semester was noted on the checklist to determine if there was a difference between students of different semester completion. The data were input into one Microsoft Excel spreadsheet for ease of manipulation and analysis using SPSS statistics 20. The spreadsheet and data were kept in a locked file cabinet in the researcher’s office and student anonymity was insured by the use of unique identifiers.

Data Analysis

A paired t-test was used to compare the pre- and post-test data. Simulation number one was considered pre-test data and simulation number two was considered the post-test data. (Thorne & Giesen, 2000). Two variables were compared: the dependent variable was the number of medication errors and the independent variable was the high-fidelity simulation experience. The data collection tool was divided into different aspects of medication administration and errors were broken down into the types of the most errors.
With a confidence level of .05, the researcher compared the data analysis to the hypotheses. If there were no significant change between the pre and post-test data, the researcher would fail to reject the null hypothesis. If there were a difference between pre and post-test data, the researcher would reject the null hypothesis.

**Validity**

Internal validity refers to the degree that the study findings reflect reality and if the independent variable affects the dependent variable. The independent variable was the simulation experience and debriefing, the dependent variable was the number of medication errors. Variables must be controlled to the fullest extent possible so that if a change in the number of medication errors occurs in the second simulation, only the first simulation and debriefing influenced this result. Many threats to internal validity exist including time passage between the first and second simulations, the loss of participants during the data collection period, the quality of instruction about medication administration which may be inconsistent throughout the nursing program, and the items on the data collection instrument that could introduce unwanted variables (Black, 2005). The time between the first and second simulation was minimal and only about twenty minutes. Students in the ADN program would be currently enrolled and there was very little chance of losing any participants during the data collection period. The items on the data collection instrument are only related to the administration of medication without any extraneous information (Pauly O’Neill, 2009).

External validity refers to the generalizability of the study results to a larger population. Threats to external validity include not having a representative sample, time influence interfering with the data collection process, and inability to manipulate the
variables (Black, 2005). The sample is a diverse group of ADN students in a community college. There was very little to ensure this was a representative sample because it was one of convenience. The time that elapsed between the first and second scenario was minimal and the only extraneous variables that might threaten the external validity was if students have life experience that allows them to perform better. The students were kept in the same simulation groups in the first and second simulation to help control for this phenomenon. If any participants chose not to participate, their data would not be included in the analysis.

**Informed Consent**

Informed consent was obtained prior to participation in the simulation activity (see Appendix E). The students were notified that they could withdraw at any time before, during, or after the study without penalty. They were notified that they would be participating in simulation on a voluntary basis and would be provided with a synopsis of the research for their resume should they decide to participate.

**Confidentiality**

All student data remained confidential. Each student was given a unique identifier in the form of numbers and letters for dissemination of information related to the study. This identifier was written on each checklist and the Microsoft Excel spreadsheet. The list of unique identifiers was kept in a locked cabinet in the researcher's office.

**Geographic Location**

The completed study took place at a community college in Southern California. The nursing student population was racially and economically diverse with a majority of females. The simulation laboratory is located in the health and sciences building and included a robotic mannequin and hospital equipment that students encounter in the clinical setting.
Summary

This chapter established the appropriateness of the quantitative, quasi-experimental design and sampling process. The data collection tool was examined and its use explained. The procedure for data collection and analysis was described and the process for null hypothesis rejection was outlined. Chapter 4 will present the results of the study including a presentation of the data and statistical analysis.
Chapter 4: Results

The purpose of this quantitative study was to determine the effects of high-fidelity simulation as a learning strategy for associate degree nursing students. Medication administration served as the objective of the simulation used in the study to address the problem of medication administration errors in nursing. A quasi-experimental research design served to determine the differences in medication errors after students had the opportunity to administer medications in the simulated environment, followed by self-reflection. The researcher observed medication errors before and after a debriefing session in which the nursing students reflected on their performance and were asked a series of questions related to medication administration processes (see Appendix F). The researcher used a validated checklist to record the medication errors that occurred during each simulation session as a method to test the research hypothesis (see Appendix C).

Research Question and Hypothesis

The study was guided by the following question:

Research Question 1: How does simulation affect medication administration errors in associate degree nursing students?

H0: There is no significant change in number of medication administration errors, between the first and second simulation sessions.

HA1: There is a significant decrease in number of medication administration errors, between the first and second simulation sessions.

HA2: There is a significant increase in number of medication administration errors, between the first and second simulation sessions.
Medication errors continue to be a major cause of mortality and injury in health care. In 2009, the National Council of State Boards of Nursing (NCSBN) recommended that nursing programs use learning strategies to incorporate increased medication safety practices into the curriculum (Kohn, Corrigan, & Donaldson, 1999; NCSBN, 2009). Nursing schools used simulation across the United States as a method to improve learning outcomes related to patient care (Jeffries & Rizzolo, 2006).

Very few studies used simulation as a strategy to teach medication administration in the associate degree nursing population. Only one study utilized simulation as a strategy to improve medication administration practices and BSN students were the focus of the study (Pauly O’Neill, 2009). As a result of the gap in the research, this study was designed to determine the effectiveness of simulation as a learning strategy focused on medication administration with associate degree nursing students.

Kolb’s (1984) experiential learning theory served as the framework for the completed study. Students who participated in the study were in the second and fourth semester of the associate degree nursing program and had completed a fundamentals course in addition to the IV module. The students had a foundation of knowledge about the principles of medication administration via the oral, injectable, and intravenous routes. The students had the opportunity to assess the robotic mannequin and administer medications using previously learned knowledge. After the first simulation, the students were asked a series of questions related to medication administration (see Appendix F) and had the opportunity to reflect on their performance in the lab. Taking this new knowledge or fresh perspective and performing a second simulation the students applied this new knowledge to a similar set of circumstances (Kolb, 1984).
Chapter 3 outlined the research design, including the plan for data collection and analysis. Chapter 4 provides a detailed description of the quantitative data obtained during data collection. This chapter will present a discussion about the population, data collection, data analysis procedures, research questions, hypotheses, and the statistical significance of the results.

Population

Associate degree nursing students currently enrolled in the nursing program and who had completed the fundamentals course and the IV module were invited to participate in the study via e-mail. Using these criteria, the possible number of participants included approximately 150 students. The final sample included 22 students, four enrolled in fourth semester and 18 enrolled in second semester. The participants were female, except one, with a wide array of grade point averages. The demographics of the sample were representative of the community college where the data collection took place.

Data Collection

The nursing simulation lab was reserved for four different days. The chosen days were random and directly affected by the availability of the simulation lab. Participants were invited to volunteer for the study via e-mail one week prior to the data collection period. The e-mail was sent through a secure server via the Antelope Valley College e-mail system to all currently enrolled second, third, and fourth semester students. A second e-mail was sent one day prior to the end of data collection. Participants received the informed consent upon arrival and were provided the opportunity to ask questions. The researcher clarified with each participant the understanding of confidentiality, the ability to withdraw from the study at any time and that the study had no bearing on the student’s grade. The researcher collected
the informed consent forms and signed the forms in view of the participants. The participants were randomly assigned to groups of three. The participants were oriented to the simulation room to ensure students were aware of location and availability of supplies. The participants were asked to treat the simulation as if it were occurring in real-time and the times on the medication administration record reflected the time the students participated in the simulation. The students received a report on the robotic patient. The students had access to physician orders and medication administration sheets with scheduled and pro re nata (as needed) medications (see Appendix G). The students performed assessments on the patient and collaborated to provide care for the patient based on the provided information and obtained assessment data. The researcher observed scenario 1 and completed a checklist, with the appropriate type and number of medication errors, for each participant (see Appendix C). When the students had completed three medication administrations, including intravenous, injection, and by mouth routes, the simulation session stopped (approximately 20 minutes). The students went to the next room with the researcher and answered a series of questions related to medication administration (see Appendix F). While the students were participating in the debriefing session (approximately 10 minutes), the volunteer managing the computer software configured the mannequin and equipment for scenario 2. The students returned to the simulation lab and obtained a report on the new patient (see Appendix H). The students performed a new assessment and collaborated to provide care for the new robotic patient. The researcher completed new checklists in the same manner for each participant. Once the three medication administrations were complete, the simulation ended (approximately 20 minutes).
Data Analysis

A quantitative analysis was used to compare the independent variable (simulation experience) and dependent variable (number of medication errors). The number of errors in scenario one (pre-test data) was added to a Microsoft Excel spreadsheet (see Appendix I). The number of errors in scenario two (post-test data) was added to a second Microsoft Excel spreadsheet (see Appendix J). IBM SPSS version 20 statistical software was used as a method of facilitating analysis.

Table 1

Frequency of Medication Errors

<table>
<thead>
<tr>
<th>Test</th>
<th>Order</th>
<th>Exp.</th>
<th>Action</th>
<th>S/E</th>
<th>Identif</th>
<th>On</th>
<th>PRN</th>
<th>Route</th>
<th>Site</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>4.5%</td>
<td>45.5%</td>
<td>31.8%</td>
<td>45.5%</td>
<td>36.4%</td>
<td>27.3%</td>
<td>9.1%</td>
<td>0.0%</td>
<td>9.1%</td>
<td>27.3%</td>
</tr>
<tr>
<td>Post</td>
<td>0.0%</td>
<td>13.6%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>18.2%</td>
<td>4.5%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>4.5%</td>
</tr>
</tbody>
</table>

Note. A frequency of errors displays the types of medication administration errors.

As shown in Table 1, the errors were widely distributed in relation to the types of errors made during scenario one. Errors when checking for expiration date on the medication packaging and identification of side effects before administering medication occurred at a rate of 45.5%. Students did not verify allergies 90.9% of the time during scenario one and
the reasons for taking the medication were not explained to the patient or family 54.5% of the time. Errors related to administration of IV medications occurred at a rate of 50%. After the debriefing session, errors decreased considerably. Checking for expiration date on packaging decreased to a 13.6% error rate. During scenario 2, no errors were made when identifying possible side effects, verifying allergies, and explaining actions of medications to the patient and family. The errors related to IV medication decreased to 9.1%.

Table 2

Paired t-test

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Mean</th>
<th>SD</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of Difference</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td></td>
<td></td>
<td>Lower</td>
<td>Upper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Pre</td>
<td>4.045</td>
<td>2.535</td>
<td>.540</td>
<td>2.921</td>
<td>5.169</td>
<td>7.485</td>
</tr>
<tr>
<td>Post</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<.05

Note. A paired t-test shows statistical significance of the data and change in number of errors after the intervention.

The statistical analysis in Table 2 reveals the mean errors (n=22) to be 4.045. The statistical table for significance of t-tests with a degree of freedom (df) 21, the statistical significance requires a t-score of greater than 2.0796. The t-score in this analysis is 7.485 that is greater than 2.0796, revealing the difference in pre and post-test scores is statistically significant (p<.05). The change in the number of errors are 95% related to the intervention applied by the researcher and not by chance alone (Black, 2005).
Table 3

*Power Analysis*

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Power^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Post</td>
<td>180.023</td>
<td>1</td>
<td>180.023</td>
<td>56.026</td>
<td>.000</td>
<td>.727</td>
<td>56.026</td>
<td>1.000</td>
</tr>
</tbody>
</table>

*Note. a significant p<.05*

Table 3 displays a power analysis demonstrating the observed power is statistically significant with a power greater than 0.80. The Partial eta squared indicates that elements of the research design accounted for 72.7% of the overall variance. The Partial eta squared is used to determine the effect size and illustrates the effectiveness of the intervention in this study. This information illustrates the effect size closely resembles true population results and the simulation and debrief interventions in the study were responsible for the results at a 95% confidence interval and less likely related to chance.

**Answers to Research Question**

The following question guided the study:

Research Question 1: How does simulation affect medication administration errors in associate degree nursing students? The data indicated that simulation appears to help associate degree nursing students improve medication administration safety. Figure 2 illustrates a decrease in medication errors after the simulation and debriefing.
Figure 2. Pre and post mean comparison. The results indicate the errors decreased after the intervention.

Hypothesis Testing

Many assumptions about the data were made when testing the hypotheses. The observations were independent of each other. The dependent variable was measured on an interval scale. The differences in data collected were normally distributed in the population. The hypotheses will be discussed based on these assumptions. The literature review and anticipated outcomes led to the following hypotheses:

H0: There is no significant change in number of medication administration errors, between the first and second simulation sessions. The data led to the rejection of the null hypothesis (p<.05).
HA1: There is a significant decrease in number of medication administration errors, between the first and second simulation sessions. The data appears to support this hypothesis (p<.05),

HA2: There is a significant increase in number of medication administration errors, between the first and second simulation sessions. The data led to the rejection of this hypothesis because the medication errors were decreased.

The paired t-test (Table 2) illustrates the significant decrease in medication errors with a 95% confidence interval. The null hypothesis must be rejected because of the t-score of 7.485 (p<.05). The first hypothesis is supported with a decrease in medication administration errors from 100 errors to 11 errors after the simulation and debriefing experience. The second hypothesis is rejected because no increase in the number of errors was found.

Summary

Chapter 4 presented the results of the data collection and data analysis for this quantitative study. The participants (n=22) demonstrated a decrease in medication errors after participating in simulation and debriefing. The results were statistically significant based on a paired t-test with a confidence level of 95%. Chapter 5 will further discuss the problem addressed in the study, an analysis of findings, and the significance of the results. Chapter 5 includes discussion of the problem, purpose, outcomes, limitations, delimitations, data collection, data analysis, discussion of findings, implications for leadership, recommendations for future research, and conclusions.
Chapter 5: Conclusions and Recommendations

Medication administration errors are a threat to patient safety in health care. These errors account for 1.5 million injuries annually and can be prevented (NLN, 2006). The Institute of Medicine (IOM) instituted a call to action to prevent medical errors in a report called *To Err is Human* in an effort to alert the public to the severity of medication errors in health care (Kohn, Corrigan, & Donaldson, 1999). Medication administration errors are caused by distraction, inexperience, workload, and increasingly complex decision making demands (Harding & Petrick, 2008; Jones, 2009; Sheu, Wei, Chen, Yu, & Tang, 2008; Tang, Sheu, Yu, Wei, & Chen, 2007). Nurses at the bedside have the opportunity to prevent errors related to medication administration if following the basic principles of medication administration taught in nursing curriculum. The National Council of State Boards of Nursing (NCSBN) encouraged nursing schools to incorporate new and innovative teaching strategies to improve medication administration education in nursing programs.

Simulation is one teaching strategy being used in nursing schools to allow students to practice essential nursing skills without harm to a patient (Jeffries & Rizzolo, 2006). High-fidelity simulation incorporates the use of a lifelike robotic mannequin that responds physiologically like a patient in the hospital, allowing students to observe accurate patient response to nursing interventions. Literature demonstrates the effectiveness of simulation in areas of education such as critical thinking, confidence, leadership, teamwork, and communication (Jeffries & Rizzolo, 2006; Lewis & Ciak, 2011; Gudhe, 2010). Chapter 5 will discuss the research question and hypothesis, population, data collection and analysis, answers to the research question, hypothesis testing, and summary.
Problem Statement

The general problem is the increased rate of medication errors in health care (Kohn, Corrigan, & Donaldson, 1999). Medication errors are a leading cause of injury and death in health care (NLN, 2006). Nursing educators must find innovative ways to teach nursing students how to prevent medication errors as a way of protecting the public and in response to the NCSBN. The specific problem is how to structure educational training effectively to reduce medication errors in nursing students. The quantitative, quasi-experimental study focused on the application of high fidelity simulation to associate degree nursing (ADN) students to determine the effect on medication errors.

Purpose Statement

The purpose of this quantitative, quasi-experimental study was to determine the effects of high-fidelity simulation as a learning strategy on the skill of medication administration in associate degree nursing students. Nursing students can practice medication administration in the simulation lab without fear of harm to a patient. Nursing students can administer medications to a robotic mannequin and see a realistic physiologic result, helping them to understand how medication administration errors harm patients and how nurses play a vital role in protecting patient safety.

Methods

During data collection the students were given a scenario about a surgical patient who was in pain and required routine medications such as antibiotics to prevent infection and insulin to prevent increase in blood sugar. Assessing blood sugar and administering insulin is a fundamental skill learned in first semester and practiced in second semester. Content related to administering antibiotics is taught in second semester. The participants had
completed the IV module and fundamentals. According to Kolb’s Experiential Learning Theory (1984), these skills provide the foundation of knowledge that students build upon. The students practiced these skills by assessing the blood sugar of the mannequin and administering insulin. The students also administered IV antibiotics as ordered in the scenario. The students made various fundamental errors such as not identifying the patient properly, not verifying allergies, and not programming the IV pump properly. This refers to the hands-on experience portion of Kolb’s theory. The students participated in debriefing or self-reflection and discussed the basics of medication administration and how they performed during the simulation. The students determined what errors they made and made a plan to avoid the errors in the future, correlating with Kolb’s learning phase. The students were provided with an opportunity to use the new knowledge in the simulation lab and demonstrated fewer errors, demonstrating that learning had occurred.

Previous studies discussed in Chapter 2 revealed a gap in the literature in the area of simulation as a learning strategy to reduce medication errors. The study by Pauly O’Neill (2005) suggested that simulation might be an effective strategy to reduce medication errors in BSN students. Permission was obtained to use the checklist from the Pauly O’Neill study as a valid and reliable tool to measure types and numbers of medication errors.

The study by Pauly O’Neill (2009) revealed an improvement in medication errors after using simulation and debriefing with BSN students in a pediatric setting. The Pauly O’Neill (2009) study was similar to the completed study with an observation of medication errors during two simulation sessions. The Pauly O’Neill study found that before the intervention, students demonstrated the majority of errors in the area of the correct medication, assessment of allergies, explaining the procedure to the patient, and correct
administration. These findings are similar to the completed study, adding to the validity and generalizability of results. The completed study was different because the focus was associate degree nursing students and adult medical-surgical patients. This study filled the missing gap related to high fidelity simulation and associate degree nursing students administering medications in the simulation lab. The Pauly O’Neill (2009) study focused on BSN students in a pediatric setting utilizing simulation as a learning strategy.

Kolb’s experiential learning theory served as the framework for this study (Kolb, 1984). The data suggest that the study was consistent with the theoretical framework. The students had a foundation of knowledge in basic skills and medication administration. The students participated in the simulation scenario and used previously learned skills. The students reflected on their behaviors in simulation during the debriefing session, and because the data were statistically significant in showing improvement, it appears the students applied new knowledge to the second simulation, demonstrating improvement.

Limitations

Possible limitations identified in Chapter 3 included assistance with data collection, sample size, realism, technology issues, and participation. The possible limitation of lack of funding to pay for assistance with data collection was not a problem because of the ample support by volunteers to manage the simulation equipment and software. A sample of 60 students was the goal of the proposed study and the final sample included 22 students. Participation may have been decreased because of the timing of the data collection and upcoming examinations. The power analysis reveals that the sample size was adequate due to the observed effect of 1.000. Realism may have been an issue due to equipment, accuracy of patient condition, and computer versus paper resources. Students had to pretend to obtain
a blood specimen from the mannequin to test blood sugar. The scenarios included an abdominal incision on the mannequin and only a dressing was applied due to the lack of supplies to make a realistic incision. A paper medication administration record was available to the students and they had been using a computer record in previous courses. Students were introduced to paper medication forms, but had no experience using them in practice. This caused some confusion in the beginning of the scenario even though it was explained during orientation. Technology issues were not a problem related to the mannequin functioning, software, or medical equipment. One unanticipated limitation that occurred during the simulation process was the effect of group dynamics on performance. Some groups had an obvious leader who directed the group and others had no direction. The group collaboration abilities may have had an effect on the success of the student’s performance. The majority of participants were in second semester courses and had very little experience in the simulation laboratory.

**Delimitations**

Chapter 1 included several delimitations including the eligibility to participate and generalizability of results. Only students who had completed first semester and the IV module were eligible to participate. This was not an issue because the participants had been exposed previously to all of the skills and concepts necessary to care for the patient during the simulation. New delimitations did not arise during data collection.

**Assumptions**

Chapter 1 outlined many assumptions made by the researcher prior to data collection. The researcher assumed the students would act professionally in the simulation lab and the participants did act professional during data collection. The researcher assumed that students
would treat the scenario as real and act the same as in the hospital setting. Some of the
students had difficulty understanding that the simulation occurred in real time and were not
sure when medications were due. Some of the students used the term “pretend” and were
redirected by the facilitator to perform tasks realistically. The researcher assumed that
students would make errors and they did. The researcher assumed that only the students with
the highest grades would participate and students from all levels of success in the program
chose to participate.

Data Collection

The data collection process involved mostly second semester students (n=18) who
had limited experience in the simulation lab. The participants were given an orientation to
the simulation room and equipment prior to performing in scenario one. Students placed in
groups of three offered many different past experiences and some groups functioned more
effectively because a member of the group was more confident and assertive. The paper
medication administration record was an issue for some groups who were not sure how to
read it or document on it. These groups asked the person acting as the charge nurse who was
a volunteer helping to manage the simulation software. This was effective, but may have had
an effect on group performance.

Interrater reliability was maintained through having the researcher as the only
observer collecting data. Consistency was maintained with the simulation by having the
same volunteer manage the robotic mannequin and software. The data collection tool had an
area where allergies were included in two places and this was not an issue because only one
person observed the simulations and used consistent technique in all instances.
Data Analysis

The results of the paired t-test revealed a statistically significant outcome to the change in medication errors between pre and post-testing at a 95% confidence level. The frequency of errors demonstrated a decrease in the occurrence of errors after scenario one and debriefing. The power analysis supported the significant effect size at a 95% confidence interval. The statistical findings support the rejection of the null hypothesis. The results show that simulation and debriefing appear to provide an effective teaching tool for nurse educators in the area of medication administration. These results are generalizable to other associate degree nursing programs because of the statistical power described in Chapter 4.

Discussion of Findings

The results of this study suggest that simulation may be an effective way to teach concepts to nursing students. Nursing schools must take the results of this study and structure curriculum to include simulation activities. Associate degree nursing programs already using simulation must include medication administration as a skill focus when designing learning experiences in an effort to improve patient safety.

The literature review in Chapter 2 revealed a limited number of studies focusing on nursing students and medication errors. Konkloski, Wright, and Hammett (2001) examined the reasons for medication errors in nursing students (n=27) and found the amount of errors directly correlated to the amount of supervision the students’ received. Wolf, Hicks, and Serembus (2006) conducted a much larger study (n=1305) and identified the types of errors made by nursing students consisted of the wrong dose or omission of a dose and were directly related to inexperience and distraction. Reid-Searl, Moxham, Walker, and Happell
(2008) found increased supervision by an instructor decreased medication errors in final year nursing students (n=28) in Australia.

Only two studies focused on simulation as a learning strategy to improve medication errors. The study by Ford, Seybert, Smithburger, Kobulinsky, Samosky, and Kane-Gill (2010) demonstrated simulation as an effective strategy to reduced medication errors when used with registered nurses. Pauly O’Neill (2009) found that simulation was effective when utilized with BSN students in a pediatric setting. The body of knowledge related to simulation and medication errors in nursing has expanded with the addition of the results of the completed study. As evidenced in Chapter 2, this is the only study conducted using associated degree students. This study demonstrated that simulation appears to improve the ability of nursing students to administer medications more safely.

Implications for Leadership

The results of this study suggest that high-fidelity simulation may be a successful learning method to reduce medication errors in nursing students. Nursing faculty members can use the information from this study to design learning activities to improve student training in medication administration. Hospital administrators and educators may use the information from this study to train staff nurses in medication administration safety. Increased patient safety leads to higher patient satisfaction and lower overall costs (Joint Commission, 2013). Hospital administrators can collaborate with nursing programs to coordinate training using simulation or they can use mannequins they may already possess to a more effective extent.
**Recommendations**

The results of this study can be used to improve public safety and learning outcomes of nursing programs across the nation. Hospitals can use this information and structure simulation training in health care institutions for new graduates or skills updates in an effort to provide more effective, safe patient care to the community.

The participants of the study may benefit from exposure to simulation focused on medication administration and practice safer medication administration principles when in the hospital during clinical rotation in future semesters. It would be helpful to survey these students in another research opportunity to determine the long term effects of participation in this study.

During the data collection process the researcher found that the participants had less exposure than anticipated to the high-fidelity simulation lab. Because of the positive results of the study, associate degree nursing students must be introduced to simulation from the fundamentals course as an effective way to teach skills and safe nursing practices. This study looked at short term change in behavior related to medication administration, resulting in a decrease in medication errors. Future research should look at long term change and if simulation and debriefing interventions continued to show improvement at eight weeks or twelve weeks. This study also looked at associate degree nursing students. Research could be directed at registered nurses, BSN, or MSN trained nurses. Researchers could also add intravenous push medications for fourth semester students, as this was not a skill related to medication administration included in the study. The study revealed many errors related to side effects and actions of medications. A medication knowledge test could be included to
see if the simulation had any effect on the knowledge of the included medications in the scenario.

Additional studies could address the issues of increased workload, increasing patient acuity, and the need to make decisions that are more complex by using a similar format to this study and incorporating multiple patients. The students expressed that the experience of participating in the study was beneficial as anecdotal, informal comments and a survey requesting information about student perception would have beneficial to determine effectiveness as a learning strategy.

Future research should look at the limitations in this study and find alternative ways to avoid them. Students were offered a synopsis of the study and an opportunity to place research participation on their resumes when applying for jobs. A more enticing incentive may have encouraged a greater sample size; this would depend on the setting and potential population of the study. A computer medication record might improve performance for students using this type of documentation in the clinical setting. Realism could be improved by adding more creative moulage for the students to assess a more lifelike incision on a surgical patient or use a solution for the students to obtain a blood sugar test.

Summary

Medication errors are a threat to national safety and nurses are on the front lines to protect the public from harm. It is essential that nurses have the knowledge and skill to prevent medication errors. Simulation is a learning strategy that is used in nursing schools across the nation to allow students to perform learned skills and concepts to a patient without the fear of harm.
A quantitative, quasi-experimental study using a validated checklist involved a researcher observing behavior of nursing students in a simulation laboratory to determine the effect of simulation and debriefing on medication administration in associate degree nursing students. The participants were second and fourth semester nursing students and were observed caring for a medical-surgical patient and administering medications via various routes. The students participated in debriefing and practiced an additional simulation session.

This study found that simulation and debriefing have a statistically significant effect on reducing medication errors. This strategy can be used by nursing schools to train nursing students to practice medication safety effectively when they graduate and practice with a license.

This study is important because it allows leaders from health care facilities and educational institutions across the nation to identify a creative way to structure curriculum and improve the safe care of the population and the community.
References


student self-confidence and clinical competence. *International Journal of Nursing Education Scholarship, 7*(1). DOI: 10.2202/1548-923X.2035


Classen, D.C., Resar, R., Griffin, F., Fredrico, F., Frankel, T., Kimmel, N., Whittington, J.C.,


Dillard, N., Sideras, S., Ryan, M., Carlton, K., Lasater, K., & Siktberg, L. (2009). A collaborative project to apply and evaluate the clinical judgment model through simulation. *Nursing Education Perspectives, 30*(2), 99-104.


Luctkar-Flude, M., Pulling, C., & Larocque, M. (2010). Ending infusion confusion:
Evaluating a virtual intravenous pump educational module. *Clinical Simulation in Nursing, e1-e10.*


## Appendix A: Key Words Search

<table>
<thead>
<tr>
<th>Key words Searched</th>
<th>Responses</th>
<th>Peer-reviewed articles</th>
<th>Dissertations</th>
<th>Books</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulation</td>
<td>4,100,000</td>
<td>208</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Simulation and nursing</td>
<td>75,900</td>
<td>167</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Simulation and education</td>
<td>1,760,000</td>
<td>190</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Associate degree nursing students and simulation</td>
<td>6880</td>
<td>100</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Technology in nursing</td>
<td>1,130,000</td>
<td>180</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Nursing and Medication administration</td>
<td>184,000</td>
<td>20</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Medication errors</td>
<td>409,000</td>
<td>15</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Adverse drug events</td>
<td>1,080,000</td>
<td>15</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Medication errors and nursing students</td>
<td>27,000</td>
<td>12</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Medication errors and nursing students and simulation</td>
<td>3130</td>
<td>12</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Appendix B: Literature Review Map

This document was created using Inspiration® Maps™ for iPad. See www.inspiration.com/ipad to try Inspiration Maps for yourself.
## Appendix C: Skills Checklist

<table>
<thead>
<tr>
<th>IV Module complete</th>
<th>Yes</th>
<th>No</th>
<th>Faculty running simulation</th>
</tr>
</thead>
</table>

### Right Medication

| Yes | No | N/A | Verifies current MD order for medication. |

| | | | Compares name of the drug on the medication order to the label. Ensures that drug is not expired. |

| | | | Verbalizes the action of the drug. |

| | | | Identifies potential side effects of the drug. |

### Right Patient

| Yes | No | N/A | Verifies name and medical record number on ID band. |

### Right Time

| Yes | No | N/A | Med is given within 30 min. of scheduled time. |

| | | | Checks timing of PRN meds. When was the last dose given? |

### Right Route

| Yes | No | N/A | Ordered route is used or a change is requested by student. |

| | | | Selects correct site for administration. |

### Right Dose

| Yes | No | N/A | Correctly calculates dose and states safe dose range. |

| | | | Dose is questioned if outside of safe dose range. |

| | | | Verifies allergies or special precautions ie. Labs or VS |

| | | | Correct dose is drawn up into appropriate syringe, appropriate length and gauge of needle if IM or SQ. |

### Safety Measures

| Yes | No | N/A | Assesses patient for drug allergies. |

| | | | Safely dilutes the medication so it does not exceed maximum final concentration. |

| | | | Explains med procedure to patient/family. |

| | | | Correctly sets the IV pump, including the flush. |

© Susan Pauly-O’Neill, PNP-BC, DNP
Appendix D: Permission to use Data Collection Tool
Appendix E: Informed Consent

INFORMED CONSENT: PARTICIPANTS 18 YEARS OF AGE AND OLDER

Dear Student,

My name is Casey Scudmore and I am a student at the University of Phoenix working on a doctorate of education degree. I am doing a research study entitled “A Quantitative Analysis of the Effect of High Fidelity Simulation on Medication Errors in Associate Degree Nursing Students." The purpose of the research study is to determine the effects of simulation on the number of medication errors made by associate degree nursing students. This study is completely separate from any academic courses or programs at Antelope Valley College.

Your participation will involve participating in two, twenty minute simulations and a twenty minute debriefing session. You will care for a simulated patient in each simulation using skills you have already learned. The simulations will be offered on four different days and will be entirely voluntary. You will be expected to act professionally and sign a confidentiality statement as required in the nursing program. The sample size of the research study will be approximately 60 students. Before, during, or after the study you can withdraw without any penalty or effect to your course grade. The results of the research study may be published, but your identity will remain confidential and your name will not be made known to any outside party. Your name will be given a unique number that is only known to the researcher and only this number will be used when discussing the study.

In this research, there are no foreseeable risks to you except any anxiety normally felt when entering a simulation exercise.
Although there may be no direct benefit to you, a possible benefit from your being part of this study is helping nursing faculty to design effective and meaningful curriculum and improving patient safety.

If you have any questions about the research study, please contact me. For questions about your rights as a study participant, or any concerns or complaints, please contact the University of Phoenix Institutional Review Board via e-mail at IRB@phoenix.edu.

As a participant in this study, you should understand the following:

1. You may decide not to be part of this study or you may want to withdraw from the study at any time. If you want to withdraw, you can do so without any problems. Contact the researcher to discuss any concerns or feelings of pressure to participate.

2. Your identity will be kept confidential.

3. Casey Scudmore, the researcher, has fully explained the nature of the research study and has answered all of your questions and concerns.

4. Data will be kept in a secure and locked area. The data will be kept for three years, and then destroyed.

5. The results of this study may be published while always keeping your name confidential.

“By signing this form, you agree that you understand the nature of the study, the possible risks to you as a participant, and how your identity will be kept confidential. When you sign this form, this means that you are 18 years old or older and that you give your permission to volunteer as a participant in the study that is described here.”
(□) I accept the above terms.  (□) I do not accept the above terms.  (CHECK ONE)

Signature of the participant ___________________________ Date ____________

Signature of the researcher ____________________________ Date ____________
Appendix F: Debriefing Script

The following questions were asked during the debriefing session:

1. Was the right medication given?
   a. Was the order verified?
   b. Did you verify the expiration date?
   c. Did you verbalize the action of the medication?
   d. Did you identify any potential side effects of the medication?

2. Did you identify the patient using 2 identifiers?

3. Was the medication given within 30 minutes of the scheduled time?

4. Did you verify the last dose given if ordered prn (as needed)?

5. Was the correct route used?

6. Was the dose in a safe range? If not did you question it?

7. Did you verify allergies or special precautions such as labs or vital signs?

8. Was the correct dose of medication drawn up in the correct syringe?

9. Did you set up the IV pump correctly?
Appendix G: Simulation Scenario 1

**NLN Scenario Vernon Watkins-Core Case**

Report to Students: Mr. Watkins is a 69-year-old male who had an emergency hemicolecction for a perforated colon 3 days ago. He has a midline abdominal incision. He has a right forearm peripheral IV with D5½ Normal Saline infusing at 80 mL/hour. IVPB of Ancef is due; we have been waiting for pharmacy to send up. He has received his Hydrochlorothiazide tablets and is tolerating full liquids. He has an NG tube to low intermittent suction and a 16fr Foley catheter, draining to gravity. He was medicated with 2 Percocet tablets for a pain of “6” on a pain scale.

Clinical signs immediately visible: alert and responsive, expressing pain, appears uncomfortable.

**Date of Birth:** 4/9/43

**Allergies:** Penicillin

**Prior Medical History:** Cataracts, controlled hypertension, diabetes mellitus, smoking.

**Recent Medical History:** Presented to the Emergency Department 3 days ago with complaints of nausea, vomiting, and severe abdominal pain. He was admitted for emergent surgery for bowel perforation.
**Scenario 1: Medication Administration Record**

<table>
<thead>
<tr>
<th>NO.</th>
<th>Medication</th>
<th>Start/Stop</th>
<th>First Shift</th>
<th>Second Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DS Y2.5NS at 80m/1hr</td>
<td>0730-1929</td>
<td></td>
<td>1930-0729</td>
</tr>
<tr>
<td>2</td>
<td>Ancef 1gm IVPB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>every 8 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>HETZ 25mg PO daily</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Regular Insulin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>150-199</td>
<td>2 units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>200-249</td>
<td>4 units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>250-300</td>
<td>6 units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>301-350</td>
<td>8 units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>above 351</td>
<td>10 units +</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>400 1-2 po every</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 hours prn pain</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Signature:  
Signature:  
Signature:  
Signature:  
Signature:  
Initials:  
Initials:  
Initials:  
Initials:  
Initials:  

**Note:**  
Citic Code:  
REG-REFUSED  
*SEE HTR  
RVG-RT VENTRALGLUTEAL  
LVG-LT VENTRAL GLUTEAL  
LG-LT GLUTEUS  
RG-LT GLUTEUS  
LAG-LT ANTECUBITAL FOSSA  
MAK-KI FUREARM  
RH-RT HAND  
RF-RT FOOT  
SCP-SCALP  
LD-LT DELTOID  
RD-RT DELTOID  
LL-LT LEG  
RL-RT L FR  
ABD-ABDOMEN  
RUA-RT UPPER ARM  
LUA-LT UPPER ARM  
RAC-RT ANTECUBITAL FOSSA  
LAC-LT FOREARM  
LL-LT HAND  
LHL-LT HAND  
LFT-LT FOOT  
LFT-LT FOOT  

**Allergies:**  
Penicillin
### Scenario 1: Physician Orders

**Physician Orders**

- **Patient Name:** Vernon Watkins
- **DOB:** 04/09/XX
- **Age:** 69
- **Height:** 72 inches (1.82 meters)
- **Weight:** 176 pounds (80 kg)
- **MR#:** PCS40900
- **Gender:** Male
- **Diagnosis:** Post Operative Hemicolecotomy

#### Physician Order and Signature

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Physician Order and Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Diet: Full liquid progress to soft as tolerated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Activity: Out of bed ambulating with abdominal binder 4 times a day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vital Signs every 4 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intake and output every shift</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incentive spirometer 10 times every 2 hours while awake</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O2 at 2 L/min via nasal cannula to maintain SpO2 greater than 92%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IV of 3.5% Normal Saline at 80 mL per hour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compressions stockings</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Meds:</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percocet 1-2 PO every 4 hours prn pain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ancef 1g IVPB every 8 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hydrochlorothiazide 25 mg a day PO</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Regular Insulin Sliding Scale</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>150-199 2 units 301-350 8 units</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200-249 4 units 351-400 10 units and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>250-300 6 units Call MD</td>
</tr>
</tbody>
</table>

---

**Physician/Provider Signature**

[Signature Image]
Appendix H: Simulation Scenario 2

NLN Scenario Vernon Watkins-Core Case (name change to Joe Watkins)

Report to Students: Mr. Watkins is a 69-year-old male who had an emergency hemicolecotomy for a perforated colon 3 days ago. He has a midline abdominal incision. He has a right forearm peripheral IV with D5½ Normal Saline infusing at 125 mL/hour. IVPB of Ancef is due; we have been waiting for pharmacy to send up. He has received his Hydrochlorothiazide tablets and is tolerating full liquids. He has an NG tube to low intermittent suction and a 16fr Foley catheter, draining to gravity. He was medicated with 2 Tylenol tablets for a pain of “6” on a pain scale.

Clinical signs immediately visible: alert and responsive, expressing pain, appears uncomfortable.

Date of Birth: 4/9/43

Allergies: Penicillin, Percocet

Prior Medical History: Cataracts, controlled hypertension, diabetes mellitus, smoking.

Recent Medical History: Presented to the Emergency Department 3 days ago with complaints of nausea, vomiting, and severe abdominal pain. He was admitted for emergent surgery for bowel perforation.
### Scenario 2: Medication Administration Record

<table>
<thead>
<tr>
<th>NO.</th>
<th>Medication</th>
<th>Start/Stop</th>
<th>First Shift</th>
<th>Second Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DSYzNS at 125mL/hr</td>
<td></td>
<td>0730-1929</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Ancef IgM W&amp;B every 8hr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>HCTZ 25mg PO Daily</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Regular Insulin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ISO-199 2 units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>200-249 4 units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>250-300 6 units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>301-350 8 units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Above 351 10 units+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Call MD</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Percocet 12 PD every 4 hours for pain

---

**Signature:**

**Initials:**

**Site Code:**
- DC: DISCONTINUED
- H/R: REFUSED
- "SEE HTR"
- RVG/RT VENTRAL GLUTEAL
- LG/LT VENTRAL GLUTEAL
- LG/LT GLUTEUS
- RG/RT GLUTEUS
- LAC-LT ANTECUBITAL FOSSA
- R4A-RT FOREARM
- RH/RT HAND

**Location:**
- LD-LT DELTOID
- LD-RD DELTOID
- LD/LT LEG
- RL-LT LEG
- RL-RT LEG
- ABD-ABDOMEN
- KUA-LT UPPER ARM
- LUA-LT UPPER ARM
- RAC-RD ANTECUBITAL FOSSA
- L4A-LT FOREARM
- L4A-LT DORSUM
Scenario 2: Physician Orders

### Patient Information

- **Patient Name:** Vernon Watkins
- **DOB:** 04/00/XX
- **MNHI:** 1234567890
- **Age:** 69
- **Height:** 72 inches (1.82 meters)
- **Weight:** 176 pounds (80 kg)
- **Gender:** Male
- **Diagnosis:** Post Operative Hemicolecystomy
- **No Known Allergies**
- **Allergies & Sensitivities:** Penicillin (hives)

### Physician Orders and Signature

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>PHYSICIAN ORDER AND SIGNATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Diet: Full liquid progress to soft as tolerated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Activity: Out of bed ambulating with abdominal binder 4 times a day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vital signs every 4 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intake and output every shift</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incentive spirometer 10 times every 2 hours while awake</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O2 at 2 L/min via nasal cannula to maintain SpO2 greater than 93%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LV of 25% Normal Saline at 60 mL per hour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compressions stockings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meds:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percocet 1-2 PO every 4 hours prn pain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ancef 1g IV/P8 every 8 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hydrochlorothiazide 25 mg a day PO</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Regular Tourniquet Staining Scale</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>150-199</strong> 2 units</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>200-249</strong> 4 units</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>250-300</strong> 6 units</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>301-350</strong> 8 units</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>above 351</strong> 10 units and</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Call MD</strong></td>
</tr>
</tbody>
</table>

### Physician/Provider Signature

[Signature]

---

National League for Nursing
## Appendix I: Pre-test Data Collection Summary

<table>
<thead>
<tr>
<th>ID</th>
<th>Sem.</th>
<th>Orders</th>
<th>Exp</th>
<th>Action</th>
<th>S/E</th>
<th>Identify</th>
<th>Time</th>
<th>PRN</th>
<th>Route</th>
<th>Site</th>
<th>Dose</th>
<th>Quest</th>
<th>Allergy</th>
<th>Syringe</th>
<th>Explain</th>
<th>IV</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4th</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>4th</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>4th</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>4th</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>11</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>2nd</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>13</td>
<td>2nd</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>14</td>
<td>2nd</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>15</td>
<td>2nd</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>16</td>
<td>2nd</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>17</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>18</td>
<td>2nd</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>19</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>20</td>
<td>2nd</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>21</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>22</td>
<td>2nd</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

Total Errors: 100
Appendix J: Post-test Data Collection Summary

<table>
<thead>
<tr>
<th>ID</th>
<th>Sem.</th>
<th>Orders</th>
<th>Exp</th>
<th>Action</th>
<th>S/E</th>
<th>Identify</th>
<th>Time</th>
<th>PRN</th>
<th>Route</th>
<th>Site</th>
<th>Dose</th>
<th>Quest</th>
<th>Allergy</th>
<th>Syringe</th>
<th>Explain</th>
<th>IV</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4th</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>4th</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>4th</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>4th</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>2nd</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>17</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>19</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>21</td>
<td>2nd</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>22</td>
<td>2nd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Total Errors: 11