EVALUATION OF SAFE MEDICATION ADMINISTRATION KNOWLEDGE OF PRE-LICENSURE BACCALAUREATE SENIOR NURSING STUDENTS IN PRECEPTORSHIPS

by

LISA KAY MURPHREE

VIVIAN H. WRIGHT, COMMITTEE CHAIR
NIRMALA EREVELLES
HEATHER CARTER-TEMPLETON
JOSHUA C. EYER
KAREN WARD

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ABSTRACT

Medication errors are known to occur at unacceptable rates with potential serious clinical and financial harm [Institute of Medicine (IOM), 2006; Lahue et al., 2012]. Safe medication administration in today’s complex health care system requires effort from multiple disciplines, of which nurses play an essential role. Nurse educators have the responsibility to prepare students to begin their first nursing job after graduation with the ability to practice safe nursing care, including the essential component of accurate medication administration. Based on a theoretical framework of cognitive learning theories, this study used a pretest-posttest quasi-experimental approach to investigate the degree to which two teaching strategies: senior-level preceptorships and a researcher-developed safe medication administration clinical workbook, would increase student knowledge of safe medication administration. Student knowledge was assessed using the Safe Medication Administration (SAM) Scale (Ryan, 2007). Data were collected from 28 senior nursing students and analysis was carried out using independent-sample t tests on pretest and posttest data comparing students in their usual critical care preceptorship (control group) with students using the clinical workbook in their usual critical care preceptorship (experimental group). Self-confidence data were also collected using a modified NLN Student Satisfaction and Self-Confidence in Learning Questionnaire, SSSCL-SAM. Use of the workbook increased learning satisfaction and self-confidence, but not SAM knowledge. An analysis was also carried out comparing data from the senior students in their 4th semester 72-hour critical care preceptorship plus workbook to the senior students in their 5th semester 150-hour capstone preceptorship plus workbook. Mixed design ANOVAs were used in these analyses. The 4th
semester 72-hour critical care preceptorship plus workbook was more effective in increasing student SAM knowledge, learning satisfaction, and self-confidence than a 150-hour capstone preceptorship plus workbook. A researcher-developed checklist, the Survey of Use of Pharmacology Resources, was used to explore student pharmacology resource use.
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CHAPTER ONE:
INTRODUCTION

Patient safety must always be the goal of nursing care and is the purposed aim of nursing education as well. Alarmingly, it has been approximated that each day of hospitalization, an error will occur related to one of the medications given to any one patient (Aspden, Wolcott, Bootman, & Cronenwett, 2007). The Institute of Medicine’s (IOM) 1999 report on the safety of patient care in the United States reported an estimated 7,000 persons died in 1993 from medication errors (Kohn, Corrigan, & Donaldson, 2000). The IOM report (Kohn et al., 2000) acknowledged that hospitals are the frequent site of medication errors and that medication errors contribute to the death of 1 person per 854 inpatient deaths (p. 27). In 2006, the IOM provided an estimate of preventable medication errors in US hospitals at 400,000 per year, and a yearly cost of $3.5 billion (IOM, 2006, p. 2).

Harm from medication errors, also known as preventable adverse drug events (ADEs), can cause serious physical harm or death to patients, affecting quality of care and adding financial burdens to patients (missed work, rehabilitation, disability) as well as to healthcare providers (Lahue et al., 2012). Injectable medication-related preventable ADEs alone affect an estimated 1.2 million patient hospitalizations at a per hospital cost of $600,000 annually, an increase of $2.7 billion to $5.1 billion health care costs in the United States (Lahue et al., 2012).

Registered nurses spend a significant amount of time in tasks related to medication administration. To provide safe medication management, nurses must possess an adequate knowledge base about each drug to be administered and be able to apply that knowledge in the
specific context of their patient’s situation. Nurse educators are tasked with equipping students with this essential foundational information and fostering the transfer of this knowledge to clinical situations.

A review of recent nursing literature revealed that current undergraduate nursing pharmacology education is not adequate to prepare students to manage medications safely. Hanson (2016) noted that improved pharmacology instruction has incorporated active teaching and learning strategies. Incorporation of technology into nursing pharmacological instruction generally yields increased student retention and application of pharmacology knowledge (Devi et al., 2010; Thompson & Bonnel, 2008). Further investigation into which nursing education teaching and learning strategies are effective for pharmacology instruction, using a variety of research methodologies (Sulosaari et al., 2015) is desirable (Dilles, Stichele, Van Bortel, & Elseviers, 2011; Sulosaari et al., 2015).

This study focused on the safe medication administration knowledge base of students in their senior year of their baccalaureate degree. Typically, nursing students in their senior year have had a prior pharmacology course and the opportunity to administer medications in several instructed clinical courses. Common undergraduate models of clinical instruction typically take the form of an instructor-supervised clinical where groups of 6 to 10 students are instructed by a nursing faculty member, or alternately, individual clinical experiences where the student is assigned to a registered nurse preceptor in a clinical facility.

In pre-licensure upper level clinical courses, it is common for the preceptor model to be used (Gaberson, Oermann, & Shellenbarger, 2015). Leading up to the preceptor-based clinical, senior-level students typically have had didactic courses such as fundamentals, medical-surgical, critical care, obstetrics, pediatrics, and mental health nursing which usually incorporate
medication management information into their curricula. Senior-level students must synthesize medication knowledge from all of these sources in order to transfer their knowledge into safe practice before and after graduation.

Nurse educators are challenged with the task of and have the primary responsibility to “successfully teach transfer of knowledge within the practice discipline of nursing” (Papastrat & Wallace, 2003, p. 460). The literature revealed a need to increase pharmacology theoretical content and medication management skill development beginning early in nursing programs and at each level of the curriculum, aligning classroom learning and clinical application (Cleary-Holdforth & Leufer, 2013). Strengthening connections between theory and practice are essential factors toward bridging the theory-practice gap among clinical nursing students (Dadgaran, Parvizy, & Peyrovi, 2012). Nurse educators can assist in this effort by presenting knowledge in a practice context (Benner, Sutphen, Leonard, & Day, 2010). To link theory with practice, it has been suggested that a student workbook, based upon activities from theory and clinical practice, is needed during nursing clinical experiences where pharmacology knowledge is applied (Honey & Lim, 2008). This study tested a safe administration of medication clinical workbook which was developed for this study by the researcher to be used in preceptorships.

**Problem Statement**

The goal of pharmacology education in the nursing curriculum is that the student nurse will carry out safe medication administration and avoid medication errors in today’s complex, multidisciplinary healthcare environment. The essential and increasingly complex task of administering medications is important for the safety of patients (Kavanaugh, 2017). Nurses are accountable for knowing the purpose, actions, side effects, and dose, as well as potential interactions of each drug they administer in order to be able to teach patients about their
medications (Barber & Robertson, 2015). The literature reveals that nursing students, new graduates, and practicing registered nurses are aware of their important responsibilities related to medication management (Dilles et al., 2011; Honey & Lim, 2008; King, 2004; Meechan, Mason, & Catling, 2011); however, they typically have insufficient knowledge and low confidence in their abilities in carrying out these tasks (Dilles et al., 2011; Manias & Bullock, 2002; Ndosi & Newell, 2009; Vaismoradi, Jordan, Turunen, & Bondas, 2014). Making students aware of potential problems and how to decrease errors may improve the care novice nurses provide and yield better patient outcomes and less liability (Saintsing, Gibson, & Pennington, 2011). With the ongoing shortage of nursing faculty and the increasingly popular capstone clinical curricular approach, senior-level nursing clinical courses are often preceptorships. The literature is unclear as to which model of clinical education provides better student support. Berry (2005) concluded that student self-confidence and critical thinking were higher using a preceptor-based clinical model; however, Walker, Dwyer, Moxham, Broadbent, and Sander (2013) found that students preferred and were encouraged to critically think more when a group clinical model was used. To decrease medication errors and prepare students to independently administer medications safely upon graduation, “it is imperative that universities design effective teaching strategies, based on critical thinking” (Coyne, Needham, & Rands, 2013, p. 1014). Nursing research focused on effective teaching and learning strategies for medication competence is needed (Sulosaari et al., 2015). Researchers have identified a need for studies using a pretest-posttest design to measure nursing student competencies prior to and following preceptorship clinical experiences (Weiland, Altmiller, Dorr, & Wolf, 2007). Preceptor studies using psychometrically tested instruments are lacking (Billay & Myrick, 2008). It is hoped that this study generated important data to assist in
filling a gap in the literature related to the effectiveness of teaching and learning in preceptorship clinical nursing courses.

**Statement of Purpose**

The purpose of this quantitative study was to determine the effectiveness of teaching and learning strategies, such as preceptor-supervised clinical instruction and an educational intervention (clinical workbook), on the knowledge of safe medication administration of senior baccalaureate pre-licensure nursing students in their final 2 semesters of study. A related purpose was to determine the extent to which the clinical workbook was used and whether students perceived it as helpful. A third purpose of this study was to determine which currently available resources students perceived as most helpful in learning and applying safe medication administration knowledge.

**Significance of Study**

It is anticipated that this study will be beneficial to nurse educators and future nursing students. The research findings of this study may provide nurse educators with safe medication administration teaching strategies. This study yielded recommendations for future studies that may add to the body of nursing knowledge in relation to safe medication administration and preceptorships.

**Theoretical Framework**

Several theoretical perspectives informed the design of this study. The underlying theoretical framework of this study’s interventions (independent variables) was the cognitive learning theories of constructivism, social constructivism, and situated cognition. Safe medication administration requires not only knowledge (dependent variable), but using that knowledge in context by making clinical judgments. Undergraduate nursing students need to
build their pharmacology knowledge base and clinical judgment throughout their program of study in order to provide safe medication administration during clinical rotations and upon graduation. This framework supported the predictive hypotheses: (a) nursing students in preceptorships which incorporated a clinical workbook would demonstrate knowledge gains in safe medication administration, and (b) nursing students in preceptorships which incorporated a clinical workbook would demonstrate greater gains in safe medication administration knowledge than students in a preceptorship without a clinical workbook.

**Constructivist Learning Theory**

The view that knowledge is constructed was presented by Piaget in the early 1970s (Piaget, 1973). Piaget believed that representations of new information are added to the learner’s existing knowledge base through a succession of equilibrations, a process of constructive autoregulation (Wartofsky, 1983). Each learner’s knowledge base (cognitive schema) is revised constantly by assimilating new information and refining mental structures in order to fully use the information: “the organism constantly assimilates the milieu to its structure while, simultaneously, accommodates the structure to its milieu” (Piaget, 1973, p. 166). This, according to Piaget, requires the learner to be actively involved in the learning process, interactive with one’s environment (Mandler, 1983; Webb, 1980). During a learning experience, Piaget thought, learners will be at various levels of learning readiness, and will notice and assimilate different information (Webb, 1980).

There are four key assumptions of the constructivist educational philosophy: (a) student learning is founded on prior learned constructs, (b) new constructions are founded on the processes of assimilating congruent content and accommodating new content, (c) making predictions and use of construct knowledge yields greater learning than memorizing facts
(Brandon & All, 2010). The fourth assumption is that through reflection and linking new information to the framework of one’s prior knowledge base, meaningful learning takes place (Muirhead, 2006).

Cognitive constructivist perspectives have increasingly been embraced by nursing education in both classroom and clinical settings. Creating student-centered active-learning strategies has been noted as a key role of nursing faculty in clinical, classrooms, skills lab (Brandon & All, 2010) and in online learning environments (Kala, Isaramalai, & Pohthong, 2010). Faculty are tasked with providing a collaborative learning environment, and being facilitators of learning, while promoting independent learning (Brandon & All, 2010; Kala et al., 2010). “In applying constructivism theory to nursing education curricula in the clinical setting, the ideal is that students are taught concepts rather than large amounts of content-laden material” (Brandon & All, 2010, p. 91).

**Social Constructivism**

Varying from Piaget’s view of persons learning from interactions with the environment, Vygotsky held that when learners experience concepts, they negotiate the meaning of the concepts in the social, authentic context of a learning environment that is complex (Jaramillo, 1996). Vygotsky held a sociocultural view of learning: he believed that students’ development cannot be separated from their social experiences (Jaramillo, 1996). Education should be egalitarian with power balanced between the teacher and student (Jaramillo, 1996). Further, Vygotsky believed that experiential learning with students actively involved in doing is an important means of learning (Jaramillo, 1996). This notion resonates with nursing education: active engagement in learning has been identified as important for satisfaction in learning by baccalaureate students (Walker, Rossi, Anastasi, Gray-Ganter, & Tennet, 2016).
Situated Cognition

Nursing education in the United States started out as hospital-based, on-the-job training. As nursing education shifted to academic settings, clinical courses needed to be incorporated into the curriculum to provide contextual learning. Fairly recent theory explains this phenomenon as situated cognition: the activity and authentic environment where knowledge is gained is a vital part of what is learned (Brown, Collins, & Duguid, 1989). “Knowledge . . . indexes the situation in which it arises and is used. The embedding circumstances efficiently provide essential parts of its structure and meaning” (Brown et al., 1989, p. 36).

In applied professions such as nursing, those in training need to be acclimated to nursing culture through authentic activities, which Brown et al. (1989) described as practices that are ordinary to a culture. Learning in context involves being attentive to the interactions and intersections between the tools, persons, and context in the learning environment (Hansman, 2001). The context then is not just the physical site where learning takes place, but includes the social interaction between the student and teacher who demonstrates use of tools of the trade and how to be a problem solving practitioner (Brown et al., 1989). Further, this learning in context may make subsequent similar tasks in similar environments much more efficient (Brown et al., 1989). The knowledge base of nursing science is not static, but changes and expands: nurses who can critically think and apply knowledge in context of patient care are more effective than if they were to only memorize data (Brandon & All, 2010).

Overview of Pharmacology Knowledge in Undergraduate Nursing Education

Safe Medication Administration

Ultimately, the goal of pharmacology instruction to undergraduate nursing students is the safe administration of medications to patients and the avoidance of medication errors. Safe
medication administration incorporates more than practicing the five rights of safe administration (Dolansky, Druschel, Helba, & Courtney, 2013). The nurse must consider the context of the patient’s situation, condition, and level of stability; the medication’s actions and potential side effects; and the actions and responsibilities of other health care team members (Dolansky et al., 2013). Advances in drug therapy and technology necessitate more nursing knowledge related to drug monitoring, and the appropriateness of drug therapy (Lim & Honey, 2006). Managing medications incorporates communication skills, legal and ethical elements, as well as application of biological science knowledge (Lim & Honey, 2006).

**Medication Errors**

There are more than 10,000 medications that can be prescribed. Close to one-third of all adults residing in the United States are prescribed at least five medications [Agency for Healthcare Research and Quality (AHRQ), 2017]. The administration of medications is an essential and complex nursing activity (Hewitt, Tower, & Latimer, 2015; Jones & Treiber, 2010) that is prone to errors (Harkanen, Voutilainen, Turunen, & Behvilainen-Julkunen, 2016), and carries high risk (Cloete, 2015; Papastrat & Wallace, 2003). Medication administration risk is high particularly among elderly (AHRQ, 2017) and pediatric patient populations (AHRQ, 2017; Pauly-O’Neill, 2009). Nurses work in a complex health-care environment and system; hospital nurses spend a substantial quantity of time on tasks related to medication administration (Barkhouse-MacKeen & Murphy, 2012). In the clinical setting, nurses administer “hundreds of medications daily to multiple patients with multiple disease processes and via multiple routes” (Jones & Treiber, 2010, p. 240). Unfortunately, medication errors do occur, and represent a multifaceted, multidisciplinary problem (Adhikari, Tocher, Smith, Corcoran, & MacArthur, 2014; Cleary-Holdforth & Leufer, 2013) that can occur from the time of prescription through
actual administration and are affected by individual and system-wide shortcomings, with nurses significantly impacting medication safety (Page & McKinney, 2007).

Examples of contributors to unsafe medication administration have been noted as interruptions during medication administration, inadequate dosage calculation ability, deficient pharmacology knowledge, and nursing education strategies related to teaching and learning (Cleary-Holdforth & Leufer, 2013). Additionally, nurse inexperience, fatigue, and stress are factors that affect patient safety related to assessment, administration, and monitoring of medications (Barkhouse-MacKeen & Murphy, 2012). Nursing educators need to equip students with a sound theoretical knowledge base and the mindset that multiple factors contribute to medication errors (Page & McKinney, 2007).

**Theory-Practice Gap**

The acquisition of pharmacology knowledge and medication management is an essential component of baccalaureate nursing education. The American Nurses Association (ANA) identified medication administration as one of the key responsibilities of registered nurses (ANA, 2015b). It was proposed by Armitage and Knapman (2003) that even though a nurse spends 40% of his or her clinical time in activities surrounding the administration of medications, pharmacology education may not be given sufficient consideration in the undergraduate nursing curriculum. Nursing educators are tasked with preparing undergraduates for safe entry-level practice upon graduation and for fostering life-long learning (Barkhouse-MacKeen & Murphy, 2012).

The existence of a practice-theory gap related to pharmacology knowledge and clinical practice has been described in the literature. Studies have shown that, typically, nursing students as well as practicing nurses lack confidence in the level of pharmacologic knowledge they
possess (Dilles et al., 2011; Honey & Lim, 2008; King, 2004; Meechan et al., 2011;). An inadequate pharmacology knowledge base has implications for clinical decision making and the provision of safe patient care; lack of confidence and ability in basic math skills can also affect patient safety (Dilles et al., 2011).

Inadequately educated nursing students generate inadequately prepared nurses: when the pharmacology knowledge of working surgical nurses in Britain was evaluated related to medications they commonly administer, a knowledge deficit was identified (Ndosi & Newell, 2009). Similarly, a study of Australian newly graduated working nurses (completed undergraduate studies less than 1 year earlier) demonstrated inadequate pharmacology preparation (Manias & Bullock, 2002). Additional research is needed to better understand the practice-theory gap and to discover strategies to remedy this significant problem. A map overview of references related to pharmacology theory-practice gap, teaching strategies, and learning strategies is included in Appendix A.

**Teaching Strategies**

Best practice teaching strategies and application of learning theory are needed to optimize undergraduate nursing pharmacology education. Pharmacology instruction in the curricula should align with opportunities for clinical application to enrich student learning (Cleary-Holdforth & Leufer, 2013). In addition to theory, safe administration methods, and dosage calculations, instruction should include how to maintain currency in pharmacology information (Barkhous-MacKeen & Murphy, 2012). Student perspectives of learning needs should be taken into account when developing instruction (Cleary-Holdforth & Leufer, 2013). Lack of consistency of pharmacology education among nursing curricula has been identified (Dilles et
al., 2011). Development of specific registered nurse medication administration competencies are needed to guide undergraduate pharmacology curricula (Manias, 2009).

**Preceptorships**

The preceptorship teaching approach in undergraduate nursing education involves the student assigned to a staff nurse during a clinical rotation. The preceptor role models and shares practical wisdom from their experiences in nursing practice (Myrick, Yonge, & Billay, 2010). A teaching focus on the potential for practice errors and how to avoid them may help reduce error rates of student nurses transitioning to practice (Saintsing et al., 2011).

Strategies to develop student learning specific to preceptor-based clinical experiences were noted by Honey and Lim (2008): facilitate communication between a student’s preceptor and nursing faculty; ensure that the importance of pharmacology is apparent in the school’s curriculum; and use a pharmacology workbook in a preceptor-based clinical to assist with transfer of learning medications. This research reinforces the need for improved pharmacology education for nursing students and provides suggestions to assist senior students in contextualizing pharmacology theory. Nurse educators are challenged with the task and have the primary responsibility to “successfully teach transfer of knowledge within the practice discipline of nursing” (Papastrat & Wallace, 2003, p. 460). The literature reveals a need to increase pharmacology theoretical content and medication management skill development in the curriculum (Adhikari et al., 2014; Cleary-Holdforth & Leufer, 2013) using a safety science and systems approach (Bush, Hueckel, Robinson, Seelinger, & Molloy, 2015).

**Teaching and Learning Medication Knowledge Summary**

Few studies address current learning theory application related to nursing teaching and learning strategies. Studies involving creative teaching strategies often describe the use of
expensive technology. Studies are needed that investigate low-cost educational strategies. In addition, the relationship between student approaches to studying and success in pharmacology knowledge acquisition need investigation. An additional gap in the literature is a paucity of studies evaluating the effectiveness of student learning in the preceptor-based clinical model. Finally, and surprisingly, there is a near absence of reliable and validated instruments for measuring safe medication administration of undergraduate nursing students.

**What is known.** To date, all studies (Dilles et al., 2011; Honey & Lim, 2007; King, 2004; Manias & Bullock, 2002; Meechan et al., 2011; Ndosi & Newell, 2009) this researcher has discovered on the topic have helped her conclude that current undergraduate nursing pharmacology education is inadequate to prepare students to safely manage medications. Successful efforts to improve pharmacology instruction have incorporated active teaching and learning strategies (Hanson, 2016; Meechan et al., 2011; Thompson & Bonnel, 2008), though such efforts are not always embraced by all students (Manias & Bullock, 2002). Incorporating technology into pharmacology instruction generally results in increased student retention and application of pharmacology information (Devi et al., 2010; Pauly-O’Neill, 2009; Thompson & Bonnel, 2008). Educators and students may have different perceptions as to best teaching and learning strategies.

**What is not known.** Breaking away from other noted authors, Wright (2009) proposed that nursing has invented the issue of poor dosage calculation ability among nursing students and working nurses. Her reasoning was that nurses do not calculate dosages as a separate task apart from the context of the clinical setting; therefore, a pen and paper evaluation of dosage calculation is not a true reflection of skill and falsely underestimates ability (Wright, 2009). An
examination of how nurses develop competence in dosage calculation in practice is needed in order to develop effective ways of teaching (and evaluating) this skill (Wright, 2009).

Further research is needed on medication administration and patient monitoring (Vaismoradi et al., 2014) and patient education (Sulosaari et al., 2015). Research is needed on strategies for lifelong learning of safe medication delivery and competence for both nursing students and working nurses (Dilles et al., 2011). The relationship between medication competence and the clinical environment needs to be investigated (Sulosaari et al., 2015); this research hopes to contribute to knowledge in this area.

**Evaluation of Safe Administration of Medication Knowledge**

The Safe Administration of Medications (SAM) Scale (Ryan, 2007) is an instrument to evaluate the ability of student nurses to administer medications safely. The instrument is based on the traditional “five rights” of safe medication administration: right patient, right drug, right dose, right time, and right route. Nursing students must read through case studies and associated vignettes in the SAM scale to determine whether the nurse in the vignettes violated one of the “five rights,” and made a medication error. The score from the 70-item instrument is used as an assessment of safe medication administration ability (Ryan, 2007). The instrument developer administered the SAM scale initially to 40 baccalaureate nursing students, then to 267 baccalaureate and associate degree student nurses and found that the level of ability among student nurses to identify medication errors does vary (Ryan, 2007).

**Evaluation of Self-confidence in Learning Safe Administration of Medication**

The literature did not reveal a tool to measure self-confidence specifically related to safe medication administration in preceptorships. A tool developed to measure self-efficacy of medication administration and related nursing care before and after online versus in-person
instruction was reported (Sung, Kwon, & Ryu, 2008). Another tool, the NSE-Math, measured student confidence related to dosage calculations (Andrews, Salamonson, & Halcomb, 2008). This study used an adapted NLN Satisfaction and Self-confidence in Learning (SSSCL) instrument to assess student self-confidence in safe administration of medication (SAM) pre- and post-clinical preceptorship. The SSSCL for SAM questionnaire is located in Appendix B.

**Survey of use of Pharmacology Resources**

A two-part researcher-developed survey, the Survey of Use of Pharmacology Resources (SUPR) is located in Appendix C. All participating students were asked to fill out Part 1, a checklist of pharmacology resources used during their nursing education. Part 2, brief Likert-type and open-ended questions about clinical workbook use and helpfulness toward SAM knowledge and self-confidence, was filled out by all participants as well.

**Research Questions**

The purpose of this quantitative study was to determine the effectiveness of teaching and learning strategies, such as preceptor-supervised clinical instruction and an educational intervention (clinical workbook), on the knowledge of safe medication administration of senior baccalaureate pre-licensure nursing students in their final 2 semesters of study. A related purpose was to determine the extent to which the clinical workbook was used and whether students perceived it as helpful. A third purpose of this study was to determine which currently available resources students perceived as most helpful in learning and applying safe medication administration knowledge.

Research questions should show linkage to the study problem and significance (Marshall & Rossman, 2016). The proposed study relates to a particular population, that of pre-licensure baccalaureate nursing students, and whether certain teaching and learning strategies affect their
knowledge of safe medication administration. To investigate this topic, this researcher sought to answer the following questions:

**Question 1**: Which intervention, a preceptorship clinical, or a preceptorship plus use of a clinical workbook, is more effective in increasing participant’s SAM and Self-Confidence in Learning scores?

**Question 2**: Which intervention, a 72-hour critical care preceptorship plus use of a clinical workbook, or a 150-hour capstone preceptorship plus use of a clinical workbook, is more effective in increasing participant’s SAM and Self-Confidence in Learning scores across the two time periods (pre-intervention and post-intervention)?

**Question 3**: To what extent do pre-licensure senior baccalaureate nursing students find a clinical workbook helpful or useful in learning safe medication administration during preceptor-based clinical courses?

**Question 4**: What resources do pre-licensure baccalaureate nursing students use in today’s academic and clinical environment to increase safe medication administration knowledge?

**Research Design**

To investigate safe medication administration knowledge of pre-licensure baccalaureate senior nursing students, a quasi-experimental pretest/posttest study design with two comparison treatments was implemented. The literature does not describe an evaluation of the effect of a preceptor-supervised clinical on student safe medication administration; therefore, this was treated as an independent variable. The proposed educational intervention of a safe medication administration clinical workbook was a second independent variable. Due to concerns of data contamination, it was determined that all study participants would receive the workbook
intervention, as discussion between students was likely. An overview of the research design is located in Appendix D.

Definitions

**Medication Error**: This study will utilize the definition adopted by AHRQ: “an error (of commission or omission) at any step along the pathway that begins when a clinician prescribes a medication and ends when the patient actually receives the medication” (2017).

**Safe Medication Administration**: Safe medication administration is the process of accurately administering medications using each of the medication rights in the context of the patient’s unique situation.

**Theory-practice gap**: A theory-practice gap indicates a discrepancy between the needed knowledge base one has for a particular task and the actual level of knowledge possessed.

**Preceptor**: A preceptor is an experienced nurse working in a clinical setting who serves as a mentor, resource, and role model to a nursing student collaboratively with the clinical site and educational institution for a set time frame (Parrot, Schumann, & Manning, 2010). The preceptor is a role model and guide assisting the student in “critical-thinking, gaining proficiency in nursing skills and responsibilities, prioritization and socialization in the culture of the agency staff/unit” (Parrot et al., 2010, p. 298).

**Preceptor-based Clinical (Preceptorship)**: A preceptor-based clinical is a method of clinical instruction for transition of students nearing completion of their program of study into a real-world workplace. A preceptor-based undergraduate clinical is contracted between the educational institution and the healthcare facility that pairs the near-graduate with a competent, experienced nurse (Parrot et al., 2010).
Capstone Clinical Course: A capstone (or practicum) course provides students with the opportunity to work in a healthcare facility with an expert clinician as the student synthesizes and applies nursing knowledge and principles accrued from all prior courses in their program (Gaberson et al., 2015).

Clinical Workbook: The clinical workbook was based upon and organized around the rights of safe medication administration as noted from the literature review and expert sources such as the Institute for Safe Medication Practices (ISMP). The format included the concept, explanation of relevant information, example (case), and questions related to each of the medication rights. Workbook content was concise and user-friendly as a clinical resource for encouraging conversations between student and preceptor regarding safe medication practices.

Summary

Medication administration is an essential nursing task of increasing complexity that is important for the safety of patients (Kavanaugh, 2017). Nurse educators are tasked with teaching pharmacology theory and facilitating the transfer and application of this knowledge to the clinical setting. A literature review revealed that nursing students are graduating with an inadequate medication knowledge base and low self-confidence in their ability to safely administer medications.

The purpose of this pretest-posttest quasi-experimental study was to determine the effectiveness of the teaching and learning strategies of the preceptorship clinical model and an educational intervention of a clinical workbook. A secondary purpose was to determine the extent to which the workbook was used and found useful by nursing students in preceptorships. A third purpose of the study was to investigate which currently available resources students use and find most helpful in learning and applying safe medication administration knowledge. The
information from this study can potentially add to safe medication teaching strategy knowledge of nurse educators.
CHAPTER TWO:
REVIEW OF THE LITERATURE

An overview of the review of literature for this study is presented in this chapter. The literature review focused on the following major concepts: safe medication administration, medication errors, theory-practice gap, self-confidence, workbooks as a teaching strategy, and clinical supervision models, preceptorships specifically. Literature relevant to the study was reviewed in CINAHL, PubMed, Medline, Science Direct, and ProQuest Digital Dissertations. Searches were made for multiple configurations of key words including safe medication administration, nursing student, nursing education, medication errors, preceptor, preceptorship, workbooks, and self-confidence.

Safe Medication Administration

To prepare senior nursing students for practice, theoretical instruction should be connected to the complexities of medication administration to help students understand their role in error prevention (Bourbonnais & Caswell, 2014). “Drug administration is not a simple task; it demands clinical judgment before and during preparation, immediately before administration and afterwards” (Edwards & Axe, 2015, p. 406). Current efforts to prevent adverse events in the complex health care environment use a multifactorial approach (Bourbonnais & Caswell, 2014). A discussion of the processes used for safe medication administration follows.

Rights of Medication Administration

The medication administration process starts with the nurse carrying out the traditional five rights: “identifying the patient, the drug, the dose, the route, and the time” (Pauly-O’Neill,
2009, p. e182). Some sources refer to “6-rights of medication administration” (Bush et al., 2015, p. 170), adding right documentation to the process. Following the rights of medication administration (AHRQ, 2017; Anderson, 2010; Elliott & Liu, 2010) is an essential strategy in providing safe patient care.

Bourbonnais and Caswell (2014) listed the “8 Rights” of medication administration citing the College of Nurses of Ontario (2014), and adding the right frequency, right site, and right reason, while leaving off the right documentation. Nine rights were described by Elliott (2010): the five rights plus right action, form, response, and documentation. Further, a list of 10 rights, the traditional five plus the right of the patient or nurse to refuse, the nurse’s right knowledge (understanding of the medication), the right questions or challenges, the right advice (to the patient), and the right response or outcome have been reported (Edwards & Axe, 2015). All aspects of the additionally identified rights of medication administration in the literature are essential; however, it could be argued that most are closely associated to and addressed in the traditional five rights, which are right patient, right drug, right dose, right route, and right time.

**Right patient.** An important aspect of medication management and error avoidance is following protocols; however, poor protocol adherence by nurses has been noted (Jones, 2009). Using two unique patient identifiers when administering medications is a Patient Safety Goal requirement of The Joint Commission (2017). Unfortunately, checking patients’ identities using hospital wristbands is a frequently neglected protocol. According to Jones (2009), only 57% of nurses confirmed patients’ identities by checking their wristbands. Of medication incidents reported to the National Patient Safety Agency, 10% to 15% were attributed to “mismatching patients and medications” (Harris, 2014, p. 403).
Another aspect of administering medications to the right patient is taking their rights into consideration. Nurses must know the state laws and policies regarding a patient’s right to refuse medications (Morris, 2014). Another ethical and legal issue related to patient rights is that of the right of the patient to receive education about each medication being administered (Morris, 2014).

**Right drug.** Each medication to be administered should be triple-checked before it reaches the patient. For the three checks, the medication labels should be examined when removed from stock, the drug and label should be examined before measuring the dose, and the dose should be reviewed just before it is administered to the patient (Pickar, 2013). The barcode on the medication is commonly electronically scanned at the third check prior to administration.

Nurses must know about each drug they administer, that it is appropriate for their patient. Nurses must question the order to the prescriber if they have concerns about the order (Elliott & Liu, 2010; Morris, 2014). Medications should not be administered unless the health care professional giving them can state what the drug is being given for, can explain it to the patient, and understand the side-effects for which they should be monitoring (Edwards & Axe, 2015). Nurses also need to know the usual dosage range and contraindications for each medication administered, and should use a reliable and up-to-date drug reference for unfamiliar medications (Morris, 2014). The nurse must also know which medications patients have immunologic allergies to before administering medications in order to avoid errors (Elliott & Liu, 2010).

**Right dose.** Arriving at the correct dose for each medication to be administered involves not only an understanding and application of basic mathematical principles, but an understanding of clinical information (Bagnasco et al., 2015; Wright, 2006). The mathematical principles must be applied and understood in the context of the situation and available resources (Wright, 2006).
The main areas in which nursing students have difficulty with drug calculation are arithmetic skills, inability to conceptualize the calculation to solve the problem, and the inability to “symbolize the drug measurements involved in the drug calculation” (Wright, 2008, p. 857).

Difficulty converting between different units of measure is another problematic area for nursing students (Weeks, Lyne, & Torrance, 2000; Wright, 2006). In a mixed-methods Italian study of 726 undergraduate nursing students, scores were lowest on the following mathematical principles: multiplication of fractions; calculations of fractions, percentages, proportions, or of infusion speeds; and “divisions and multiplications by 10, 100 and 1000” (Bagnasco et al., 2015, p. 35). Adverse patient events can result from errors in mathematical calculations, as well as from conceptual errors (Fleming, Brady, & Malone, 2014).

A constructivist framework was used by Weeks et al. (2000) to explain the theory-practice gap and deficit in student ability to conceptualize calculations. Nursing student ability to calculate dosage problems relies on skills acquired prior to college and construction of an evolving knowledge of how to solve calculation problems (Revell & McCurry, 2012). Using a constructivist approach in teaching nurtures the student’s internal process that “actively builds understanding and decreases anxiety” (Revell & McCurry, 2012, p. 1355).

Wright (2009) contended that by improperly testing dosage ability on paper, out of the context of the clinical setting, nurse educators have invented the crisis that nursing students cannot accurately calculate dosage amounts. Citing Lave and Wenger (1991), Wright (2009) insisted that calculations need to be studied within the social context of the complex healthcare environment. Evidence for using a situated cognition framework to teach medication administration was found when medication concepts practiced in the nursing skills lab proved challenging for nursing students to apply in a fast-paced acute care clinical (Krautscheid, Orton,
Chorpenning, & Ryerson, 2011). This is consistent with the social constructivist and situated cognition framework of this study. Wright (2009) concluded that “only then will they be able to participate in drug administration practice, learn the social language of nursing and gain the meaning and context required to understand the numbers in the calculation problems and how to solve” (p. 548).

Nursing students also need to understand the meaning and difference between a safe dose and an effective dose, and know to address concerns about doses outside of safe dose ranges with prescribers prior to medication administration (Martinez de Castillo & Werner-McCullough, 2017). In critical care areas, nurses must be aware of whether intravenous drip (IV) medications are to be titrated by facility protocol or by physician-ordered parameters. Nurses must know the initial dose of IV medications, how they can be titrated, the minimum and maximum dose range, as well as expected patient response in order to safely administer the infusion (Martinez de Castillo & Werner-McCullough, 2017). There is a wide range of knowledge and skill needed by nurses in order to safely administer the right dose; however, much of the literature related to right dosage centered around mathematical ability.

Causes of administering the wrong dose of medication beyond calculation errors are unclear medication labels or information or prescriber handwriting [Institute for Safe Medication Practices (ISMP), 2017a]. Nurses too comfortable with accepted safety practices such as double-checking doses can have confirmation bias or rely on social relationships more than professional ones, increasing risk of error (Armitage, 2009). For effective double checks, nurses should faithfully carry out the process without showing the verifier the first nurse’s calculations (Harris, 2014).
The literature is packed with studies related to student dosage calculation ability. Coyne, et al. (2013) concluded that a multifaceted teaching strategy increased second year baccalaureate nursing student medication calculation accuracy. Pre- and post-tests were given to 156 Australian 2nd year students around an 8-week multifaceted intervention. The intervention included weekly interactive face-to-face tutorials covering basic mathematical skills and instruction on how to choose the appropriate mathematical formula for the needed dosage calculation. Students received practice connecting medication knowledge to patient examples in case studies. They also were assigned 2 weeks clinical placement in an acute care facility (Coyne et al., 2013). Medication calculation accuracy, ability to choose the correct formula for use, and ability to identify calculation errors improved post-intervention (Coyne et al., 2013).

In another study using a multifaceted approach, a statistically significant improvement on dosage calculation was accomplished after use of mathematical and conceptual teaching strategies (Wright, 2007). Second-year nursing students (n=71) were given a drug calculation pretest before and posttest following a teaching strategy which included online mathematical lessons, a 2-hour lecture on formulas, a workbook for drug calculation practice, and skills lab practice sessions to connect theory to clinical practice (Wright, 2007). Although posttest scores improved, scores remained unacceptably poor (Wright, 2007).

Student success was found using multiple methods of medication calculation instruction by Wright (2008). Skill sessions, online and face-to-face math instruction, and a drug calculation workbook were used as interventions in a study of 172 Australian nursing students’ dosage calculation abilities (Wright, 2008). Another successful teaching strategy is to use the same method of dosage calculation throughout a nursing program, use online practice assignments,
ensure consistent faculty teaching dosage calculation, and a consistent approach to testing dosage calculation in each course (Jackson & De Carlo, 2011).

Visual cues have been shown to aid in dosage calculation accuracy by helping students to conceptualize relevant information in order to work the calculation (Wilson, 2003; Wright, 2008). Wright (2008) recognized the congruence of teaching strategies that use visual clues in class or clinical environments with that of a constructivist approach. The finding that practicing medication skills in context, whether by use of case studies or the clinical facility is congruent with this study’s cognitive learning framework, situated cognition and constructivism.

Further evidence of the importance of applying and practicing mathematics in the context of the clinical setting was noted in a mixed-methods English study of 231 university nursing students (Hutton, 1998). Use of a self-study instructional booklet on the mathematical principles of ratios, percentage, decimals, and fractions and an optional on-campus tutor were used as study interventions and resulted in higher posttest scores (Hutton, 1998). Student interviews, however, revealed that students reported learning more about and making sense of mathematics when applying it in the clinical area than when taught in the classroom (Hutton, 1998). The process of dosage calculation is often interwoven with influences from the practice setting, cues, and people (Rogoff & Lave, 1984, in Wright, 2009). Nurses in mentoring or preceptor roles should be informed that they can help improve mathematic ability through clinical learning experiences (Hutton, 1998). Opportunities to practice are important for improving mathematical ability in nursing education, and later in workplace settings (Polifroni, McNulty, & Allchin, 2003).

**Right route.** A single medication on the market may be available in multiple formulations for administration via several routes. Unless a medication order provides the nurse a choice of routes, the nurse must deliver the medication in the route as prescribed (Elliott & Liu,
The nurse must also have knowledge of drug onset of action and or expected rate of absorption for the route of administration being used (Elliott & Liu, 2010), and whether the prescribed route is appropriate for the drug ordered (Edwards & Axe, 2015). A drug information resource must be used by the nurse for clarification and confirmation of the route of administration of unfamiliar drugs or changes in the patients’ situations such as the insertion of a nasogastric tube that would affect the route of administration (Pickar, 2013).

**Right time.** The Institute for Safe Medication Practices (ISMP) provides national guidelines for timely administration of scheduled medications in acute care settings (ISMP, 2011). Health care facility policies provide parameters for determining the timeframe for when medications should be administered. Administration outside of the timeframe constitutes a medication error for the “right time,” and applies to scheduled, stat, now, one time, or as needed (prn) medications. Medication bioavailability could be affected if the drug is not given at the right time (Elliott & Liu, 2010).

Errors involving the timing of medication administration are common. A Swedish study analyzed over 70 nurse-patient medication administration encounters, where 306 medication doses were observed, and the most frequently occurring medication error identified was that of wrong time (Gunningberg, Poder, Donaldson, & Swenne, 2014). Nurses must be proactive and look to see when medications given at intervals were last administered; they must determine if the gap was too long or too short between the last dose given and the next dose due (Edwards & Axe, 2015). Delay of treatment (Gunningberg et al., 2014) is another cause of administering a drug at the wrong time.

The right rate of administration is another aspect of patient safety in relation to administering a medication at the right time (Elliott & Liu, 2010). The most common error
related to the administration of IV bolus doses is an injection rate faster than what is recommended (Taxis & Barber, 2003). Insufficient training in how to prepare and administer IV bolus medication has been cited as a cause of improper rates of administration (Taxis & Barber, 2003).

**System Strategies**

Strategies beyond the five rights, both on an individual and system level, have been implemented or recommended in nursing education and clinical practice to increase safe medication administration competence. Clinical strategies have included use of bar-code technology (AHRQ, 2015; Harkanen et al., 2016) and computerized physician order entry (CPOE) as endorsed by the Leapfrog Group (Anderson, 2010). Other clinical strategies noted were medication reconciliation (Adhikari et al., 2014), triple checking medications during the administration process (Elliott & Liu, 2010), interprofessional collaboration (Pauly-O’Neill, 2009), and using smart infusion pumps (AHRQ, 2017). Reading back phone medication orders, double-checking high risk drugs, verifying allergies, using only approved abbreviations, staying attentive during the task, and using an oral syringe for oral or nasogastric medications are additional strategies to ensure safe medication administration (Anderson, 2010).

Health care facilities have implemented efforts to decrease nurse distractions during the medication administration process such as signage marking “do not interrupt” areas, or having nurses wear certain vests, and so forth, while preparing medications (Adhikari et al., 2014). Additional strategies in clinical practice include cautioning nurses to not blindly carry out physician orders (Elliott & Liu, 2010) or bypass safety processes by using workarounds (Anderson, 2010). Increasing health professionals’ safe medication administration skills, knowledge, and attitudes is recommended (Harkanen et al., 2016). Additionally, health care
facilities should use available guidelines, such as the 2016 Hospital National Patient Safety Goals, which recognize and list safe medication use as one of the year’s seven priority goal categories.

**Individual Responsibilities and Strategies**

Safe medication administration requires knowledge of pharmacology theory (Adhikari et al., 2014; Honey & Lim, 2008; Sulosaari, Kajander, Hupli, Huupponen, & Leino-Kilpi, 2012), clinical and diagnostic reasoning, and critical thinking (Honey & Lim, 2008). Anatomy and physiology knowledge, communication skills, collaboration, and seeking information are all necessary for safe administration, as well as carrying out the correct process of administering, storing, transporting, and disposing of medications (Sulosaari et al., 2012). Mathematical skills and dosage calculation are essential for medication administration competence (Sulosaari et al., 2012). Monitoring the patient’s status and need for medications (Sulosaari et al., 2012) and response to the drugs (Elliott & Liu, 2010; Page & McKinney, 2006; Sulosaari et al., 2012) are important to safe medication administration. Educating patients regarding their medications is another key element of safe medication administration (AHRQ, 2017; Sulosaari et al., 2012).

**Medication Errors**

Medication administration is a high-risk activity from a nursing and system perspective. To prevent medication errors, an acknowledgement that errors are going to happen in today’s complex, technical, interdependent health care system is necessary (Papastrat & Wallace, 2003). In recent years, health care systems have transitioned their error prevention efforts to focus on system and process causes more than on individuals, following the lead of aviation and nuclear energy industries (Bush et al., 2015). The literature identified that the system processes,
equipment, and human tasks all provide opportunities for error in a complex system (Papastat & Wallace, 2003).

A broad definition of a medication error was identified by the Division of Medication Error Prevention and Analysis (DMEPA) of the Center for Drug Evaluation and Research (CDER):

any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing; order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use. [National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP), 2017]

The Agency for Healthcare Research and Quality (AHRQ) provided a more succinct definition: “an error (of commission or omission) at any step along the pathway that begins when a clinician prescribes a medication and ends when the patient actually receives the medication” (2017, ¶2).

In addition to varying definitions of the term medication error, there are various ways to detect, identify, and quote rates of medication error occurrences as well (Aspden et al., 2007). The majority (77%) of in-hospital medication errors happen during the prescribing and administration stages of the medication process (Aspden et al., 2007). Conservative figures of 380,000 to 450,000 preventable adverse drug events occur annually in hospitalized patients (Aspden et al., 2007). Studies using comprehensive methods to detect medication errors noted administration error rates of hospitalized patients per dose given in the range of 2.4 to 11.1%, not including medications given at the wrong time (Aspden et al., 2007). Based upon research findings of errors reported, it has been approximated that each day people are hospitalized an error will occur related to one of the medications given (Aspden et al., 2007).
The best method for discovering nurse medication administration errors is direct observation (Montesi & Lechi, 2009). When 113 nurses were directly observed preparing and administering over 400 intravenous (IV) medications in two United Kingdom hospitals, a 49% error rate (7% preparation; 36% administration; 6% both types of errors) was observed; 29% of the errors were potentially moderately severe (Taxis & Barber, 2003, p. 343). An alarming 73% error rate was observed for IV push medication administration, 95% of which were due to too fast administration rates (Taxis & Barber, 2003, p. 343). An error rate of 14% has been reported for intravenous drugs that require numerous steps of preparation (Taxis & Barber, 2003, p. 343).

Inadequate drug information, drug labeling, packaging, and storage issues, device use, and workflow issues contribute to IV medication errors (ISMP, 2015). Though the majority of medication errors do not result in patient harm, the consequences of those that do can include patient injury or death, lengthened hospital stays, and litigation costs (Nute, 2014). A need to address the deficit of perceived risk by nurses, nurse knowledge deficits, and system issues associated with these medication errors calls for a multifaceted approach, including addressing these needs in nursing education (Taxis & Barber, 2003).

**Individual and System Causes of Medication Errors**

Contributing factors to medication errors have been described in terms of individual and system causes (Harkanen et al., 2016; Hewitt et al., 2015; Leufer & Cleary-Holdforth, 2013; Page & McKinney, 2007; Valdez, Guzman, & Escolar-Chua, 2013). Individual, or human error, causes can be attributed to an error in action or from using a wrong plan related to insufficient knowledge or not following rules (Papastrat & Wallace, 2003). Poor mathematical ability has been cited as a source of individual medication error causation (Cleary-Holdforth & Leufer, 2013; Sulosaari et al., 2012).
System errors in the complex, specialized, technical healthcare system may be related to system design in terms of: processes or tasks used or equipment used in those processes or tasks (Papastrat & Wallace, 2003). A commonly cited system-related cause of medication errors is that of interruptions during medication administration (AHRQ, 2015; Anderson, 2010; Cleary-Holdforth & Leufer, 2013; Harkanen et al., 2016; Page & McKinney, 2007). Medications that have names that sound or look alike or that have labels similar in appearance are also sources of system errors (AHRQ, 2015; Hewitt et al., 2015).

**Nursing Student Medication Errors**

Nursing students may not be prepared to administer medications adequately in the complex and unpredictable clinical environment: students have reported poor self-confidence in the preparation and administration of medications, and related caring actions such as monitoring drug effects and patient teaching (Vaismoradi et al., 2014). A case study approach has been used to investigate nursing student medication errors using a root cause analysis (RCA) method in hope of preventing future student errors (Dolansky et al., 2013). The analysis uncovered not only personal, environmental, and unit factors (culture and communication), but education factors as well (Dolansky et al., 2013). A retrospective study of 325 baccalaureate nursing student records in South Asia revealed seven reported medication errors, all of which occurred during preparation or administration of the medications (Tabassum, Saeed, Dias, & Allana, 2016). Additional themes identified in the literature as factors influencing medication errors are incomplete pharmacology learning, inadequate caring skills, and contextualizing pharmacology information (Vaismoradi et al., 2014). The RCA method focuses on understanding the underlying causes of the error rather than indicting the student, therefore, creating a fair and just culture in nursing education (Dolansky et al., 2013).
Errors related to medical tubes and catheters have also been reported. The United States Pharmacopeia (USP) operates a nationwide internet database for voluntary reporting of medication errors: MEDMARX ® (ISMP, 2017b). A retrospective study of student nurse medication errors related to tubes or catheters reported to MEDMARX during 2000-2006 revealed 27 errors resulting from deficient performance or knowledge, or not following a protocol (Wolf, Hicks, Altmiller, & Bicknell, 2009). Many (12 of 27) errors involved clamps on IV tubing, and highlighted the need for “constant vigilance among professional staff nurses involved with student medication administration” (Wolf et al., 2009, p. 687).

Further study of factors affecting medication errors made by student nurses revealed the following causes: omitting doses (Harding & Petrick, 2008; Wolf et al., 2006), administering drugs at the wrong dose or time (Wolf, Hicks, & Serembus, 2006), and a deficit in performance. Performance deficit may be from the student not correctly using their knowledge or skills (Wolf et al., 2006) or failing to follow established policies or procedures (Harding & Petrick, 2008). Valdez et al. (2013) described five causal dimensions of medication errors that result from the combination of (human) student nurse failures and system failures that led to not carrying out the five rights: “In-violation, In-writing, In-excess, In-experience and In-tension” (p. 226).

A theme of not carrying out the five rights of safe medication administration as a cause of medication errors was noted by several research studies of nursing student errors (Griffith, Griffiths, & Jordan, 2003; Valdez et al., 2013). Non-adherence to the five rights by registered nurses also results in medication errors (Cohen, Robinson, & Mandrack, 2003; Cohen & Shastay, 2008; Jones & Treiber, 2010). Cohen and Shastay (2008) acknowledged that even when the five rights are dutifully carried out, medication errors can still occur due to problems within the system.
Novice Nurses Need Medication Error Instruction

An integrative review of clinical decision-making and error avoidance identified medication errors, along with patient fall occurrences, and delayed patient treatment as the most common types of errors made by novice nurses (Saintsing et al., 2011). Though implications were aimed at nursing management, assessing and fostering critical thinking and decision making in nursing education were cited as important to a student’s transition to clinical practice, yet evidence on educating student nurses on error reduction is sparse in the literature (Saintsing et al., 2011). “Simply being aware of the type of problems may be an important first step in improving the care by novice nurses”; reducing errors can reduce liability and improve patient outcomes (Saintsing et al., 2011, p. 354).

Improving Preceptor Safe Medication Administration Consistency

While registered nurses are commonly required to demonstrate competency in inserting vascular access devices, they are rarely required to demonstrate competency in IV medication delivery (ISMP, 2015). There is variance in IV knowledge and skill among registered nurses, including those in the role of preceptor. The varied ability levels may be due to organization-specific policy and procedure content as well as a deficit of standard practices for IV medication preparation and administration. Standard practices have not been published until recent years (ISMP, 2015). High error rates have been documented for intravenous (IV) medication administration (Taxis & Barber, 2003).

Increasing preceptor knowledge of strategies to reduce medication errors has been studied as a quality improvement initiative (CQI) in response to inconsistent nurse practices confusing novice nurses (Harris, 2014). “Novice nurses reported witnessing and experiencing inconsistency in medication administration practices, inconsistency in interpretation of
medication administration policies, and inconsistency in following medication administration protocols and procedures” (Harris, 2014, p. 402). In the Harris study, a sample of 21 preceptors completed a pretest, and then viewed a three-part online module on strategies to reduce medication errors. Following the posttest, data analysis identified an increase in learning over the dismal pretest results related to safe medication practices (Harris, 2014). Areas identified as needing improvement included double-checking practices, drug reaction knowledge, dosage calculations, when to notify the physician, and use of high-risk IV drugs, to name a few (Harris, 2014).

A discussion of the responsibilities and challenges of medication administration has been presented. The following section identifies an important finding in the literature, that of a theory-practice gap related to nursing student medication knowledge and administration. A discussion of teaching strategies related to this study will follow with a focus on preceptorship clinical experiences and workbooks.

**Theory-Practice Gap**

The literature revealed a need to increase pharmacology theoretical content and medication management skill development in undergraduate nursing education (Cleary-Holdforth & Leufer, 2013). Beginning early in nursing programs and at each level of the curriculum, aligning classroom learning and clinical application is needed (Cleary-Holdforth & Leufer, 2013). Nurse educators are challenged with the task and have the primary responsibility to “successfully teach transfer of knowledge within the practice discipline of nursing” (Papastrat & Wallace, 2003, p. 460). Evaluations of student pharmacology knowledge and dosage calculation ability reported in the literature are often dismal.
When Belgium undergraduate students nearing graduation were tested, a deficient knowledge base was identified (Dilles et al., 2011). A survey revealed poor confidence in student ability to safely administer medications, with baccalaureate scores barely higher than diploma student scores (Dilles et al., 2011). Working nurses provide further evidence of inadequate undergraduate pharmacology training. When studied, English surgical nurses were not well informed about medications they often administer to patients (Ndosi & Newell, 2009). Pharmacology knowledge of newly graduated registered nurses was evaluated by clinical nurse peers, who found the new nurses to be lacking in knowledge of drug groups, terminology, and ability to read orders (Manias & Bullock, 2002).

A study of what influences undergraduate acquisition of pharmacology knowledge identified the academic element of grade point average (GPA) and the nonacademic element of family responsibilities and dependence as predictors of pharmacology success or failure (Strayer & Beitz, 2010). Interestingly, prior academic performance has been shown to be a predictor of pharmacology success in the early semesters of nursing school; however, this is replaced in later semesters by a student’s motivation and ability to self-regulate and manage their learning (Sulosaari et al., 2015). In the information age, assisting students to manage course content through self-regulated learning is necessary (Sulosaari et al., 2015).

A theory-practice gap was phenomenologically investigated among English emergency room nurses (King, 2004). Possible causes of the gap between theory and practice were attributed to nursing’s transition from a medical model, decreasing clinical time, poor facility and faculty collaboration, and sequencing of coursework and practice issues (King, 2004). Students should be helped to prepare for additional pharmacology education on the job to lessen
theory-practice gap (Manias & Bullock, 2002). Admittedly, students cannot learn everything in school about medication management that they will ever need to know.

**Teaching Strategies**

Creative teaching strategies reported in the literature have been implemented to enhance pharmacology retention and application. Examples of technology-based pharmacology instruction as well as other creative approaches to pharmacology education in the nursing curricula are briefly discussed next. One example is a “Medication Safety Day” implemented in the final year of an undergraduate nursing program that increased student awareness of medication administration risk management and highlighted system and individual factors such as high-risk medications (Page & McKinney, 2006).

Dosage calculation learning and assessment teaching strategies should be designed using authenticity to real-world activities (Weeks, Hutton, Coben, Clochesy, & Pontin, 2012). Authentic visuals such as medication orders, labels, syringes, along with numerical calculations should be incorporated into learning activities (Weeks et al., 2012). A medication dosage calculation problem-solving (MDC-PS) educational intervention was created using text and visuals in a virtual web-based learning environment and tested in the United Kingdom and United States (Weeks, Clochesy, Hutton, & Moseley, 2013). Nursing students who used the authentic web-based learning environment showed significantly (p < 0.001) higher scores than students who were taught dosage calculations in a didactic teaching strategy (Weeks, Clochesy et al., 2013).

Another technology-based approach investigated for learning pharmacology is use of videos. Students are better able to reason clinically and choose correct therapeutic responses when instruction included having students view pharmacology videos over traditional live
lectures (Devi et al., 2010). Video instruction allowed for repetition and spaced learning (Devi et al., 2010).

Increasing student engagement with course content may have potential to improve pharmacology retention and application. An Australian study found that when the teaching strategy of flipping the classroom to teach pharmacology was used, students surveyed noted deeper understanding, application, and critical thinking of the topic was improved (Hanson, 2016). Being able to pause and review recorded content and connect it with clinical application were noted as positive aspects of a flipped classroom (Hanson, 2016). Students can also practice clinical decision making in simulated clinical laboratories with scenarios that allow multiple decision pathways for students to think through non-linear, complex situations and prioritize actions (Simones et al., 2014).

A problem-based learning, interactive approach has been described using authentic medication error cases and an error analysis framework as a means to assist undergraduate nursing students transfer knowledge of medication errors into the clinical environment, increasing student inquiry and critical thinking (Papastrat & Wallace, 2003). The problem-based learning perspective was also used in developing the teaching intervention of several brief digital recordings related to medication safety for the purpose of showing the complexity and interdisciplinary nature of medication administration system failures (Hewitt et al., 2015). The brief digital recordings were perceived by a majority of nursing students as showing a systems approach to practicing medication administration safely; however, the sample size was very small, only 28 students (Hewitt et al., 2015).

Another teaching strategy that may address the theory-practice gap is to integrate pharmacology topics into the curricula as opposed to offering a separate pharmacology course.
Assisting students to connect patient monitoring skills and pharmacology knowledge, for example, may lessen the theory-practice gap by contextualizing theory (Meechan et al., 2011). Integrated pharmacology education (dosage calculations, pharmacokinetics, and drug groups) compared to clinical- and workbook-based pharmacology instruction proved to result in greater pharmacokinetic learning and application in undergraduate nursing students (Meechan et al., 2011).

Wright (2005), using action research, demonstrated an effective approach to drug calculation by use of three stages: improving student use of mathematical concepts, providing instruction in dosage calculation formulas, and having students practice dosage calculation in the context of clinical sites or skills laboratories. It was also observed that teaching dosage calculation in small class sizes was more effective than a larger number of students (Wright, 2009). Using syringes and other medication administration equipment as visual clues has been shown to improve dosage calculations (Weeks et al., 2000).

Use of scaffolding as a clinical instructor teaching tool has been advocated to assist nursing students in connecting theory and the practice of medication administration (Valdez et al., 2013). A qualitative study of 31 undergraduate nursing students found that Filipino clinical instructors used cognitive apprenticeship teaching methods in medication administration instruction (Valdez et al., 2013). Modeling skills, coaching, and encouragement in problem solving are used to increase critical thinking related to medication administration (Valdez et al., 2013).

**Nursing Clinical Experiences**

Clinical experiences in undergraduate nursing education build upon each other and prior learning and experiences (Tilley et al., 2007) to support student learning and assist in application...
of theoretical knowledge. Professional development is another goal of clinical education. Learning experiences in clinical instruction should focus on the “essentials” in order for students to enter nursing practice competently, and transition into the role of a professional registered nurse (Hickey, 2010, p. 40).

Nursing clinical experiences occur in a complex environment (McClure & Black, 2013). Such experiences allow for practice of psychomotor skills, physical assessment, role modeling and socialization, self-reflection, and critical thinking (Chan, 2002). The application of previously learned theory in the context of an authentic setting at a clinical site provides for an integrative experience (Gubrud-Howe & Schoessler, 2008), and is a major focus of the senior year nursing curriculum (Nielsen, Noone, Voss, & Mathews, 2013).

Clinical Supervision Models

Common undergraduate clinical supervision models identified in the literature are (a) a group supervised/facilitation of up to eight students, (b) facilitation-preceptor such as is used on Dedicated Education Units (DEUs), (c) the preceptor model, and a (d) mentor model reflecting a longer timeframe than a preceptor model situation (Walker et al 2013). Internationally, the organization of clinical supervision is further varied, without a clearly identified superior model (Wellard, Williams, & Bethune, 2000). A discussion of advantages and challenges of nursing education clinical models follows.

Faculty-led Clinical Group Model

Traditional faculty-led clinical groups are still very much in use, but are not without challenges. Faculty usually teach 8 to 10 students in a clinical group on a designated hospital unit over part or all of a semester (Gaberson et al., 2015). This student-faculty ratio does not allow adequate individual instruction (Gaberson et al., 2015), resulting in much student time waiting
for the faculty member to answer a question or supervise the performance of a skill (Hendricks, Wallace, Narwold, Guy, & Wallace, 2013). The main challenge and responsibility of the nurse educator is to facilitate knowledge transfer (Papastrat & Wallace, 2003). Though the setting for group clinical experiences is contextualized, the student is not able to experience a typical flow of a nurse’s workday “by taking experiences out of their contexts, important supporting cues and structure are lost” (Hendricks et al., 2013, p. 311), which are needed for authentic learning (Hendricks et al., 2013).

**Faculty-led Clinical Group Advantage**

Studies comparing various models of clinical supervision are few. A Norwegian study of 380 baccalaureate nursing students sought to measure and compare student satisfaction of teacher-led and preceptor-led clinical experiences (Lofmark, Thorkildsen, Raholm, & Natvig, 2012). Data were collected using a modified Nursing Clinical Facilitator Questionnaire (NCFQ) instrument and analyzed to reveal students rated both models of clinical supervision highly; however, teachers were given higher scores (Lofmark et al., 2012). An explanation of the teacher advantage included a teacher’s awareness of which stage of learning the student was in, allowing for adjustments in teaching and learning outcomes (Lofmark et al., 2012).

Australian researchers compared two models of undergraduate clinical supervision (Walker et al., 2013). The study used an online questionnaire to survey 159 students in either facilitator-led clinical groups or individual preceptorships to gain further understanding of the support students need to learn. Students who were in facilitator-led groups were statistically more likely to “reflect, think, build on existing skills and knowledge and to problem-solve issues” (Walker et al., 2013, p. 530).
The group facilitation model was likewise favored, when compared with the preceptor model, as it was found to provide greater undergraduate student support according to Australian researchers Croxon and Maginnis (2009). Further evidence of student support using a group clinical model was found by Swedish researchers in a qualitative study of 51 undergraduate nursing students in nurse teacher-led clinical groups of five to eight students (Holmund, Lindgren, & Athlin, 2010). It was found that students gained confidence in their nursing identity and readiness for practice, and valued group supervision (Holmund et al., 2010).

It is possible that a facilitator-led group could better assist students to connect theory to practice, as learning has been shown to be optimized when students experience continuity with a consistent preceptor (Calaghan et al., 2009, in Walker et al., 2013; Zilembo & Monterosso, 2008). A group clinical model with a consistent instructor may have advantage over preceptorships when students have multiple preceptors. A consistent preceptor is an important element of the preceptorship model (Walker et al., 2013, p. 533). Other advantages the faculty-led clinical model may have are that faculty are aware of the level of student learning and can adapt their instruction accordingly (Calpin-Davies, 2001 in Lofmark et al., 2012). Additionally, faculty tend to ask more higher-level questions (Phillips & Duke, 2001, in Lofmark et al., 2012).

**Preceptorships**

Preceptorships are a common teaching and learning strategy in nursing education, and the main method for engaging students in socialization of the profession (Billay & Myrick, 2007). Among baccalaureate nursing programs in the US, 85.9% of professional schools use the preceptorship model (Altmann, 2006). The preceptorship experience helps students transition from class to clinical and to the nursing role as a novice professional (Parker, Lazenby, &

Students in preceptorships are in a clinical facility working alongside a staff nurse one-on-one, with nursing faculty generally not present. Students are usually required to meet with faculty to discuss clinical events. A supportive environment and a positive preceptor-student relationship are important to encourage accountability and give feedback (Omer, Suliman, Thomas, & Joseph, 2013) and to foster student learning, confidence, and competence (Croxton & Maginnis, 2009). Conversely, when the student-preceptor relationship is lacking, learning is inhibited (Lofmark et al., 2001).

**Faculty role in preceptorships.** In the preceptorship model, faculty serve in the role of liaison between academia and the clinical facility (Andrews et al., 2006; Barrett, 2007; Horton et al., 2012; Kalischuk, Vandenberg, & Awosoga, 2013). Faculty should communicate clear expectations (Horton et al., 2012) and learning outcomes to preceptors and students (Harden, 2007). Assessment and grading student assignments are faculty responsibilities in preceptorships (Andrews et al., 2006).

Fostering a supportive relationship with staff nurses in senior preceptorship practicum courses is a necessary faculty role in order to evaluate student strengths and areas of weakness (Murphy, 2008; Rogan, 2009). The frequency of how often faculty visit students and preceptors varies (Yonge, Ferguson, Myrick, & Haase, 2003). To benefit student learning and the level of satisfaction preceptors have in their role, nurse educators need to actively engage in the preceptorship experience (Parker et al., 2012, p. 561). Faculty and preceptors share the responsibility to connect theory and research to nursing practice and to ensure learning outcomes are met (Lofmark, 2012).
**Preceptorship advantage/preceptorships improve learning.** The knowledge and experience of the preceptor provide a valuable benefit to the student (Billay & Myrick, 2007). Student success is positively impacted by the preceptor’s level of involvement, active listening, and provision of learning opportunities, constructive feedback, and help in socialization into the profession (Billay & Myrick, 2007). Preceptors help students apply knowledge and practice decision-making skills (Staykova, Huson, & Pennington, 2013). A qualitative study of senior baccalaureate nursing students in a preceptor-led acute-care clinical practicum reported an increase in student knowledge, skill, and for many, integration into the clinical team (Wieland et al., 2007). Students self-reported increased medication knowledge and administration skill following the acute-care preceptor-led practicum (Wieland et al., 2007).

Positive student outcomes from preceptorships have been reported in the areas of time management, documentation, integration with staff, accountability, efficiency, skill competence and confidence, and collaboration with staff (Weiland et al., 2007). Critical thinking and self-confidence were reported outcomes of preceptorships by Berry (2005) and Myrick (2002). A study of more than 400 Finnish students revealed greater satisfaction with preceptorships when compared with the group clinical model (Saarikoski, Warne, Aunio, & Leino-Kilpi, 2006). The preceptor model was found to contribute to meeting learning outcomes, and was perceived as positive and helpful by students (Lofmark et al., 2012).

The faculty-led group clinical model was compared to the preceptorship model in a study of 73 junior and senior nursing students (Hendricks et al., 2013). The Student Evaluation of Clinical Education Environment (SECEE) and a researcher-developed tool to measure satisfaction and opportunities in practice were used to collect data (Hendricks et al., 2013). Data revealed that during the first semester of nursing school there were significantly greater
satisfaction, perceived support, and SECEE clinical education environment scores for the preceptor group; however, no difference was detected between groups on standardized ATI scores or course grades (Hendricks et al., 2013).

A mixed-methods Swedish study of 114 undergraduate students compared two models using preceptor supervision (Gustafsson, Engström, Ohlsson, Sundler, & Bisholt, 2015). Students from University A met with a university teacher at times, usually for seminars during their preceptorship. Students at University B met weekly with a part-time nurse who was also part-time faculty in their preceptor-based clinical (Gustafsson et al., 2015). The Clinical Learning Environment, Supervision and Nurse Teacher (CLES+T) tool, with past psychometric testing history, was used to measure student perspective of the learning environment of all participants; in addition, eight student interviews were conducted (Gustafsson et al., 2015). Data revealed both models had strengths and areas for improvement such as a need for university faculty to remain up to date on clinical issues and make more site visits, and a need for the part-time faculty to articulate learning goals and assist in course planning (Gustafsson et al., 2015).

Two models of clinical preceptorship, A and B, were evaluated by Omer et al. (2013). Satisfaction of clinical supervision among 110 undergraduate nursing students in a Saudi Arabian college was evaluated (Omer et al., 2013). Data were collected using the Preceptorship Evaluation Survey (PES); PES validity and reliability were reported to be established by the tool’s originator (Omer et al., 2013). Clinical Model A, in which a college-hired nurse preceptor instructed a group of four students while caring for two patients, allowed for extensive student mentoring and was the preferred model (Omer et al., 2013). The college-hired nurse teachers used adult learning principles, were competent in asking questions, solving problems, using information technology, and introducing “new concepts in a way that help students integrate in
their existing knowledge base while considering the student learning styles and allowing them independence they needed” (Omer et al., 2013, p. 159). Model B involved a staff nurse preceptor instructing one student with six or seven patients and a college-hired teacher floating between 10 to 12 students on site, with a focus on self-directed and independent student learning (Omer et al., 2013).

**Challenges of preceptorships.** Many challenges have been reported with the preceptorship clinical model. In a mixed-methods study, Coates and Gormley (1997) reported that preceptor workloads, insufficient time, and deficient training were challenges that affect preceptorships. Billay and Myrick (2008) observed that those were still active challenges in 2007. More recent authors have reported similar concerns (de Fulvio, Stichler, & Gallo, 2015; Haggerty, Holloway, & Wilson, 2012; Hall-Lord, Theander, & Athlin, 2013; Horton, et al., 2012; Kristofferzon, Martensson, Mamhidir, & Lofmark., 2013; Madhavanpraphakaran, Shukri, & Balachandran, 2014; McClure & Black, 2013; Parker et al., 2012).

Role confusion and insufficient time to precept were challenges for preceptors (Broadbent, Moxham, Sander, Walker, & Dwyer, 2014). Nurses are foremost responsible for providing safe, direct patient care, with preceptor duties not factored into their workloads (DeWolfe, Laschinger, & Perkin, 2010). “The dual assignment places the nurse in a dilemma with their first priority being patient care, while attempting to meet the learning needs and objectives of the student” (de Fulvio et al., 2015, p. 21). The demands of juggling clinical commitments and teaching students are demanding and frustrating (Kristofferzon et al., 2013, p. 1252). Insufficient time and workload were noted to be job-related barriers during preceptorships in a mixed-methods study in Oman (Madhavanpraphakaran et al., 2014). Regular clinical
workloads were cited as problematic during preceptorships (Horton et al., 2012). The lack of time scheduled for teaching students was echoed by Hall-Lord et al. (2013).

Challenges for preceptors have been identified as conflicts between students and preceptors (Mamchur & Myrick, 2003), an increase in workload, and a lack of administrative, coworker, and faculty support (Kalischuk et al., 2013). Working with poorly skilled nursing students is an oft-cited challenge for preceptors (Kalischuk et al., 2013; Yonge, Krahn, Trojan, & Reid, 1997), highlighting the need for educators to better assess and fit students in clinical placements (Yonge et al., 1997). Preceptors also identified a lack of student interest in providing patient care and a gap between theory and psychomotor skills as additional hindrances (Madhavanpraphakaran et al., 2014).

Another important challenge is inexperience and low confidence in ability to evaluate students (Luhanga, Yonge, & Myrick, 2008) as well as a general unpreparedness to teach students (deFulvio et al., 2015). Preceptors often lack “both academic and pedagogic competence” (Hall-Lord et al., 2013, p. 509) and may focus only on the practical elements of nursing practice. Preceptors should be chosen according to ability more than their availability (Bain, 1996, in Kalischuk et al., 2013).

**Preparation and orientation of preceptors.** Regulatory and accrediting requirements for use of preceptors in undergraduate nursing education in the US and Canada were reviewed by Lewallen, DeBrew, and Stump (2014). Researchers searched all Boards of Nursing websites, and the accrediting bodies of the Commission for Education in Nursing (ACEN), the Commission on Collegiate Nursing Education (CCNE), and the Canadian Association of Schools of Nursing (CASN). It was concluded that: use of preceptors in prelicensure nursing education is common and increasing; however, “there are no standardized guidelines for qualifications, roles, and
responsibilities, or best practices” (Lewallen et al., 2014, p. 389). Accrediting bodies and numerous states with rules, standards, and guidelines should be used by academic programs and clinical agencies to develop policies for preceptorships (Lewallen et al., 2014).

When examined, preceptor preparation was found to be inconsistent (Yonge et al., 2003). Preceptor training does not usually include strategies to reduce medication errors (Harris, 2014). Inconsistencies in preceptor medication administration practices and interpretation of related policies, protocols, and procedures were observed by novice (Harris, 2014). A continuous quality improvement study demonstrated the effectiveness of an online module teaching strategy to improve preceptor knowledge of strategies to reduce medication errors (Harris, 2014).

A review of preceptor literature led McClure and Black (2013) to conclude a disconnect exists around the perceived role of preceptors: faculty claim responsibility for student learning; students noted preceptors as vital to their learning. Preceptors report being unprepared for the role; orientation programs for preceptors are not used consistently to acclimate staff nurses to the instructional role, nor does preceptor preparation have a solid evidence-base (McClure & Black, 2013).

A comprehensive program (developed by nurse leaders) was recommended by deFulvio et al. (2015) to prepare preceptors with needed information such as teaching and learning theory skills, communication skills, and how to set learning goals and evaluate student learning. Other recommendations for preparation were: “using observation and participation, engaging students in learning experiences, prompting positive feedback from students, using reflective learning, promoting self-efficacy and a sense of accomplishment, working with students who are perceived to be unprepared or unsafe, collaborating with faculty instructors, managing stress with job demands” (deFulvio et al., 2015, p. 23).
Several of the recommendations correlate with findings from a descriptive study of 75 baccalaureate nursing student preceptors in the Western U.S. (Rogan, 2009). Perceived training needs were teaching and learning strategies to assess the student’s learning needs, help setting goals and priorities and evaluating student performance, clarifying roles and responsibilities, improving communication, and ways of resolving conflict (Rogan, 2009). Critical care nurses requested knowledge on teaching critical thinking as part of preparing for the preceptor role (Rogan, 2009). Similarly, preceptor training needs of newly graduated Taiwanese nurses were noted to be making a commitment to teach, how to create learning plans, and a caring learning environment (Tsai et al., 2014). They also needed to know how to use a variety of teaching strategies; give feedback; evaluate, guide, and support students; and handle teaching stressors and frustrations (Tsai et al., 2014).

Researchers in New Zealand noted the challenging issue of finding time to train potential nurse preceptors around their workloads, as well as the need for flexible, accessible information, and the potential for technology-based preceptor education (Haggerty et al., 2012). Lack of preceptor time was also a factor in a study of a researcher developed teaching strategy, the Mission Possible CD ROM: Instructional Tool for Preceptors (Parker et al., 2012). A CD was given to 115 preceptors of baccalaureate nursing students with only 16.1% completing a pretest and 14.3% a posttest; most of these reported not having viewed the CD, with the reason of inadequate time (Parker et al., 2012, p. 563).

Examples of preceptor courses for nurse preceptors of undergraduate nursing students are also found in the literature. Smedley and Penney (2009) described a collaborative effort between an Australian college and clinical agency based upon action learning and Dick’s (1996) change process model. Preceptor training yielded positive student feedback related to mutual respect,
positive role modeling, a positive learning environment, and objective, professional student evaluations (Smedley & Penney, 2009). An online preceptor orientation course was received favorably, found to be efficient, and met the unique needs of preceptors guiding clinical nursing students early in the curricula on a Dedicated Education Unit (DEU) (Krampe, L’Ecuyer, & Palmer, 2013).

Horton et al. (2012) reported the development and effectiveness of the Nurse Preceptor Academy (NPA), a supportive and educational effort for new registered nurses (RNs) and newly hired RNs in the Kansas City area. To maintain clinical teaching skills after completing preceptor training, preceptors need and desire continued support, whether it be in-person classes or educational offerings during lunch, or online discussion boards, newsletters, or self-directed modules (Horton et al., 2012). The researchers encouraged faculty to prepare senior nursing students for preceptorships upon graduation (Horton et al., 2012).

**Other Clinical Supervision Models**

New models of supervision have been created and evaluated in recent years. Researchers evaluated a model used in a Swedish baccalaureate program which incorporated personal one-on-one preceptors, “main preceptors” over groups of precepted students (Hall-Lord et al., 2013). The four levels of supervision were in response to personal preceptors “often lacking both academic and pedagogic competence” and perhaps only taking the “practical aspects of nursing in consideration in their supervision” (Hall-Lord et al., 2013, p. 509). Student input was not evaluated in the study; questionnaires were completed by persons in the four levels of supervision, most of whom considered the model a valuable tool in need of revision to increase collaboration with and support of personal preceptors and time for supervision (Hall-Lord et al., 2013).
The “cluster model” was described by Bourgeois, Drayton, and Brown (2011). Collaboration between an Australian hospital and university resulted in a clinical model which involved pairing an experienced staff nurse with eight undergraduate nursing students (Bourgeois et al., 2011). The nurse was trained at the hospital as a clinical teacher and paid by the university. Students evaluated the experience by responding to open-ended questions, which were compiled over 5 years, and revealed the model provided a positive student experience in which they felt part of the team, less threatened, enjoyed learning from peers, were able to connect theory and practice and be responsible for their own learning. One complaint voiced was competition for learning experiences (Bourgeois et al., 2011).

Another type of academic-practice collaboration in undergraduate nursing clinical is the Clinical Liaison Nurse (CLN) model. Lovecchio, DiMattio, and Hudacek (2012) reported a significant increase in scores for individualized instruction, satisfaction, and orientation to tasks for undergraduate students in a community hospital acute-care clinical using the CLN model, as compared to students in a traditional, faculty-led clinical group. The authors described the CLN model as similar to the Dedicated Education Unit (DEU) model in that faculty are on site in the role of expert teachers alongside expert staff nurses, but with the CLN model, only faculty evaluate student performance (Lovecchio et al., 2012).

Collaboration Needed Between Preceptor and Faculty

Regardless of the clinical model used, collaboration between academia and clinical site partners is recommended by the American Association of Colleges of Nursing (2005) and the Institute of Medicine (2011). A key recommendation from a study which examined strategies to decrease the theory-practice gap in nursing education was the necessity for collaboration between academia and health care providers (Corlett, Palfreyman, Staines, & Marr, 2003). A
study of 129 Canadian preceptors for an undergraduate baccalaureate nursing program revealed that preceptors desired more in-person interactions with nursing faculty (Kalischuk et al., 2013). Similarly, Wieland et al. (2007) stated a strategy to revise the preceptorship was to maintain a consistent faculty liaison and to enhance faculty and preceptor communication. The following sections describe use of a workbook as a teaching strategy that has the potential of increasing collaboration between clinical staff and faculty.

**Summary of Clinical Nursing Models**

Faculty-led group and preceptorship models of clinical instruction were discussed. Advantages to both models were described. The preparation and orientation of nursing preceptors was outlined, as were the challenges of this clinical model. Inadequate and inconsistent preceptor preparation has been identified as a concern related to student learning. The need for increased collaboration between preceptors and faculty was identified.

**Workbooks as a Teaching Strategy in Clinical Instruction**

There is a need in nursing education to improve undergraduate pharmacology education by increasing learning experiences that are structured and that help students take more responsibility for medication administration and medications’ effects (Manias & Bullock, 2002a). Undergraduate nursing students need structured, collaborative educational experiences as well as time to reflect on their medication management abilities (Manias & Bullock (2002). Student nurses need to learn dosage calculations from real problems in the clinical practice environment in order to “participate in drug administration practice, learn the social language of nursing and gain the meaning and context required to understand the numbers in calculation problems and how to solve them” (Wright, 2009, p. 548). This researcher extends this view
beyond calculating doses to all aspects of medication administration and finds support for the use of a clinical workbook to link theory to the application of safe administration of medications.

**Radiology workbook example.** The development and theoretical basis of a clinical workbook for radiotherapy students was described by Nisbet and Matthews (2011). Efforts to improve clinical learning experiences of English radiotherapy radiographer students included adding Virtual Environment for Radiotherapy Training (VERT) for use in their six clinical placement sites (Nisbet & Matthews, 2011). To address consistency and enhance learning, a generic workbook was developed to guide students in the practice of skills and to foster clinical competence (Nisbet & Matthews, 2011).

The main goal of the workbook was “the need to integrate theory into practice” (Nisbet & Matthews, 2011, p. 73). Educational theory and congruence with the radiotherapy program’s curriculum guided the selection of workbook activities in order to best support student learning (Nisbet & Matthews, 2011). An underpinning theory of the workbook was that of Usher and Bryant (1987), who advocated for both formal and practitioner theory, a “practice reviewed through theory” (p. 201) approach as a response to theory-practice gap in continuing professional education. Workbook activities and practice problems were designed to facilitate deep learning to help students “construct their knowledge based on understanding” (Nesbit & Matthews, 2011, p. 73).

Nisbet and Matthews also cited Spouse (1998), who explored the application of social constructivist learning theories to the theory-practice gap in nursing education. Spouse noted that while gaining “formalized knowledge is crucial to professional development, a mediator is necessary to demonstrate its relevance to practice” (p. 259). Scaffolding, incremental learning explained in relation to Vygotsky’s two developmental learning stages of knowledge-in-use and
knowledge-in-waiting, can be a useful tool for clinical supervisors of nursing students to
decrease the theory-practice gap (Spouse, 1998).

The Virtual Environment for Radiotherapy Training (VERT) workbook design and
content was aligned with the program’s curriculum to strengthen learning, and it is important for
教学策略 to not confuse students (Biggs, 2003 in Nesbit & Matthews, 2011). The
activities and skill practice assignments were level appropriate and clinically relevant and
progressed in difficulty in relation to Bloom’s taxonomy levels of knowledge through analysis
and evaluation (Nesbit & Matthews, 2011). Problem-based learning activities were used with the
intention of developing student confidence in clinical reasoning and decision making and easing
the evolution from student to clinical practitioner (Nesbit & Matthews, 2011). Initial data from
post-intervention questionnaires measuring student feedback after using the workbook were
positive; 81% of students reported perceived learning gained as high and 73% of students
reported a perception of the workbook content as high (Nesbitt & Matthew, 2011, p. 75).

Biomedical science workbook example. Another application of workbooks used in
health care education involved undergraduate medical students. A workbook-based intervention
was used to improve the academic performance and self-monitoring ability of 51 2nd-year
students in a biomedical science course (Leggett, Sanders, & Burns, 2012). Half of the 51
students used workbooks with questions related to the weekly course topics, as well as self-
monitoring exercises, the other half used the same workbooks, minus the exercises (Leggett et
al., 2012). Predicting one’s performance, called calibration, is an aspect of self-regulatory
learning, a focus of the study (Leggett et al., 2012). The calibration accuracy of the intervention
group proved significantly higher; study results also revealed significantly higher self-efficacy
and biomedical exam scores for the intervention group (Leggett et al., 2012).
The simple, printed workbook of the intervention group proved effective; however, the workbook of the control group did not. The intervention group workbook contained extra exercises which required students to rate their perceived confidence on a 0 to 100 scale, satisfaction on a 5-point Likert-type scale, and self-efficacy on a 5-point Likert-type scale, and reflecting on performance proved to increase success on student 1st and 2nd year exam scores (Leggett et al., 2012).

**Antipsychotic medication workbook example.** The effectiveness of an educational workbook was evaluated in a study of physicians and nurses working in 19 psychiatric units in the United Kingdom (Thompson et al., 2010). The workbook was based on a cognitive framework related to ‘rule breaking’ behavior in terms of prescribers not going along with usual polypharmacy guidance of antipsychotic medications (Thompson et al., 2010). Case study examples and realistic solutions were included, as well as a literature review of current antipsychotic polypharmacy prescribing issues (Thompson et al., 2010). A significant change in beliefs was identified on issues specifically addressed in the workbook: “antipsychotic polypharmacy (coefficient = -0.89, P < 0.01) and rapid tranquilization (coefficient = -0.68, P < 0.01)” (Thompson et al., 2010, p. 520), and a statistically significant change in behavior “in antipsychotic polypharmacy prescribing (odds ratio 0.43, 95% confidence intervals 0.21-0.90)” (Thompson et al., 2010, p. 520).

**Library proficiency workbook example.** Student perceptions and scores on a posttest Library Proficiency Test were evaluated comparing a print workbook and an electronic version of the workbook (Gutierrez & Wang, 2001). Sixty-five freshmen university students were given print workbooks for instruction in basic research skills; 52 freshmen students were given electronic workbooks with the same content (Gutierrez & Wang, 2001). Students generally
perceived the print content was too advanced, time intensive, and not very user friendly; however, there was not a significant difference (p > 0.05) on performance posttest scores between the two intervention groups A and B (Gutierrez & Wang, 2001, p. 211). The researchers concluded that library usage frequency impacted learning more so than the particular instructional format (Gutierrez & Wang, 2001).

**Health care quality workbook example.** A workbook has been used as a study intervention to teach the theory and methods of health care continuous quality improvement (CQI) process (Kyrkjebo & Hanestad, 2003). The usefulness of the print workbook was evaluated by 44 1st-year nursing students in bachelor degree programs in Norway (Kyrkjebo & Hanestad, 2003). Following an introductory class, all students were given a Personal Improvement workbook which provided explanations and examples of the “Plan-Do-Study-Act (PDSA)-cycle” in relation to the nursing process (Kyrkjebo & Hanestad, 2003). The workbook was deemed useful by 95% (n = 42) of the students (Kyrkjebo & Hanestad, 2003).

**Nursing self-study workbook example.** The effectiveness of a self-study workbook was compared to two other teaching strategies, classroom instruction and computer-assisted instruction (CAI) in an experimental, pretest-posttest study (Bayne & Bindler, 1997). Sixty-seven nurses in the United States were taught medication calculation skills using one of the three interventions. An evaluation of test scores, cost, participant satisfaction, relationship between nurse self-assessment of skill and test scores, and type of medication calculation found to be most difficulty was carried out (Bayne & Bindler, 1997). The study revealed the workbook as least costly, followed by the CAI intervention, with the classroom instruction most expensive (Bayne & Bindler, 1997). Test scores for the classroom instruction group improved most; nurses
were most satisfied with the workbook teaching strategy but this did not correlate with improved test scores (Bayne & Bindler, 1997).

**Nursing information literacy workbook example.** A print workbook, suggested by a student, replaced the former teaching strategies of a lecture, interactive sessions, and a brief lecture followed by computer time when poor grades persisted for a 1st year nursing student module on information literacy (Ryba & Pledger, 2016). Nursing faculty and library staff collaborated to create a workbook with clear objectives and a structured step-by-step approach to searching online databases and evaluating quality of findings (Ryba & Pledger, 2016). Though print workbooks were perceived as “outmoded” (Bridge, 2015, as cited in Ryba & Pledger, 2016, p. 437), student feedback was positive for having a reference they could take notes in and appreciated it “held their attention” (Ryba & Pledger, 2016, p. 435); module grades improved, though some students deemed workbook activities as challenging.

**Preceptor workbook example.** A mixed-methods US study concluded that a preceptorship handbook was a reference useful by all participating acute care preceptors of seniors in an undergraduate nursing program (Staycova et al., 2013). The handbook content contained regulations of state boards; clinical course objectives; a list of student competencies; responsibilities of the student, faculty, and preceptor; and contact information for the preceptor and educator (Staycova et al., 2013). “Preparing content to serve as a quick reference during preceptorship leads to better preceptor’s preparation and increases the confidence of the preceptor to provide meaningful guidance to students” (Staycova et al., 2013, p. e35).

**Forensic nurse practitioner workbook example.** A practitioner evaluation toolkit in the form of a workbook was developed for use by forensic nurse practitioners (Campbell, Townsend, Shaw, Karim, & Markowitz, 2015). The effectiveness of the workbook toolkit in helping nurse
practitioners complete local program evaluations of sexual assault nurse examiner (SANE) programs was evaluated in a mixed-study (Campbell et al., 2015). The printed workbook included resources such as step-by-step instructions of the evaluation process, Excel screenshots for understanding the analysis program, and strategies for problem solving (Campbell et al., 2015).

Though the forensic nurse practitioner workbook was not for undergraduate nursing students in preceptorships, the study found that the teaching strategy contained needed information but lacked the essential element of a “seasoned evaluator” (Campbell et al., 2015, p. 116) to ask questions. The novice evaluators “did not yet have a feel for what was ‘normal’ and they did not yet trust their judgment to make on-the-ground decisions” and could not independently provide social support (Campbell et al., 2015, p. 117). The workbook, used in conjunction with an expert resource, such as would be the case with clinical preceptors, was found to be effective as a teaching strategy.

**Workbooks for Safe Medication Administration in Nursing Education**

of medication administration in Chapter 9, Preventing Medication Errors (pp. 177-198). These workbooks are excellent student resources that can be used during all levels of a nursing program; however, they are lengthy and not practical for student use in the clinical environment. These resources range in length from 539 pages (Mulholland & Turner, 2015), 545 pages (Martinez de Castillo & Werner-McCullough, 2017), and 699 pages (Pickar, 2013), to 736 pages (Morris, 2014).

A recommendation by Honey and Lim (2008), from a qualitative study of senior undergraduate nursing students’ application of pharmacology ability, was to incorporate a workbook in clinical courses. The workbook would facilitate linking theory and practice during application of pharmacology knowledge and increase communication and involvement of the preceptor (Honey & Lim, 2008). The idea of a workbook was based on Banning’s work in 2003 (Honey & Lim, 2008).

Banning (2003) developed and proposed an applied pharmacology and therapeutics framework for nurse educators based upon the 1997 critical thinking and diagnostic reasoning model of O’Neill and Dulhy and the transformational learning principles of Fraser and Greenhalgh (2001). In Honey and Lim’s (2008) proposed workbooks, theory and practice would be linked by increasingly complex learning activities in clinical courses throughout a nursing program. 1st year nursing students might be provided a scenario and instructed to list the steps of medication administration and asked related questions to engage them in critical thinking (Honey & Lim, 2008). An example activity for 3rd year nursing students was noted as having students develop a case study of one of their patients including their medications specific to that patient (Honey & Lim, 2008). “The challenge for nurse educators is to create opportunities for students
to practice integrating and applying the knowledge and skills required for their role as new
graduate nurses” (Honey & Lim, 2008, p. 18).

**Development of the Safe Administration of Medication (SAM) Workbook**

The value of the workbook is the process, more than the end product (Jasper, 1995), which aligns with the study framework of adding to one’s existing knowledge and learning in the context of a practice environment supported by clinical experts (Brown et al., 1989). Similar to the outcomes of portfolio workbook use in nursing education (Jasper, 1995), rather than testing for knowledge itself, the workbook can document “cognitive and affective elements of the educational process “. . . providing some evidence of the acquisition of ‘institutionally approved’ attitudes and movement towards a professional ethos” (Jasper, 1995, p. 450). In the current study, senior nursing students were asked to use a workbook in the practice environment during their preceptorship clinical. It was anticipated that the outcome of using the researcher-developed safe medication administration (SAM) workbook in the current study would be increased knowledge and self-confidence in SAM.

Medication management and pharmacology theory and skill development should be integrated throughout undergraduate nursing education (Cleary-Holdforth & Leufer, 2013; Sulosaari et al., 2015; Wolf et al., 2006) and regularly evaluated during the undergraduate program (Sulosaari et al., 2015). Nurses should not be taught to blindly carry out a prescriber’s orders, but rather to follow safe medication administration guidelines (Elliott & Liu, 2010). Adherance to the “five rights” of SAM prevents medication errors (Griffith et al., 2003; Jones & Treiber, 2010).

The SAM Workbook is divided into seven chapters: (a) an introduction to the five rights of medication administration, (b) right patient, (c) right time, (d) right drug, (e) right dose, (f)
right route, and (g) avoiding medication errors. In Chapters 2 through 6, a case study for each of the “five rights” of medication administration is provided. Using case studies as a strategy of teaching medication administration involves students linking the dose, calculation of the dose, and the side effects of the medication to the administration of the drug, with the intent of improving medication safety (Wright, 2008). The SAM scale instrument (Ryan, 2007), used in the current study, was organized around five case studies.

Literature Informed SAM Workbook Development

The development of the Safe Administration of Medication Workbook for senior-level nursing students was informed by a review of the literature. Database searches for medication administration, medication errors, nursing students, and nursing education were carried out. A sampling of current medication administration workbooks was also used to inform the SAM workbook (Martinez de Castillo & Werner-McCullough, 2017; Morris, 2014; Mulholland, 2011; Pickar, 2013). Expert resources in medication safety, such as the Institute for Safe Medication Practices (2014, 2015, 2016) and the Institute of Medicine (2006), were also used during the development of the workbook. Examples of content from the SAM Workbook generated from a review of the literature and expert sources on safe medication administration are provided in the following paragraphs and in Appendix E.

Example from “right route” chapter. The case study in the “right route” chapter of the proposed workbook asked students to determine whether the right form of a drug was administered, or whether a medication error was made. Administering the wrong form of a drug was identified as the second most common error type in an observational study where 306 medication administration doses were evaluated (Gunningberg et al., 2014). An example of a patient situation involving increased risk of giving a wrong form of a drug is when medications
need to be administered via a nasogastric tube (Elliott & Liu, 2010). In this situation, the nurse must decide whether the ordered drug can be crushed or not (Elliott & Liu, 2010).

Example from “right time” chapter. A collaborative activity for the “right time” chapter directed the student to review a patient’s medication administration record (MAR) with the nurse and discuss the decision-making process for giving the medications at the correct time. Nursing students should be instructed on how to understand the MAR as part of their learning to give medications (Harding & Petrick, 2008). Novice nurses have few clinical experiences to draw from and may not be aware of the inherent high risk of medications or patient situations (Benner et al., 2002). The chapter on medication error avoidance in the workbook provided reinforced learning of examples of high risk drugs and strategies to avoid errors.

Wolf et al. (2009) noted that fundamental nursing textbooks address multiple aspects of medication administration; however, they do not typically mention warnings related to ensuring appropriate tubing connections. One of the “key points” in the “right route” chapter reminded students to trace any tube to its place of origin prior to administering medications through the tube. The most common cause of tube-related medication errors related to IV tubing clamps (Wolf et al., 2009), which is addressed in the “key points” and case study in the “right time” chapter.

Example from “right dose” chapter. Students most commonly have trouble conceptualizing calculations, interpreting medication calculation information, and making conversions between different units of measure (Bagnasco et al., 2015). The workbook provided review and practice converting units of measure in the Connect to Prior Learning Exercise 1 of the “right dose” chapter. An activity in the “right dose” chapter was dosage calculation practice
problems. There were adult and pediatric dosage calculation problems, as the SAM scale instrument addresses both.

**Evaluation of Medication Administration Knowledge**

Many researcher-developed tools to evaluate nursing student medication administration knowledge were reported in the literature (Dilles et al., 2011; Goodstone & Goodstone, 2013; Meechan et al., 2011; Sulosaari et al., 2015). Many of the studies did not report validation of the instruments used. “It is clear that the development of psychometrically sound performance measures of clinical competence have the potential to improve student learning, nursing education research, and clinical practice” (Goodstone & Goodstone, 2013, p. e611). Following are examples of both tested and non-tested instruments in recent nursing literature that measure indicators of medication administration knowledge or performance.

In studying the pharmacological knowledge and dosage calculation ability of undergraduate nursing students, Dilles et al. (2011) utilized the Medication Knowledge and Calculations test (MKC). The MKC instrument was researcher developed to test 613 graduating nursing students’ knowledge level of general principles of pharmacology. Students taking the MKC were asked to evaluate 25 statements as to their degree of truth, and work five dosage calculation exercises (Dilles et al., 2011). Authors described expert validation by way of seven nurses verifying that the 25 evaluative statements accurately reflected the category assigned related to nursing responsibilities for medication administration (Dilles et al., 2011). Psychometric testing was not reported (Dilles et al., 2011).
The Medication Competence and Associated Factors (MCAF) is another researcher-developed instrument for the evaluation of pharmacological knowledge and medication management of undergraduate nursing students (Sulosaari et al., 2015). Developers cited use of a literature review and an expert multidisciplinary panel of 10 persons was used for instrument development (Sulosaari et al., 2015). Psychometric testing was not reported for the MCAF (Sulosaari et al., 2015).

The Pharmacology Assessment Tool (PAT) and the Pharmacokinetics On-Line Test (POT) are researcher-developed instruments designed to evaluate medication management following the intervention of an integrated pharmacology and medication management curriculum (Meechan et al., 2011). The PAT tested applied drug knowledge through 69 short answer questions that related to a vignette (Meechan et al., 2011). Procedures to examine face validity using expert nurse faculty, practice educators, and pharmacists, as well as a pilot study with students were noted in the study (Meechan et al., 2011).

A performance-based evaluation of medication administration competency, the medication administration safety assessment tool (MASAT), was developed by Goodstone & Goodstone (2013). The MASAT, an eight-item “yes” or “no” checklist, was developed for evaluation of student performance using the rights of medication administration in the nursing laboratory with human patient simulation (HPS) or in a clinical setting (Goodstone & Goodstone, 2013). A survey to determine ratings by subject matter experts of the 17 behaviors was one approach the developer used to assess content validity which yielded the final eight items on the checklist (Goodstone & Goodstone, 2013).

The MASAT was piloted on 14 undergraduate nursing students and intrarater reliability was determined (Goodstone & Goodstone, 2013). The small number of
participants used in the pilot study is illustrative of the issue of time involved in performance-based evaluation. An additional issue with using a performance-based tool in preceptor-based clinical research would be interrater reliability among the vast number of preceptors needed for an adequate sample of nursing students. The MASAT instrument has been used in a simulation-based study testing a researcher-developed medication rights checklist and a web-based learning module (Goodstone, 2013).

**Safe Administration of Medications (SAM) Scale**

At present, the Safe Administration of Medication (SAM) Scale developed by Deborah Ryan (2007) is the only existing comprehensive evaluation of safe medication administration in the literature to efficiently evaluate individual student knowledge. Safe medication administration and the prevention of medication errors have been important topics of interest in the nursing literature for decades and remain so. It was a surprise to find a near absence of evaluative instruments for measuring the five rights of medication administration. Comprehensive evaluation refers to testing knowledge of all five rights of medication administration: most instruments reported in the literature evaluated only one of the five rights of medication administration, the right dose, and are in the form of dosage calculation tests.

The SAM scale is a 70-item test based upon the traditional five rights of medication administration. The five rights are evaluated using a case study approach based upon five hospitalized patient cases of adults and children (Ryan, 2007). The five cases incorporate two or three vignettes each and contain descriptions of the patient’s diagnosis, main complaint, medical history and physical, and physician orders, including medication orders (Ryan, 2007).

Nursing actions, based on the patient information given, are described in each of the vignettes. At the end of each vignette, a chart with each of the five rights of SAM is provided.
with space to mark one’s answer below each medication “right” (Ryan, 2007). Students must determine whether an error was made by the nurse in the vignette for each of the 70 items (5 rights x 14 vignettes = 70) in the instrument (Ryan, 2007). Sixteen medication errors are distributed among 13 out of the 14 patient vignettes; the intent of the instrument is to evaluate student ability to determine whether a medication error occurred (Ryan, 2007). Space is also provided below each vignette for students to write out a brief description of correct nursing actions for each identified error (Ryan, 2007). Students were allotted 45 to 60 minutes to take the test, and could use a calculator and a nursing drug reference (Ryan, 2007).

The SAM scale was piloted, then tested for validity and reliability on a total of 267 undergraduate nursing students, 137 in associate degree programs, and 130 baccalaureate students (Ryan, 2007). Ryan (2007), who used Rasch measurement testing, concluded the scale needed further validity and reliability testing, an increased level of difficulty, and to be tested on larger student population, but did yield evidence that a “psychometrically defensible instrument” (p. 47) could be created to evaluate safe student medication administration using clinical cases and vignettes. Ryan (2007) stated a potential for error was demonstrated when the nursing student was unable to “confirm the five rights of medication administration each time a medication is given to a patient” (p. 46). Permission for use of the SAM scale instrument in this current study was obtained from the Director of Graduate Studies in the Emory Nursing PhD program.

Using traditional statistical measures including an evaluation of content validity, construct validity, and reliability of internal consistency, Gonzales (2011) determined validity and reliability of the SAM scale. Recommendations for revising the SAM scale were made: shortening the tool, increasing its difficulty, evening out the categories of errors among test
items, and adding the error of omission in a scenario (Gonzales, 2011). Additionally, Gonzales (2011) recommended updating abbreviations, use of military time in the case studies and vignettes, and creating two parallel versions. In 2014, Bravo revised the SAM scale (SAM-R), to update and increase the level of difficulty, using both Rasch and conventional psychometric analyses to determine validity and reliability. Bravo (2014) determined the SAM-R scale required further revision before wide-spread use.

One study using the SAM scale was discovered. A pretest-posttest Malaysian study of diploma nursing students used a control group of 42 2nd year students and an experimental group of 41 3rd (final) year students (Guntalib, 2015). The intervention was a 2-hour simulation-based medication administration knowledge and performance refresher course. The Medication Administration Safety Assessment Tool (MASAT) was used as a guide to the students during the simulation and aide to the faculty observers (Guntalib, 2015). Two posttests were given, the first was 1 month after the intervention and the second took place 2 months after the intervention. A significant increase in SAM scores was noted in both the control and the experimental group over time; however, there was not a significant difference between the scores of the experimental group over the control group on posttest 1 (p > 0.05) or posttest 2 (p > .129) (Guntalib, 2015, p. 102).

**Factorial Analysis of SAM Scale and SSSCL-SAM Data**

To analyze data from the SAM scale and SSSCL-SAM questionnaire, a mixed between-within analysis of variance (ANOVA) analysis was carried out. This statistical test is also referred to as mixed design ANOVA (Cronk, 2016; Field, 2013). The mixed design ANOVA is a type of general linear model (GLM) that is a combination of repeated measures variables and between-groups measures, thus the “assumptions of homogeneity of variance and sphericity”
(Field, 2013, p. 593) must be met for this parametric test. There is not a non-parametric test for this calculation (Field, 2013; Pallant, 2013).

Homogeneity of variance relates to the in between-groups ANOVA design and refers to whether the participants in one’s sample derive from populations that have the same variance: if there is homogeneity of variance, the spread of scores in relation to the mean would be similar when plotted (Field, 2013). If there is not homogeneity of variance, a bias exists and can result in incorrect confidence intervals as well as significance tests due to biased standard error calculation (Field, 2013).

Sphericity, \( \varepsilon \), refers to a condition where there is “equality of variances of the differences between treatment levels” (Field, 2013, p. 545) or, more simply, where there are similar relationships between the pairs of variables (Ho, 2014). Mauchly’s test is the calculation used to test the assumption of sphericity in repeated measures analysis (Ho, 2014). F-test bias is the concern when the assumption of sphericity is violated in repeated measures calculations (Field, 2013).

A two-factor mixed design ANOVA was used to analyze study data in order to answer Research Question 2. Two-factor mixed design ANOVA is used when there is one between-groups independent variable, one within-groups independent variable (repeated measures), and one continuous dependent variable (Pallant, 2013, p. 121). Factorial ANOVA is an appropriate statistical approach for examining the effectiveness of two educational strategies (Ho, 2014).

An example of nursing research using repeated-measures ANOVA to compare effects between two teaching strategies was carried out by Kao, Hsu, Hsieh, and Huang (2012). Seventy-nine gastrointestinal nurses were given a pretest and two posttests evaluating their knowledge, self-evaluation, and learning satisfaction before and after using one of two study
interventions (Kao et al., 2012). The nurses were given either a CD-ROM (n = 25) or pocket booklet (n = 40) to show how to provide patient teaching to gastroscopy patients (Kao et al., 2012).

**Student Confidence with Medication Administration**

As a link between knowledge and action, self-efficacy can be described as an “operative competence,” an integration of not only cognitive, but social and behavioral skills to manage ones’ changing situation (Bandura, 1982, p. 122). One’s self-perceptions act as “cognitive mediators” of action (Bandura, 1982, p. 126). When people lack confidence in their ability to sufficiently control their actions, they often weaken their efforts in situations they perceive as beyond their capabilities (Bandura, 1982). A nursing example related to an essential skill is that a correlation between self-efficacy, mathematical ability, and performance on dosage calculation ability was revealed (Cloete, 2015).

Honey and Lim (2008) reported that nursing students have a perceived deficit of confidence related to putting their pharmacology knowledge to use with regard to academic preparation and ability to retain and apply pharmacology knowledge. How much pharmacology knowledge a nursing student perceives they need and the amount of knowledge the student perceives is necessary to be confident of it should be considered (Latter, Yerrell, Rycroft-Malone, Yerrell, & Shaw, 2000). Patient safety and the quality of care provided are concerns related to deficient self-confidence among new nursing graduates (Drexler, 2009). Honey and Lim (2008) described the strategy of increasing collaboration between nurse educators and staff nurse preceptors so that the student will be actively supported during clinical experiences. Collaboration between nursing education and clinical partners is essential in getting students ready for safe nursing practice (Loevecchio et al., 2012).
An important factor in the development of student confidence and success in fulfilling learning outcomes is the clinical learning environment (Lofmark et al., 2012). Attention to the clinical learning environment has increased in recent years, leading to a greater focus on developing student confidence and competence and meeting the learning needs of students over the delivery of health care during clinical time (Croxon & Maginnis, 2009; Lofmark et al., 2012). Preceptorship clinical experiences provide students with an opportunity to grow in self-confidence within the practice setting (Billay & Myrick, 2007).

White (2003) reported that students in a senior-level clinical grew in confidence in skills when supported by staff nurses who were active participants in their education. Preceptors take on the role of socializing students into the professional role, while faculty support the preceptors’ efforts and facilitate learning (Billay & Myrick, 2007). Staff nurse preceptors and university instructors are essential resources in the student’s preparation for their professional nursing roles (Lofmark et al., 2012). When students have increased self-confidence in their skill ability, the likelihood of understanding the skills as important and implementing them into their nursing care increases (Clark, Owen, & Tholckcn, 2004).

**Evaluation of Self-confidence in Safe Administration of Medication**

Sung et al. (2008) developed a 23-question tool on a 100-point scale to measure self-efficacy of medication administration and related nursing care. They evaluated medication administration knowledge, ability, self-efficacy, and satisfaction in learning pre- and post-intervention. The experimental group of 26 new nurses were given blended instruction that included online learning along with face-to-face instruction (Sung et al., 2008). This group gained greater medication knowledge than the control group of 24 new nurses, who were only given face-to-face instruction (Sung et al., 2008). There was not a significant difference in the
level of self-efficacy (Sung et al., 2008). The untitled self-efficacy tool was not included in the article.

The nursing self-efficacy for mathematics (NSE-Math) instrument is another example from the literature of assessing student confidence related to dosage calculations (Andrews et al., 2008). The NSE-Math aims to measure nursing student self-confidence in mathematical concepts and their application to nursing practice (Andrews et al., 2008). The current study will use an adapted self-confidence in learning instrument to assess student self-confidence in SAM pre- and post-intervention.

**Student satisfaction and self-confidence in learning questionnaire.** The National League for Nursing (NLN) offers simulation instruments for use in nursing research endeavors. One available instrument on the NLN website is the Student Satisfaction and Self-Confidence in Learning (SSSCL) questionnaire, which was developed during a research study partnership between the NLN and Laerdal, a leading simulation company (NLN, 2017). The SSSCL and related information is available on the NLN website: http://www.nln.org/professional-development-programs/research/tools-and-instruments/descriptions-of-available-instruments. The study questionnaire was adapted from this instrument developed by NLN; both aim at measuring student perceptions of learning nursing knowledge related to a teaching strategy.

The original SSSCL questionnaire contained a total of 13 items, 5 of which asked students about their satisfaction with their current learning simulation lab situation, and 8 questions related to their self-confidence in learning of content covered in a simulated clinical situation (NLN, 2017). The questionnaire is a self-report instrument (NLN, 2017). Reliability testing on the original SSSCL yielded a Cronbach’s alpha score of 0.94 for satisfaction section of the questionnaire and 0.87 for the self-confidence section (NLN, 2017).
The SSSCL questionnaire was adapted for use in the preceptorship clinical model to evaluate student confidence in medication administration ability. The adapted scale was called the SSSCL-SAM and maintained the original structure of five questions on learning satisfaction and eight questions about self-confidence. The five questions on satisfaction were completed by students during the pretest in relation to their most recent clinical instructor or preceptor and in the posttest phase of the study, in relation to this semester’s preceptor-led learning experiences. The SSSCL-SAM scale is located in Appendix B.

Care must be taken to consider whether using an existing scale is appropriately valid and reliable for the new study population and measurement of a different activity or purpose (Adamson, Kardong-Edgren, & Willhaus, 2013). Researchers should report efforts to pilot or gain expert review of the content of an existing scale (Adamson et al., 2013). Establishing face validity and content validity meets a minimum requirement to have an acceptable scale (Bannigan & Watson, 2009). Expert review of the SSSCL-SAM is described in the Methods chapter.

**Survey of use of Pharmacology Resources (SUPR)**

The researcher developed Survey of Use of Pharmacology Resources (SUPR) was created to explore student efforts to increase SAM in the current academic and technologically advanced environment. The survey has two parts: (a) a resource checklist and (b) open-ended workbook questions. The discussion below provides examples of the resources noted on the checklist that were informed by the review of literature.

The current academic and health care environments are increasingly technology focused. Publishers of nursing education resources offer an expanding selection of print and technological resources not available to nursing students in the past. The list of resources listed on the SUPR
was influenced by a review of the literature. Resources used by nursing students to increase medication administration knowledge and skills have been reported as practicing dosage calculations alone or with peers, attending lectures, using textbooks, and using computer-assisted programs (Grandell-Niemi, Hupli, Leino-Kilpi, & Puukka, 2003). Problem-based learning scenarios have been used to increase student understanding of medication error causes and ways to prevent errors (Papastrat & Wallace, 2003). Simulation laboratory scenarios using medication administration supplies are another teaching strategy for reinforcing principles of safe medication administration (Thompson & Bonnel, 2008; Wolf et al., 2006).

Other teaching strategies for increasing safe medication administration, dosage calculation in particular, are to emphasize conceptual and mathematical skill, provide online math sessions, drug calculation workbooks, and to have students practice with supplies in the skills lab (Wright, 2007). Practicing dosage calculation using in-person math tutorials is another teaching strategy (Wright, 2008). Web-based tools such as eDose™ and safeMedicate are technology-based strategies for increasing problem solving dosage calculation problems (Weeks, Hutton, et al., 2013).

**Summary**

A review of the literature of key concepts for this study was provided in this chapter. The key concepts reviewed were safe medication administration, medication errors, theory-practice gap, and the teaching strategies of nursing clinical models and use of workbooks. The five rights of medication administration, causes of medication errors, and faculty-led and preceptorship clinical experiences were secondary concepts reviewed. Finally, evaluation of nursing student medication administration knowledge and self-confidence and use of pharmacology resources were reviewed.
CHAPTER THREE:

METHODOLOGY

The purpose of this pretest-posttest quasi-experimental study was to determine the effectiveness of two teaching strategies on the knowledge of safe medication administration of senior baccalaureate pre-licensure nursing students in their final 2 semesters of study. The teaching strategies were preceptor-supervised clinical instruction (preceptorships) and a safe medication administration clinical workbook. A related purpose was to determine the extent to which the clinical workbook was used and whether students perceived it as helpful. A third purpose of this study was to determine which currently available resources students perceived as most helpful in learning and applying safe medication administration knowledge.

In this chapter, data collection from three instruments; the Safe Administration of Medication (SAM) scale, The Student Satisfaction and Self-Confidence in Learning SAM (SSSCL-SAM) questionnaire, and the Survey of Use of Pharmacology Resources (SUPR); checklist are discussed. Analysis of data addressing the research questions is considered. Finally, ethical considerations, including informed consent are addressed and study limitations and delimitations explored in this chapter.

Research Questions

**Question 1**: Which intervention, a preceptorship clinical or a preceptorship plus use of a clinical workbook, is more effective in increasing participant’s SAM and Self-Confidence in Learning scores?

**Question 2**: Which intervention, a 72-hour critical care preceptorship plus use of a clinical workbook or a 150-hour capstone preceptorship plus use of a clinical workbook, is more
effective in increasing participant’s SAM and Self-Confidence in Learning scores across the two
time periods (pre-intervention and post-intervention)?

**Question 3:** To what extent do pre-licensure senior baccalaureate nursing students find a
clinical workbook helpful or useful in learning safe medication administration during preceptor-
based clinical courses?

**Question 4:** What resources do pre-licensure baccalaureate nursing students use in
today’s academic and clinical environment to increase safe medication administration
knowledge?

**Research Design and Cognitive Learning Theory**

The cognitive learning theories of constructivism, social constructivism, and situated
cognition made up the theoretical framework of this study. Pharmacology theory and
foundational concepts, as well as psychomotor skills for medication administration, are taught
early in the nursing curriculum to prepare students for their first clinical experiences. Senior
baccalaureate nursing students need to build upon foundational medication administration
knowledge in preparation for independent medication management upon graduation
(Bourbonnais & Caswell, 2014). Similarly, students need to practice medication administration
safety and skills such as dosage calculation throughout the nursing program (Wolf et al., 2006).

Linkages between theoretical knowledge and application to the clinical environment are
facilitated when practiced in a complex health care setting (Bourbonnais & Caswell, 2014). Dosage calculation, for example, needs to be studied in the clinical setting where it is “immersed in the social practice of nursing and is relevant and meaningful” (Wright, 2009, p. 548). When learners collaborate with others in a learning community they experience various points of views when trying to solve problems (Nickle, 2007). In order for undergraduate nursing students to
learn safe medication administration knowledge, teaching strategies beyond the classroom or skills lab are needed to provide learning in context (Benner et al., 2010).

The study design involved senior nursing students taking two tests, one measuring knowledge and one, self-confidence. The SAM test was given both pre- and post-intervention in order to detect knowledge gains. Knowledge gained is situated and is partially a result of activity, context, and enculturation (Brown et al., 1989). One intervention, a preceptorship clinical, provided students with situational learning opportunities where they could assimilate, integrate, and apply pharmacology theoretical constructs in the clinical setting (Banning, 2003). Preceptors make, or guide students to make, links between “existing knowledge and the culture and practices of the clinical placement . . . or profession” (Spouse, 1998, p. 264) so the student can learn by rearranging their zone of proximal development (Spouse, 1998). The preceptor relationship provides cognitive as well as social learning (Spouse, 1998).

The clinical workbook intervention provided a review of medication administration “rights” so learners can scaffold or connect prior learning to the information and exercises presented. Another goal of the clinical workbook was the integration of theory into clinical practice to decrease the theory practice gap (Nisbet & Matthews, 2011). The workbook also provided opportunities for students to reflect on their clinical practice. The collaborative learning experiences required active engagement by the student (Walker et al., 2016). Also in the study, student feedback from the experimental group was collected on the usefulness of the workbook. Student feedback was collected on which medication management resources they found to be most useful.
Risk of Contamination

Originally, a design was proposed to randomly assign half of 4th- and half of 5th-semester students to the treatment group and half to the control group, with only the experimental group receiving the intervention of the SAM workbook. A process for randomly assigning participants to either the control or experimental group was identified. As an example, a 4th semester participant name drawn from a container and placed in the control group and assigned the number CG1, the next name drawn would be assigned to the experimental group, assigned the study number, EG2, and so on. Students in the experimental group would be instructed to not share the workbooks with those in the control group.

The research design was updated and evolved into the current design based on feedback related to probable contamination of data. Students in the experimental group would likely share information about the workbook with students in the control group. Though the students in 4th and 5th semester would be in preceptorships, each assigned to a nurse one-on-one in a clinical unit, spread out in 1 of at least 10 area hospitals, some on day shift, some on night shift, there would still be opportunity for contamination. Though students would not be in a clinical group instructed by one faculty member, they would be in the same didactic courses (4th-semester students in critical care and pediatrics, 5th semester in leadership and community health). Additionally, social media provides endless other opportunities for students to share experiences and comments related to nursing school. It was determined there would be less contamination if all students were given the workbook.

Research Design

A pretest/posttest quasi-experimental study design, using two groups, investigated the safe medication administration knowledge of pre-licensure baccalaureate senior nursing students.
An evaluation of the effect of a preceptor-supervised clinical (preceptorship) on student safe medication administration was not discovered in the literature; thus, this was treated as an independent variable. The preceptorship only (5th-semester students taking the pretest) treatment group served as the control group. The educational intervention of a safe medication administration clinical workbook was a second independent variable. The preceptorship plus workbook group (4th-semester students taking the posttest) served as the experimental group.

For the study, 5th-semester participants were in the control group, attended their usual preceptor-supervised critical care clinical rotation during the prior semester. The 4th-semester participants were in the experimental group and attended their usual preceptor-supervised critical care clinical along with using the SAM workbook. The composition of the two groups was senior nursing students in a baccalaureate program. A chart outlining the research design is provided in Appendix D.

This pretest/posttest study took place in three stages over the course of the Fall 2017 academic semester. The first stage occurred at the beginning of the semester. The study was introduced and briefly outlined to all students in 4th and 5th semester at a convenient time for each class and the professors. Students were given an information sheet via email with the study information and an invitation to participate (see Appendix F). Students were given up to 3 days to consider participation before the pretest.

At a time convenient for study participants at the beginning of the semester, a demographic survey, SAM pretest, and Student Satisfaction in Learning and Self-Confidence in Learning SAM (SSSCL-SAM) survey were administered to both treatment groups. Fourth and 5th semester course coordinators were asked to assist in coordinating a time for the pretest (and the posttest) that would not interfere with student orientations, exams, and so forth. Students
were given 45 to 60 minutes to take the SAM pretest, and an additional 10 minutes to complete the SSSCL-SAM survey and demographic questions. Calculators were provided by the School of Nursing for use, and students were allowed to use medication guides/nursing drug books, as these were allowed by the instrument author, Ryan (2007), who noted they are available in clinical practice. Instructions were given to students to write only the study participation number on each instrument. Students were given a snack and water bottle while completing the instruments. The completed instruments were stored in a secured cabinet in the researcher’s office.

During the second stage of the study, both the 4th- and 5th-semester participants attended their usual preceptor-supervised clinical with instructions to use the clinical workbook during clinical in collaboration with their preceptor. At the end of the pretest, students were given a print copy of the SAM workbook with a letter to be provided to their preceptor. The preceptor letter explained the study, encouraged collaboration with the student on workbook activities, and provided the preceptor contact information to obtain a digital or print copy of the SAM workbook upon their request.

The SAM posttest, Learning Satisfaction and Self-Confidence in Learning SAM (SSSCL-SAM), and Survey of Use of Pharmacology Resources (SUPR) Parts 1 and 2 would be administered to all 4th- and 5th-semester participants after clinical rotations were completed, making up the third stage of the study. Students were given 45 to 60 minutes to complete the posttest, and an additional 10 minutes to fill out the LSSCL-SAM and SUPR surveys. As with the pretest, only the study number was used as an identifier on each of the study instruments. Upon receipt of the instruments, students were given a note of appreciation for participating in
the study, a chocolate bar, and a $10 gift card. The completed instruments were stored in a secure 
cabinet in the researcher’s office.

Setting

This study took place at one School of Nursing at a public university in the southeastern 
United States (US). The university had an enrollment of over 20,000 students with a faculty of 
nearly 1,000 instructors at the time of the study. Undergraduate studies were divided among 
eight colleges, 40 departments, and 140 possible degree programs.

The School of Nursing is under the College of Behavioral and Health Sciences. The 
baccalaureate nursing degree is one of 17 undergraduate programs of study in the college. The 
college offers 18 graduate programs of study. The undergraduate nursing program is approved by 
the state board of nursing and accredited by the Commission on Collegiate Nursing Education 
(CCNE). The School of Nursing enrollment is approximately 300 undergraduate students. A 
cohort of approximately 64 undergraduate students is admitted each fall and spring semester.

Implementation of the study instruments was scheduled in collaboration with didactic 
course instructors at a time convenient for students, such as before or after an already scheduled 
class. The interventional workbook was intended to be used mainly while the students were in 
clinical, which took place at one of the multiple acute care hospitals utilized in the school of 
nursing program.

Sample

To conduct the study, pre-licensure baccalaureate senior nursing students enrolled in a 
southeastern public university were invited to participate. The baccalaureate nursing student 
population at this university was comprised predominately of Caucasian women from the 
southeastern US in their early to mid-20s seeking their first college degree. The average cohort
age range was 21 to mid-50s. Undergraduate nursing students typically completed prerequisites in three semesters and entered nursing school as second semester sophomores. Students were required to achieve a final grade of 80% in each nursing course of the 5 semester nursing program to matriculate. An unsuccessful final course grade in two nursing courses resulted in dismissal from the program.

Students who were enrolled in their 4th or 5th semester of the baccalaureate nursing program were recruited. To eliminate an opportunity for study bias, students assigned to the researcher’s 4th semester clinical group were excluded from participation in the study. At the beginning of the semester of data collection, there were 81 senior students who met the inclusion criteria. A clinical and didactic 4th semester and clinical 5th semester faculty encouraged participation by use of verbal reminders during course orientation, for example, during the 1st week of the semester. A total of 34 students (42% of potential participants) consented to be in the study. It became clear that enrollment was affected by both 4th- and 5th-semester students being sensitive to time constraints from course requirements and wary of adding extra tasks that were not requirements of their courses.

Of those who took the pretest, 13 (94%) of 5th-semester students and 14 (70%) of 4th-semester students took the posttest. Multiple and flexible times were offered for students in both 4th and 5th semesters to take the posttest. Printed signs of available posttest times were posted on often used laboratory spaces and emailed to students by course faculty. Verbal reminders of the posttest dates were provided by the clinical course coordinators and a 4th semester didactic course faculty member. During the last week of the semester when the posttest was given, 4th-semester students were concerned with passing the didactic portion of the critical care course. Fifth semester students relayed that they had one more exam after the posttest and it was not one
they were anxious about; they were much more upbeat and occupied with plans related to graduation.

Students in their senior year of study had completed a pharmacology course and encountered additional pharmacology content in other nursing courses such as fundamentals, medical-surgical, and obstetrical nursing. These students had completed several clinical courses in their curriculum which afforded them opportunities to practice medication management. This population, by being in their final year of nursing school, had successfully demonstrated use of strategies for acquiring and applying at least a minimal level of pharmacology knowledge and application.

**Interventions**

*Preceptorship clinical.* Exclusion criteria for the study involved being an assigned student to the researcher’s critical care clinical rotation. Inclusion criteria for both the 5th semester (control group) and 4th semester (experimental group) was participation in regularly assigned preceptor-supervised clinical rotations. For 4th-semester students, the usual preceptor-based critical care rotation consisted of six 12-hour shifts providing total patient care in a critical care unit in one of seven area hospitals. The 12-hour shifts for each student are either all on day shift, 7:00 AM to 7:00 PM, or night shift, 7:00 PM to 7:00 AM. Each student was paired with one preceptor, assigned by the health care facility, and optimally worked with the same preceptor for each of their six clinical shifts. Prior to their critical care rotation, students were required to participate in the usual 1-day skills laboratory including a simulation scenario related to a critical care patient required for the course. They also took the usual required paper and pencil dosage competency quiz. A contract between the university and health care facility, as well as a list of skills allowed by category of independent action, supervised, or not allowed (observation only)
provided parameters for the student clinical experience. During the preceptorship, students were required to meet three times on campus with their assigned faculty to review the events, patient situations, and nursing care experienced during each of the 6 clinical days. The faculty member assigned the final grade for the clinical course.

Similarly, 5th-semester students participated in their regularly assigned preceptor-based capstone practicum. This clinical involved 11 12-hour shifts on either day shift or night shift on their assigned acute care clinical unit in one of many area hospitals contracted with the School of Nursing. Prior to the start of their preceptorship, Capstone students took a dosage competency quiz, but did not have a skills lab or simulation lab. Students in the Capstone preceptorship worked with multiple preceptors in a variety of activities including patient care assignments and leadership related activities. As with the critical care clinical course, a facility/university contract and skills guidelines serve to provide parameters in this clinical. Students were required to meet with an assigned faculty member to review events of their clinical experiences. Faculty assign the final grade in this course. The researcher was not an instructor in the Capstone course.

**Safe administration of medication workbook.** Using a cognitive learning theory framework, a Safe Medication Administration (SAM) Workbook was developed for the study intervention. The workbook contained realistic, acute care case studies, resource information from the literature, and collaborative activities to be used with the clinically expert preceptor in carrying out SAM and error avoidance. The preceptor, as a clinical supervisor, assists the student to link or connect existing knowledge with the culture and practices of the health care environment and profession, allowing the student to adapt their, according to Vygotsy, “zone of proximal development,” “the difference between knowledge-in-use and potential knowledge-for-use” (Hedegaard, 1996, in Spouse, 1998, p. 263).
Ongoing situation coaching is necessary in order for students to understand the “changing relevance, and demands, resources, and constraints in a particular situation” (Benner et al., 2010, p. 83). It was anticipated that student use of the workbook would increase preceptor coaching and assist the student to develop clinical reasoning with regard to medication administration safety. The educational process must provide students the necessary knowledge and standards to help decrease medication errors in clinical practice (Papastrat & Wallace, 2003).

The SAM workbook developed for this study addressed each of the rights of medication administration, was concise, and was intended for use during senior-level clinical preceptorship experiences. In the workbook, five additional rights of medication administration found in the literature were incorporated into the traditional five rights. The intent of the workbook was to reinforce safe administration practices and avoidance of medication errors, according to current literature, in order to support learning, increase posttest scores on the SAM scale, and ultimately strengthen the student’s knowledge base for providing safe care in clinical practice beyond graduation.

The workbook also provided some structure for undergraduate students to learn medication administration and monitoring (Manias & Bullock, 2002). Preceptor preparation in medication management is varied and can be lacking (Harris, 2014) A general unpreparedness of preceptors to teach has been reported (deFulivo et al., 2015). Increased faculty involvement and collaboration in preceptorships is needed (AACN, 2005; Corlett et al., 2003; IOM, 2011; Wieland et al., 2007). The clinical workbook intervention demonstrated an effort to increase not only student and preceptor collaboration, but increased preceptor collaboration with faculty as well.
A brief review of teaching strategies related to medication administration was described in the review of literature. Similarities to the clinical workbook for preceptorships were not found in the nursing literature. Numerous resources in the form of workbooks are available for purchase by nursing students to aid in the learning of medication administration. The vast majority of these resources are hundreds of pages in length and are not practical for use during clinical experiences. Most have dosage calculation, the “right dose,” as their main focus but only briefly mention the other rights of safe medication administration.

The content for the workbook was developed based upon the rights of safe medication administration (SAM) and related concepts gleaned from current nursing literature and experts of patient safety as identified in the literature review. The SAM scale instrument is also based upon the five rights of SAM. The workbook was divided into seven chapters: an introduction to the five rights, a chapter devoted to each of the traditional five rights of medication administration, and a chapter on avoidance of medication errors.

Each of the “five rights” chapters contained (a) connections to prior learning, (b) a patient example (case study), (c) key points of information relating the administration right to medication management, and (d) an interactive section intended to be used during the clinical experience to enhance collaborative learning with the preceptor. Case studies were included as a way to tie the intervention to the SAM scale instrument which uses case studies. The case studies in the SAM workbook and the SAM scale instrument provided realistic acute care patient situations in order to test whether students could identify medication errors in violation of the rights of medication administration.

The interactive section of the workbook included activities such as (a) questions to discuss with the preceptor, (b) items to locate on the unit, (c) prompts for reflection on practice,
and (d) a space for a preceptor-provided case example. Workbooks were provided to students and offered to preceptors at the beginning of each preceptorship. Excerpts from the SAM clinical workbook are located in Appendix E.

**Expert Review of Workbook Content**

Content experts comprised of experienced clinical faculty reviewed the workbook. Three clinical faculty (two medical-surgical clinical instructors and one critical care clinical instructor) were asked to review the workbook. Each of the faculty experts have been Registered Nurses for over 20 years and nurse educators for at least 3 years.

Content was reviewed for accuracy, relevance for the level of student, and whether the information was congruent with current clinical practice. Case studies were reviewed to ensure they provided a reasonable scenario for the medication they were intended to reinforce. Answers to the workbook practice questions were double-checked for accuracy.

Faculty comments were constructive and positive. An example of a change that was made in the workbook based on faculty feedback concerned the nutrition information related to anticoagulants. A faculty member recognized that the information related to high-risk anticoagulants in Exercise 3 on workbook page 41 needed to be updated: The most current recommendation for patients on anticoagulants is that if they consume foods such as turnip greens, spinach, and broccoli that they be taken in moderation and in consistent amounts, due to their Vitamin K content.

Recommendations for clarifying the wording of selected assignments were made. The checklist of factors for the “Key Point” related to only complete medication orders being legal on workbook page 9 was reworded for clarification. The second and third true-false questions on workbook page 12 were re-ordered due to faculty feedback. An example of needed clarification
was to change the initials of the two patients in the “Right Patient” case study on page 13 of the workbook from Mr. Z and Mr. S to initials not similar. A spelling error of the word *tube* was corrected on page 36. The statement about trialysis catheters on page 37 was updated for clarity to read “for trialysis catheters, only use the IV port for IV fluids or medications.” Faculty suggested adding drug examples for oral hypoglycemic and insulin on the chart of high risk drugs on page 48. Another faculty recommendation was to add “anterior superior iliac spine” to the landmarks for ventrogluteal intramuscular (IM) injections in the answer key on page 54.

**Preceptor input.** Prior to data collection, effort was made to obtain the perspective of potential preceptors on the usefulness of the workbook. A visit was made to a clinical partner site. After providing a description of the study design, two Registered Nurses (RNs) in an area hospital Intensive Care Unit agreed to review the workbook. Both nurses provided feedback that they believed the workbook would be of value. One of the RNs, a former student of the nursing program, stated she wished she had had the workbook, especially for the capstone course. She stated that new graduates attend the preceptor class at the end of new graduate orientation but cannot become preceptors until they have 1 year experience as a nurse.

The RNs gave overall positive feedback and approval with few specific comments related to content. A specific change made to the workbook based on nurse feedback was to add *MD notified* to the following “Key Point” on workbook page 9: If a medication was refused by the patient or held by nursing judgment, it must be documented when the decision is made to not administer it. She pointed out that notifying the provider is expected current practice.

**Instruments**

Each of the three instruments used in this study were administered using paper and pencil. This study used the original SAM scale. A revised version, SAM-R, of the SAM scale
was tested in an electronic format by the developer, who received student feedback that it was burdensome going back and forth on the computer between the vignettes and case studies when answering questions (Bravo, 2014). Data from each study instrument were entered into the IBM software Statistical Package for the Social Sciences (SPSS) 24.0.

**Demographic Survey**

Descriptive analysis was carried out for the survey demographic data. A researcher-developed demographic survey is located in Appendix G. Descriptive statistics provided details and a description of study sample characteristics (Guiliano & Polanowicz, 2008). The survey provided data on participant gender, race, and category of age. *Yes* and *no* questions inquired whether students had a prior college degree, algebra course, or dosage calculation course, or had prior hospital work experience.

**Safe Administration of Medications Scale**

The SAM scale is a 70-item test based upon the traditional five rights of medication administration. The five rights are evaluated using a case study approach based upon five hospitalized patient cases of adults and children (Ryan, 2007). The five cases incorporate two or three vignettes each and contain descriptions of the patient’s diagnosis, main complaint, medical history and physical, and physician orders including medication orders (Ryan, 2007). The descriptions of the patient’s clinical case provide real-world context for students to use clinical reasoning to determine whether a medication error was made in the clinical scenario.

Currently, the Safe Administration of Medication (SAM) Scale developed by Deborah Ryan (2007) is the only comprehensive evaluation of safe medication administration in the literature that can be used to efficiently evaluate individual student knowledge. Simulation-based instruments are time and labor intensive and prohibitive for evaluating large clinical groups.
Comprehensive evaluation refers to testing knowledge of all five rights of medication administration. Most instruments reported in the literature evaluate only one of the five rights of medication administration, the right dose, and are in the form of researcher-developed dosage calculation tests.

**Student Satisfaction and Self-confidence in Learning Questionnaire for SAM**

The NLN Student Satisfaction and Self-Confidence in Learning (SSSCL) measures student perceptions of their self-confidence related to performance of nursing care in a simulated clinical setting (NLN, 2017). The SSSCL contains the self-confidence subscale (eight questions) and a learning satisfaction subscale (five questions). The adapted version of this questionnaire for the study, SSSCL for Safe Administration of Medication (SSSCL-SAM), was adapted for use to measure self-confidence related to performance of medication administration nursing tasks and learning satisfaction in the context of preceptorship clinical experiences. Language pertaining to the simulation was changed to reflect the clinical experience: the word *instructor*, for example, was changed to *preceptor*, and terms such as “simulation covered critical content necessary for the mastery of medical surgical curriculum” (NLN, 2017) was changed to “clinical experience covered critical content necessary for the mastery of safe medication administration.” Another example of a wording change is “I enjoyed how my instructor taught the simulation” was changed to “I enjoyed how my preceptor taught medication administration.” The structure of 13 total items, 5 related to student satisfaction, and 8 related to self-confidence was not changed in the SAM study version of the questionnaire.

The SSSCL for the SAM instrument has been tested for face validity and content validity by nurse educators who are faculty in baccalaureate clinical nursing courses (Fundamentals of Nursing and Critical Care). The wording of two questions related to self-confidence were
updated according to feedback from expert faculty reviewers. Question 7 was updated from “I am confident that this clinical experience covered critical content necessary for the mastery of safe medication administration,” to “I am confident that this clinical rotation covered essential content necessary for the mastery of safe medication administration.” The faculty peer suggested that students may be unsure of the meaning of critical content for safe medication administration and recommended using the term essential content. Question 9 was updated from “my preceptor used helpful resources to teach safe medication administration,” to “my preceptor used available resources to teach safe medication administration.” Using available resources instead of helpful resources, a faculty peer suggested, was more appropriate in the context of the clinical setting. The SSSCL-SAM is located in Appendix B.

Survey of use of Pharmacology Resources (SUPR)

A two-part survey was developed by this researcher to gain a better understanding of which teaching and learning strategies nursing students perceive to be most beneficial in helping them learn how to safely administer medications. The first part of the SUPR was a checklist; students were asked to place a check mark by the resources they have used to study medication administration, then asked to rank the top three perceived to be most helpful. All study participants were asked to fill out the checklist. The SUPR is located in Appendix C.

The second part of the survey contained two Likert-type questions and two open-ended questions. The questions inquired about the use and helpfulness of the clinical workbook. The Likert-type questions were (a) On a scale of 0 to 10, was the workbook helpful or useful in learning safe medication knowledge, and with a scale to mark from 0 to 10, (b) How many times during your clinical rotation did you use the workbook? The open-ended questions were (a) In your own words, how was the workbook helpful or not helpful in gaining safe medication
knowledge, and (b) In your own words, how was the workbook helpful or not helpful in gaining self-confidence in the administration of medications? The rationale for the survey was explained to students and spaces were left for students to answer the open-ended survey questions (Walter, Cleary, & Rey, 1999).

A concern of the researcher was the amount of time students would have to use the workbook during the preceptorship. Input was obtained from a senior nursing student who had completed both 4th and 5th semester preceptorships. The student affirmed a workbook would have been beneficial during her preceptorships. The student believed time would have permitted use of workbook activities, particularly during the Capstone preceptorship.

Data Collection

Power analysis. A power analysis was determined using the program G*Power 3.1.9.2 for Windows (Heinrich House University, 2014). The necessary sample size for this study was calculated to be 10 participants in order to identify a genuine effect in the population (Field, 2013). The following input was used: Effect size $f = 0.236$; $\alpha$ err prob = 0.05; Power (1-$\beta$ err prob) = 0.8; number of groups = 2; number of measurements = 2; nonsphericity corr $\varepsilon = 1$; Options = GPower3.0. The effect size of 0.236 partial eta squared was obtained from output data (Guntalib, 2015, p. 101) from a Malaysian dissertation pretest-posttest study in which the SAM Scale was the primary instrument, as it is in this research project. The teaching strategy of a simulation refresher course for medication administration was the study intervention for a randomly assigned experimental group of 41 2nd and 3rd year diploma nursing students (Guntalib, 2015). The control group of 42 randomly selected 2nd and 3rd year students attended their “usual” clinical; the clinical model was not stated in the study.
An alternate power analysis was calculated using an effect size of 0.25. Using a generic 0.25 would provide a moderate effect according to Tolusso (2017, March 9, communication) when data are not available from a study. The sample size needed to detect an effect using 0.25 effect size is 34 student participants.

**Null hypothesis.** If the independent effects of the independent variables (time, level of clinical, or clinical plus workbook) are not statistically significant and no significant interaction effects between them, the null hypothesis will be accepted (Guiliano & Polanowicz, 2008). An interaction would mean that the values of one of the variables had an effect on another variable (Guiliano & Polanowicz, 2008). The null hypothesis was that preceptorships and use of a clinical workbook across the duration of a clinical rotation would have no effect on SAM scores or self-confidence scores on senior baccalaureate nursing students.

**Data Analysis**

**Data Collection and Statistical Analysis in Relation to Research Questions**

When the SAM scale was administered, students had to determine whether an error was made by the nurse in the case studies for each of the 70 items in the instrument (Ryan, 2007). The categorical “error” or “no error” data generated from the SAM scale were reported and entered into SPSS as one number per subject representing how many correct responses minus how many mistakes the student made in determining whether a medication error was made by the nurse in the vignettes. For further analyses to evaluate subscales of the SAM Scale, individual test item scores were also entered into SPSS as variables. These data were at the interval level, collected before and after the study interventions, and analyzed using independent-samples *t* tests to determine if a significant difference existed between control and experimental group mean scores. The participants in the control and experimental groups provided data for
their respective samples, not for both, providing independent samples for comparison (Cronk, 2016).

Data were analyzed by repeated measures analysis of variance (ANOVA) to determine if a significant difference existed in 4th and 5th semester scores pre- and posttest. A two-factor mixed between-within analysis of variance (mixed design ANOVA) was used. The between-groups independent variable would be the semester level of the students using the interventions of preceptorship clinical and workbook plus preceptorship clinical. The within-groups independent variable would be time 1, the pretest, and time 2, the posttest. The continuous dependent variable would be SAM scores. A second mixed design ANOVA was carried out for the dependent variable of Learning Satisfaction and Self-Confidence in Learning (SSSCL-SAM) scores. Factorial ANOVA is an appropriate statistical approach for examining the effectiveness of two educational strategies (Ho, 2014). A summary of statistical analysis in relation to each research question is located in Table 1.

**Research question 1.** Which intervention, a preceptorship clinical, or a preceptorship plus use of a clinical workbook, is more effective in increasing participant’s SAM and Self-Confidence in Learning scores?

Descriptive data, means, and standard deviations, for Time 1 and Time 2 were provided. Independent-samples *t* tests were carried out to compare the means of two different groups of samples, with the following grouping (independent) variable: the 5th-semester students after critical care clinical without using the workbook compared to 4th-semester critical care students after critical care clinical with the workbook. The assumption of homogeneity of variance was checked for violation using values from the Levene’s Test of Equality of Error Variances and the Box’s Test of Equality of Covariance Matrices (Pallant, 2013).
Table 1

Statistical Analysis in Relation to Research Questions

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<tr>
<th>Research Questions</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Statistical Test</th>
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<tbody>
<tr>
<td>Which intervention, a preceptorship clinical, or a preceptorship</td>
<td>Preceptorship</td>
<td>SAM knowledge</td>
<td>Independent t tests</td>
</tr>
<tr>
<td>plus use of a clinical workbook, is more effective in increasing participant’s SAM and Self-Confidence</td>
<td>Clinical workbook</td>
<td>Self-confidence in SAM (SSSCL-SAM)</td>
<td></td>
</tr>
<tr>
<td>in Learning scores?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which intervention, a 72-hour critical care preceptorship plus use of a Clinical workbook, or a 150-hour</td>
<td>Preceptorship</td>
<td>SAM knowledge</td>
<td>Mixed design ANOVAs</td>
</tr>
<tr>
<td>capstone preceptorship plus use of a clinical workbook, is more effective in increasing participant’s</td>
<td>Clinical Workbook</td>
<td>Self-confidence in SAM (SSSCL-SAM)</td>
<td></td>
</tr>
<tr>
<td>SAM and Self-Confidence in Learning scores across the two time periods (pre-intervention and post-intervention)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To what extent would pre-licensure senior baccalaureate nursing students find a clinical workbook helpful</td>
<td>Frequencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or useful in learning safe medication administration during preceptor-based clinical courses?</td>
<td>percentages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What resources do pre-licensure baccalaureate nursing students use in today’s academic and clinical</td>
<td>Frequencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>environment to increase safe medication administration knowledge?</td>
<td>Percentages</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Research question 2. Which intervention, a 72-hour critical care preceptorship plus use of a clinical workbook, or a 150-hour capstone preceptorship plus use of a clinical workbook, is more effective in increasing participant’s SAM and Self-Confidence in Learning scores across the two time periods (pre-intervention and post-intervention)?

Data from the mixed design ANOVA provided information on the main effect of each of the variables (Field, 2013). Data were analyzed using mixed design repeated measures ANOVA to determine to what extent, if any, there was a change in pretest and posttest scores on the SAM scale (main effect for time) between 4th- and 5th-semester students (main effect of semester level). The data also showed whether the change in SAM scores over time was different for the two intervention groups (4th and 5th semester clinicals), measuring the interaction effect between these variables. The main effects were interpreted after taking into consideration whether the interaction effect was significant (Pallant, 2013). SPSS outcome data for Tests of Within-Subjects Effects and Tests of Within-Subjects Contrasts were reviewed for significant effects as demonstrated by a $p$ value less than .05 (Field, 2013).

To further answer Research Question 2, a second, separate mixed design repeated measures ANOVA calculation was made using self-confidence as the dependent variable. A composite score and subscale scores from the SSSCL-SAM scale were used for the repeated measures value. The two between-group variables, two levels of preceptorships plus workbook used to evaluate Research Question 1 were used in evaluation of Question 2. This provided information on the extent of change, if any, in student self-confidence after the interventions, as well as any impact between group differences had on the change in variable.

Research question 3. To what extent would pre-licensure senior baccalaureate nursing students find a clinical workbook helpful or useful in learning safe medication administration during preceptor-based clinical courses?

To determine whether students found the workbook to be helpful or useful in gaining safe medication administration knowledge, students were asked to answer a brief questionnaire. The
questionnaire items were (a) On a scale of 0 (not helpful) to 10 (very helpful), how was the workbook helpful or useful in learning safe medication knowledge in clinical?; (b) How many times during your clinical rotation did you use the workbook; students were asked to mark 0 (did not use) to 10 (used 10 or more times); (c) In your own words, how was the workbook helpful or not helpful in gaining safe medication knowledge?; and (d) In your own words, how was the workbook helpful or not helpful in gaining self-confidence in the administration of medications? Questions 1 and 2 were analyzed and reported by frequencies and percentages. Survey results can be reported as numbers and percentages, or reported as means and standard deviations (Walter et al., 1999). Responses to Questions 3 and 4 were copied into a word document and reported as narrative using examples of direct student quotes.

To further assess the extent of the helpfulness and use of the workbooks, a visual inspection of the students’ work was carried out. Workbooks were requested to be collected after completion of the preceptor-based clinical rotation for each student. An evaluation of the extent to which students marked responses in the workbooks was noted by page numbers of worked activities, and as a percentage of completion. These were reported for each student who provided their workbook for inspection.

**Research question 4.** What resources do pre-licensure baccalaureate nursing students use in today’s academic and clinical environment to increase safe medication administration knowledge?

At the completion of each student’s clinical rotation, and at the time of their SAM posttest, students were asked to complete the Survey of Use of Pharmacology Resources (SUPR) checklist. The SUPR responses were reported for the entire group of study participants. Responses were tallied, assessed for frequencies, and ranked according to reported usefulness.
Ethical Considerations

In keeping with the American Nurse Association’s Code of Ethics, the nurse researcher ensured participants were treated with dignity, impartiality, and worth (ANA, 2015a). Respect for study participants also involved ensuring informed consent, confidentiality, and anonymity (Creswell, 2014). Screening for ethical issues was carried out by independent review of the proposed study by the University of Alabama Institutional Review Board (IRB) and the host university Institutional Review Board. Involvement in research to advance nursing education is in keeping with the Code of Ethics (ANA, 2015a).

To avoid a study limitation, any student to whom the researcher was assigned as a 4th semester faculty member, was excluded from the study. The researcher was the faculty for one-fourth of the 4th-semester students during their 4-week preceptorship rotation (approximately 15 out of 97 potential students, if all agreed to participate). As faculty to those assigned to my clinical group, I was required to meet with each of the 15 students for three on-campus visits to review clinical experiences. I had to assess overall progress during their 4-week rotation and assign a pass or fail grade; therefore, it would not have been appropriate to include these students in this research project.

Informed Consent

Informed consent was obtained after an explanation of the study was provided, and any student questions about the study were answered (see Appendix H). Informed consent occurred prior to data collection. Guidelines from The University of Alabama and host institution were used to generate the informed consent. Students were not coerced into signing consent (Creswell, 2014).
Potential ethical issues were addressed. It was conceivable that students would worry that a decision to not participate would impact their course grade or requested references for potential employers. The researcher was not a didactic instructor for any student participant during the semester of the study. Nor was the researcher a faculty supervisor of any preceptor-based 5th-semester student. A list of participants was not kept, and the consent forms were not shared with anyone; the course professors were not told which students agreed to participate.

Data Management

The researcher assigned a number to each participant, which is how the student was identified on study instruments and the clinical workbook. As the research proceeded, the researcher analyzed data only by the student’s assigned number, to ensure privacy. The researcher did not keep a log of students and their assigned number; only the student knew their research number. Consent forms were stored in a secured site in the researcher’s office. Individual student scores on the SAM scale or data from any study instrument were not shared with the student’s professors or anyone else other than a statistician, and the data for analysis had no identifying information.

Limitations

An important limitation of this study was a small sample size. A decreasing cohort size that started with 64 students each during their 1st semester of nursing school had diminished to 36 5th-semester and 61 4th-semester students. When subtracting my own 4th-semester students from the pool of potential participants, there were 45 4th-semester students. Therefore, at the start of the semester, there were 81 potential participants. As the semester progressed, two students (who happened to be in the study and took the pretest), withdrew from their clinical courses. A total of 34 students (42% of potential participants) agreed to participate. It became
clear to the researcher that both 4th- and 5th-semester students were sensitive to time constraints from course requirements and wary of adding extra tasks that were not requirements of their courses.

Of the participants who took the pretest, 13 (94%) of 5th-semester students and 14 (70%) of 4th-semester students took the posttest. During the last week of the semester when the posttest was given, 4th-semester students were concerned with passing the didactic portion of the critical care course. Fifth-semester students noted they had one remaining exam after the posttest which was not one they were anxious about; they were much more relaxed and concerned with plans related to graduation.
CHAPTER FOUR:

RESULTS

The purpose of this quantitative study was to determine the effectiveness of teaching and learning strategies, such as preceptor-supervised clinical instruction and an educational intervention (clinical workbook), on the knowledge of safe medication administration of senior baccalaureate pre-licensure nursing students in their final 2 semesters of study. A related purpose was to determine the extent to which the clinical workbook was used and whether students perceived it as helpful. A third purpose of this study was to determine which available resources students perceived as most helpful in learning and applying safe medication administration knowledge. The research questions that guided this study are listed next.

**Question 1:** Which intervention, a preceptorship clinical, or a preceptorship plus use of a clinical workbook, is more effective in increasing participant’s SAM and Self-Confidence in Learning scores?

**Question 2:** Which intervention, a 72-hour critical care preceptorship plus use of a clinical workbook, or a 150-hour capstone preceptorship plus use of a clinical workbook, is more effective in increasing participant’s SAM and Self-Confidence in Learning scores across the two time periods (pre-intervention and post-intervention)?

**Question 3:** To what extent do pre-licensure senior baccalaureate nursing students find a clinical workbook helpful or useful in learning safe medication administration during preceptor-based clinical courses?
Question 4: What resources do pre-licensure baccalaureate nursing students use in today’s academic and clinical environment to increase safe medication administration knowledge?

This quantitative study used a pretest-posttest design with a control group to answer one research question and compared two intervention groups to answer another research question. This study was carried out in three phases over the length of 1 academic semester. At the beginning of the semester, students were recruited, provided consent, and took the pretest instruments in the First Phase. All students in the study were given the SAM workbook intervention to use in their usual preceptorships during the semester during the Second Phase. The Third Phase occurred during the final weeks of the semester, when participants had completed their preceptorships and took the posttest instruments. The First and Third Phases were carried out in the nursing building of the university of study. The Second Phase took place in the student’s assigned clinical facility, 1 of 10 acute care clinical facility partners contracted with the university for senior student preceptorships.

Data Management

Each SAM Scale test booklet from the pretest and the posttest was graded by the researcher. Each of the 70 test items were marked with a check mark for a correct response or an “X” for an incorrect response for clarity when entering data into the statistical software. The total number of correct responses was noted and the score marked on the test booklet.

Once data from the posttest instruments were obtained, data from the pretest and posttest were entered into SPSS software on the researcher’s office computer. A code book was created in order to manage pretest and posttest instruments from 4th- and 5th-semester students. Each student was assigned a number for SPSS input; this number was written on each of their study
instruments to ensure accuracy in data input. The code book also listed the values for each variable with levels in SPSS, such as gender on the demographic survey and use and rank of pharmacology resources on the SUPR instrument. Accuracy of data input was double checked by the researcher one-by-one, and SAM subscale input was rechecked by the statistician as well.

The researcher entered responses from the demographic survey, SAM Scale, and the SSSCL-SAM one-by-one into SPSS. Data from the SUPR Part 1 were also entered into SPSS one-by-one and coded according to whether the participant used and ranked the resource. SUPR Part 2 numerical responses to the Likert-type questions were entered into SPSS and all open-ended question responses written in a list of narrative responses for review.

**Demographic Data**

Demographic information was collected from study participants. During the pretest, participants were asked to fill out a simple, seven-question researcher-developed survey. The data collected consisted of age range, gender, race, and whether the student had a prior college degree, college algebra course, dosage calculation course, or prior hospital experience. The demographic data may assist with making meaning of the study results. The data were entered into SPSS.

Of the potential 81 senior baccalaureate nursing students, 34 agreed to participate in the study and took the pretest. The 14 5th-semester students who took the pretest served as the control group. Of the 34 original participants, only 27 completed the posttest, and of these, the 14 4th-semester students served as the experimental group. A sample size of 27 senior nursing students completed the study. The total study sample was 28, experimental group (n=14) and control group (n=14).
The total study sample participants were mostly female (85.1%), in their 20s (88.5%), and Caucasian (60.7%). One-fourth of the study sample had a prior college degree and 50% have had a prior college Algebra course. None of the nursing students in the study sample had a prior dosage calculation course. Prior hospital work experience was reported by 64.3% of the study sample. Descriptive data from the demographic data are found in Table 2.

Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control group (n=14)</th>
<th>Experimental group (n = 14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 – 29</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>30 – 39</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>40 – 49</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>50 – 59</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>Male</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>White</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Asian</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Biracial</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Prior degree</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>No</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Prior College Algebra</td>
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<td></td>
</tr>
<tr>
<td>Yes</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Prior Dosage Course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No</td>
<td>14</td>
<td>14</td>
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<tr>
<td>Prior Hospital Experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>
Data Analysis

For data analysis, parametric testing was carried out using independent $t$-tests and two-way repeated measures mixed-design analysis of variance (ANOVA) for the dependent variables safe administration of medication (SAM) knowledge and self-confidence in SAM. Data were entered into Statistical Product and Service Solutions (SPSS), version 24 by the researcher. Each participant’s SAM knowledge and self-confidence (SSSCL-SAM) scores were entered into SPSS by individual items and by subsets. The SAM Scale knowledge scores were grouped by rights: person, drug, dose, time, and route. The self-confidence scores were grouped by the subscales learning satisfaction and self-confidence.

The output from mixed design ANOVAs provide information about the main effects of the variables time (pretest to posttest) and semester (4th or 5th). Main effects data were obtained from the Tests of Within-Subjects Effects section of output (Cronk, 2016). The analysis also calculated the interaction between the variables time and semester. Interaction effects data was taken from the Tests of Between-Subjects Effects section of output (Cronk, 2016). Data from the Greenhouse-Geisser test were used.

Assumptions

Normality and outliers. To investigate data for the assumption of normality, pretest and posttest SAM and SSSCL-SAM scores were evaluated. The Kolmogrov-Smirnov test revealed the following findings for the SAM scores: pretest .013 and posttest .006. Kolmogrov-Smirnov findings for the pretest and posttest, respectively, on the SSSCL-SAM were .81 and .20 for the satisfaction in learning subscale and .159 and .002 for the self-confidence subscale. Normal Q-Q Plots and Box Plots of the above analyses were also evaluated. One possible outlier was noted for each of the 5th semester SAM and SSSCL-SAM self-confidence posttests. As a rule, scores
for independent-samples $t$-test need to be normally distributed; however, “the $t$ test is robust and can handle violations of the assumption of a normal distribution. The two samples should, however, have the same variance” (Cronk, 2016, p. 62).

**Homogeneity of intercorrelations.** The assumption of homogeneity of intercorrelations should be met when using a mixed between-within subjects analysis of variance (Pallant, 2013). Box’s M statistic can be used to check this assumption. A non-significant finding using an alpha level of .001 meets this assumption (Pallant, 2013). The Box’s M for pre- and posttest total SAM scores was $p = .247$. Box’s M for total SSSCL-SAM pretest/posttest scores was $p=.393$.

**Internal consistency.** One measure of the reliability of a scale is internal consistency, which can be determined by Cronbach’s alpha coefficient (Pallant, 2013). Both subscales, student satisfaction in learning (questions 1-5) and self-confidence (questions 6-13) of the Student Satisfaction and Self-Confidence in Learning Safe Medication Administration Scale (SSSCL-SAM) were checked for internal consistency. Cronbach’s alpha for the satisfaction in learning subscale pretest was .845 and for the posttest, .836. For the self-confidence subscale, Cronbach’s alpha was .818 for the pretest, and .855 for the posttest. Cronbach’s alpha for the SSSCL-SAM (total of both subscales, $n=13$) was .895.

**Descriptive Statistics**

An initial comparison of the SAM score pretest and posttest distribution of means revealed very similar means. To investigate for significance, a paired $t$-test with and without bootstrapping was checked using a 95% confidence level. The paired samples test showed $p = .385$ (df = 26, std dev 4.355) without bootstrapping and $p = .387$ with bootstrapping. Descriptives by semester level were investigated (see Table 3). Fourth semester student scores
went from a mean of 63.36 to 64.36 and interestingly, 5th semester scores went from 64.85 to 62.23.

Table 3

*Descriptive Statistics for (Total) SAM Scores*

<table>
<thead>
<tr>
<th>Semester</th>
<th>Mean</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th</td>
<td>63.36</td>
<td>2.590</td>
<td>14</td>
</tr>
<tr>
<td>5th</td>
<td>64.85</td>
<td>2.672</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>64.07</td>
<td>2.668</td>
<td>27</td>
</tr>
<tr>
<td>Posttest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th</td>
<td>64.36</td>
<td>2.437</td>
<td>14</td>
</tr>
<tr>
<td>5th</td>
<td>62.23</td>
<td>4.226</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>63.33</td>
<td>3.519</td>
<td>27</td>
</tr>
</tbody>
</table>

Note: SD = Standard deviation.

Descriptive statistics for SSSCL-SAM scores are found in Table 4. These scores reflect the total of both subscale scores. The first subscale, learning satisfaction, contained five Likert-type questions with at a highest possible score of 25 (greatest perceived satisfaction in learning). The second subscale, self-confidence, contained eight Likert-type questions with a highest possible score of 40 (greatest perceived level of self-confidence). Thus, the highest possible total score for the SSSCL-SAM was 65. A first look at these scores revealed higher pretest and posttest scores for 4th-semester students. Over time, 4th-semester scores increased and 5th-semester scores decreased.
Table 4

*Descriptive Statistics for Total SSSCL-SAM Scores*

<table>
<thead>
<tr>
<th>Semester</th>
<th>Mean</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th</td>
<td>56.50</td>
<td>7.684</td>
<td>14</td>
</tr>
<tr>
<td>5th</td>
<td>51.23</td>
<td>9.029</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>53.96</td>
<td>8.622</td>
<td>27</td>
</tr>
<tr>
<td>Posttest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th</td>
<td>59.21</td>
<td>4.807</td>
<td>14</td>
</tr>
<tr>
<td>5th</td>
<td>49.23</td>
<td>7.596</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>54.41</td>
<td>8.001</td>
<td>27</td>
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</tbody>
</table>

Note: SD = Standard deviation.

**Analysis of Research Questions**

**Question 1:** Which intervention, a preceptorship clinical, or a preceptorship plus use of a clinical workbook, is more effective in increasing participant’s SAM and Self-Confidence in Learning scores?

To answer the first research question, the knowledge and self-confidence scores of two groups of senior students following completion of a preceptor-based critical care clinical were compared. In this study, current 5th-semester students who completed their critical care clinical without a workbook during their 4th-semester, served as the control group. Current 4th-semester study participants completed their critical care clinical this semester with a workbook, and served as the experimental group. Thus, safe medication administration knowledge and self-confidence 5th-semester pretest scores were compared to 4th-semester posttest scores.

To compare means of the control and experimental groups, independent *t*-tests were measured. A separate independent *t*-test was carried out for each of the two dependent variables: safe administration of medication knowledge and self-confidence. Levene’s Test for Equality of
Variances revealed equal variances, failing to reject the null: .457 for SAM knowledge score independent $t$-test, and .054 for self-confidence (SSSCL- SAM total of both subscales) independent $t$-test. Results of both calculations are discussed below.

**Knowledge of Safe Administration of Medication**

The mean SAM score for the control group (n=14) was 64.50 (SD=2.876) compared to 64.36 (SD=2.437) for the experimental group (n=14), see Table 5. When an independent-samples $t$-test was calculated comparing SAM knowledge between these groups, no significance was found ($t(26) = -.142, p = .457$). The mean of the group using the SAM workbook did not vary significantly from the mean of the group who did not use the workbook.

Table 5

<table>
<thead>
<tr>
<th>Semester</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAM Score</td>
<td>4th</td>
<td>14</td>
<td>64.36</td>
<td>2.437</td>
</tr>
<tr>
<td></td>
<td>5th</td>
<td>14</td>
<td>64.50</td>
<td>2.876</td>
</tr>
</tbody>
</table>

Note: SD = Standard deviation.

**Learning Satisfaction and Self-confidence in Safe Administration of Medications**

The mean SSSCL-SAM (total of both subsets) score for the control group (n=14) was 51.14 (SD=8.681) compared to 59.21 (SD=4.807) for the experimental group (n=14), see Table 6. A borderline significant difference was found when an independent-samples $t$-test was calculated to compare the control and experimental SSSCL-SAM (total of both subsets) scores ($t(26) = 3.043, p = .054$). The mean of the experimental group using the SAM workbook just missed being significantly higher than the mean of the control group who attended critical care clinical without a workbook.
Table 6

Control and Experimental Group Statistics for Total SSSCL-SAM Scores

<table>
<thead>
<tr>
<th>Semester</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSSCL Score</td>
<td>4th</td>
<td>14</td>
<td>59.21</td>
<td>4.807</td>
</tr>
<tr>
<td></td>
<td>5th</td>
<td>14</td>
<td>51.14</td>
<td>8.681</td>
</tr>
</tbody>
</table>

Note: SD = Standard deviation.

Question 2: Which intervention, a 72-hour critical care preceptorship plus use of a clinical workbook, or a 150-hour capstone preceptorship plus use of a clinical workbook, is more effective in increasing participant’s SAM and Self-Confidence in Learning scores across the two time periods (pre-intervention and post-intervention)?

SAM Knowledge

Mixed design ANOVAs were used to analyze scores from the 70-item SAM Scale. Total SAM pretest and posttest scores were compared between 4th- and 5th-semester students. Fourth semester SAM scores increased over time from a mean of 63.36 to 64.36, while 5th semester mean scores declined over time from 64.85 to 62.23. Standard deviations for these data are shown in Table 3.

The SAM scores were further evaluated by subset. Additional mixed design ANOVAs were used to evaluate the 70 items of the SAM Scale according to the five subsets: right person (n=14), right drug (n=14), right time (n=14), right dose (n=14), and right route (n=14). Main effects and interaction effects were noted for each of the mixed design ANOVA analyses; Greenhouse-Geisser test was used for each.
Total SAM Scores

A 2 x 2 mixed design ANOVA was calculated to investigate the effects of the semester (4th and 5th) and time (pretest and posttest) related to total (70-item) SAM Scores, as noted in Table 7. The main effect for time or semester was not significant. A significant time x semester interaction was noted, as presented in Figure 1. Alone, the variable of time or semester did not influence student SAM knowledge; however, the interaction of time x semester did influence student SAM knowledge level.

Table 7
General Linear Model of Total SAM Scores

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>(1,25)</td>
<td>1.086</td>
<td>.307</td>
<td>.042</td>
</tr>
<tr>
<td>Interaction</td>
<td>(1,25)</td>
<td>5.438</td>
<td>.028</td>
<td>.179</td>
</tr>
<tr>
<td>Semester</td>
<td>(1,25)</td>
<td>.131</td>
<td>.721</td>
<td>.005</td>
</tr>
</tbody>
</table>

Note: Df= degrees of freedom; Sig. = Significance = < .05

Right Person Subscale

For the subset, Right Person, a 2 x 2 mixed design ANOVA was calculated to investigate the effects of the semester (4th and 5th) and time (pretest and posttest). As shown in Table 8, there were no significant main effects for time or semester, or significant interaction effect for time x semester. Student ability to identify whether a nurse gave a medication to the correct patient was not influenced by time or semester level of the student.
Figure 1. Time x semester interaction for SAM total (n = 70 item) scores. Legend. Time 1 = Pretest. Time 2 = Posttest.

Table 8

General Linear Model of SAM Subscale: Right Person

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>(1,25)</td>
<td>.391</td>
<td>.537</td>
<td>.015</td>
</tr>
<tr>
<td>Interaction</td>
<td>(1,25)</td>
<td>.391</td>
<td>.537</td>
<td>.015</td>
</tr>
<tr>
<td>Semester</td>
<td>(1,25)</td>
<td>.246</td>
<td>.624</td>
<td>.010</td>
</tr>
</tbody>
</table>

Note: Df = degrees of freedom; Sig. = Significance = < .05

Right Drug Subscale

For the subset, Right Drug, a 2 x 2 mixed design ANOVA was calculated to investigate the effects of the semester (4th and 5th) and time (pretest and posttest). Results are provided in
Table 9. No significant main effect or interactions were discovered. Student ability to identify whether the right drug was administered was not influenced by time or semester level.

Table 9

*General Linear Model of SAM Subscale: Right Drug*

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>(1,25)</td>
<td>.681</td>
<td>.417</td>
<td>.027</td>
</tr>
<tr>
<td>Interaction</td>
<td>(1,25)</td>
<td>2.056</td>
<td>.164</td>
<td>.076</td>
</tr>
<tr>
<td>Semester</td>
<td>(1,25)</td>
<td>.119</td>
<td>.733</td>
<td>.005</td>
</tr>
</tbody>
</table>

Note: Df= degrees of freedom; Sig. = Significance = < .05

**Right Dose Subscale**

Table 10 provides the results of the 2 x 2 mixed design ANOVA calculated for the subset Right Dose. Neither a main effect or time x semester interaction was found to be significant. The student’s ability to identify whether a right dose of medication was given was not influenced by time or semester.

Table 10

*General Linear Model of SAM Subscale: Right Dose*

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>(1,25)</td>
<td>1.149</td>
<td>.294</td>
<td>.044</td>
</tr>
<tr>
<td>Interaction</td>
<td>(1,25)</td>
<td>2.043</td>
<td>.165</td>
<td>.076</td>
</tr>
<tr>
<td>Semester</td>
<td>(1,25)</td>
<td>.000</td>
<td>.991</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note: Df= degrees of freedom; Sig. = Significance = < .05

**Right Time Subscale**

The 2 x 2 mixed ANOVA analysis of the Right Time SAM subset is found in Table 11. Descriptive statistics for this data set are presented in Table 12. The main effect for semester was
not significant. The main effect for time was significant. As presented in Figure 2, a significant time x semester interaction was discovered. Student ability to identify whether a medication was administered by a nurse at the correct time was influenced by time (pretest to posttest) and the time by semester interaction.

Table 11

*General Linear Model of SAM Subscale: Right Time*

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>(1,25)</td>
<td>6.488</td>
<td>.017</td>
<td>.206</td>
</tr>
<tr>
<td>Interaction</td>
<td>(1,25)</td>
<td>8.074</td>
<td>.009</td>
<td>.244</td>
</tr>
<tr>
<td>Semester</td>
<td>(1,25)</td>
<td>.366</td>
<td>.551</td>
<td>.014</td>
</tr>
</tbody>
</table>

Note: Df= degrees of freedom; Sig. = Significance = < .05

Table 12

*Descriptive Statistics for SAM Subscale: Right Time*

<table>
<thead>
<tr>
<th>Semester</th>
<th>Mean</th>
<th>SD</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time_pre</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>12.43</td>
<td>1.089</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>12.92</td>
<td>.494</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>12.67</td>
<td>.877</td>
<td>27</td>
</tr>
<tr>
<td>Time_post</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>12.50</td>
<td>.855</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>11.62</td>
<td>1.502</td>
<td>27</td>
</tr>
</tbody>
</table>

Note: SD = Standard deviation.
Figure 2. Time x semester interaction for SAM right time subscale scores.
Legend. Time 1 = Pretest. Time 2 = Posttest.

Right Route Subscale

The results of a 2 x 2 mixed design ANOVA calculated for the SAM Subset Right Route are provided in Table 13. No significant main effects were noted. There were no significant interactions noted. Student ability to identify whether a drug was administered at the right time was not influenced by time or semester level.

Student Satisfaction and Self-confidence in SAM Learning

Studies in the literature have reported data from the original SSSCL as total scores (Zapko, Ferranto, Blasiman, & Shelestak, 2018) and as subscale scores (Lubbers & Rossman, 2017). The current study will provide data from both total and subscale scores. The SSSCL-SAM
Table 13

*General Linear Model of SAM Subscale: Right Route*

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>(1,25)</td>
<td>2.273</td>
<td>.144</td>
<td>.083</td>
</tr>
<tr>
<td>Interaction</td>
<td>(1,25)</td>
<td>.061</td>
<td>.807</td>
<td>.002</td>
</tr>
<tr>
<td>Semester</td>
<td>(1,25)</td>
<td>.073</td>
<td>.789</td>
<td>.003</td>
</tr>
</tbody>
</table>

Note: Df = degrees of freedom; Sig. = Significance = < .05

Findings were 4th semester (n=14) mean scores increased from 56.50 (SD=7.684) pretest to 59.21 (SD=4.807) posttest, while the 5th semester (n=13) mean dropped from 51.23 (SD=9.029) to 49.23 (SD=7.596), pretest to posttest. Findings from a 2 x 2 mixed-design ANOVA calculated for the SSSCL-SAM total scores are presented in Table 14. The time x semester interaction was not significant. The main effect for time was not significant. The main effect for semester was significant (p = .002) with a small effect size (partial eta squared = .336). The student’s overall satisfaction in learning and self-confidence in safe administration of medications was influenced by semester level, but not by time or the interaction of time x semester.

Table 14

*General Linear Model of Total (n=13) SSSCL-SAM Scores*

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>(1,25)</td>
<td>.036</td>
<td>.851</td>
<td>.001</td>
</tr>
<tr>
<td>Interaction</td>
<td>(1,25)</td>
<td>1.578</td>
<td>.221</td>
<td>.059</td>
</tr>
<tr>
<td>Semester</td>
<td>(1,25)</td>
<td>12.630</td>
<td>.002</td>
<td>.336</td>
</tr>
</tbody>
</table>

Note: Df = degrees of freedom; Sig. = Significance = < .05
Student Satisfaction SSSCL-SAM Learning Subscale

SSSCL-SAM scores were further evaluated by subscales: 4th semester (n=14) SSSCL-SAM satisfaction in learning scores decreased over time from a mean of 23.21 (SD=2.359) to 22.36 (SD=2.240), while 5th semester (n=13) mean scores slightly increased over time from 18.46 (4.409) to 18.69 (3.326). A 2 x 2 mixed-design ANOVA was calculated for each subset with results for student satisfaction in SAM learning found in Table 15. No significant main effect or interaction was noted for time or the interaction between time x semester for the learning satisfaction subscale. There was a significant main effect for semester, with a medium effect size (partial eta squared = .503). Student learning satisfaction was influenced by semester level, but not by time or the interaction of time x semester.

Table 15

| General Linear Model of Learning Satisfaction (n=5) SSSCL-SAM Subscale |
|--------------------------|----------|--------|------------------|
|                          | Df      | F      | Sig.             | Partial Eta Squared |
| Time                    | (1,25)  | .123   | .728             | .005                |
| Interaction             | (1,25)  | .372   | .547             | .015                |
| Semester                | (1,25)  | 25.345 | <.001            | .503                |

Note: Df= degrees of freedom; Sig. = Significance = < .05

Self-confidence in SAM Subscale

For the SSSCL-SAM self-confidence subscale, 4th semester scores increased over time from 33.29 (SD=6.232) to 36.86 (SD=3.159), while 5th semester scores declined from 32.77 (SD=5.644) to 30.54 (SD=5.681). Table 16 presents the results of the 2 x 2 mixed-design ANOVA for the self-confidence subscale. Analysis of the self-confidence subscale showed a
significant time x semester interaction (p=.029, small effect size), but no main effects for time or semester.

Table 16

*General Linear Model of Self-confidence (n=8) SSSCL-SAM Subscale*

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>(1,25)</td>
<td>.286</td>
<td>.597</td>
<td>.011</td>
</tr>
<tr>
<td>Interaction</td>
<td>(1,25)</td>
<td>5.364</td>
<td>.029</td>
<td>.177</td>
</tr>
<tr>
<td>Semester</td>
<td>(1,25)</td>
<td>4.498</td>
<td>.44</td>
<td>.152</td>
</tr>
</tbody>
</table>

Note: Df= degrees of freedom; Sig. = Significance = < .05

**Question 3:** To what extent do pre-licensure senior baccalaureate nursing students find a clinical workbook helpful or useful in learning safe medication administration during preceptor-based clinical courses?

This study sought to find out whether the SAM workbook in preceptorships affected student knowledge and self-confidence. The researcher was also interested in student feedback regarding use and perceived helpfulness of the printed clinical workbook. To gather this student input, a Part 2 section to the researcher-developed tool, Student Use of Pharmacology Resources (SUPR), was added. The SUPR instrument is located in Appendix C. Part 2 of the SUPR is discussed here in response to Research Question 3. An analysis of Part 1 of the SUPR answers Research Question 4 and follows this section.

**Helpfulness of Workbook**

Part 2 of the SUPR instrument is comprised of four questions, the first two are Likert-type scales and the last two are open-ended questions. The first Likert-type question is On a scale of 0 (not helpful) to 10 (very helpful), how was the workbook helpful or useful in learning safe
medication knowledge in clinical? The data are presented in Table 17. Of the students responding to this question, 16.7% (n=4) found the workbook not helpful. Seven students (29.1% of respondents) rated the workbook between 4 and 7 on the scale, and 54.2% (n=13) rated the workbook between 8 and 10 on the scale, 29.2% (n=7), giving the highest score of 10 (very helpful).

Table 17

Perceived Helpfulness of SAM Workbook–SUPR Survey Part 2, Question 1

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not helpful (0)</td>
<td>4</td>
<td>11.8</td>
<td>16.7</td>
<td>16.7</td>
</tr>
<tr>
<td>Response (1)</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response (2)</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response (3)</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response (4)</td>
<td>2</td>
<td>5.9</td>
<td>8.3</td>
<td>25.0</td>
</tr>
<tr>
<td>Response (5)</td>
<td>2</td>
<td>5.9</td>
<td>8.3</td>
<td>33.3</td>
</tr>
<tr>
<td>Response (6)</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response (7)</td>
<td>3</td>
<td>8.8</td>
<td>12.5</td>
<td>45.8</td>
</tr>
<tr>
<td>Response (8)</td>
<td>4</td>
<td>11.8</td>
<td>16.7</td>
<td>62.5</td>
</tr>
<tr>
<td>Response (9)</td>
<td>2</td>
<td>5.9</td>
<td>8.3</td>
<td>70.8</td>
</tr>
<tr>
<td>Very helpful (10)</td>
<td>7</td>
<td>20.6</td>
<td>29.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>70.6</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Use of Workbook

The second Likert-type question was How many times during your clinical rotation did you use the workbook? Students were asked to mark 0 (did not use) to 10 (used 10 or more
times). The results of this analysis are reported in Table 18. Seven (29.2%) of respondents reported they did not use the workbook during their preceptorship. Eight students (33.4%) reported using the workbook three times (n=4) or four times (n=4). The workbook was used in clinical six times (n=1), seven times (n=1), eight times (n=1), and 10 or more times (n=2) by students responding to this question; thus, 20.9% of students used the workbook 6 or more times during their clinical rotation. Overall, the workbook was used at least once by 70.8% of students who responded to this question.

Table 18

*Perceived Usefulness of SAM Workbook–SUPR Survey Part 2, Question 2*

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did not use</td>
<td>7</td>
<td>20.6</td>
<td>29.2</td>
<td>29.2</td>
</tr>
<tr>
<td>Used 1 time</td>
<td>1</td>
<td>2.9</td>
<td>4.2</td>
<td>33.3</td>
</tr>
<tr>
<td>Used 2 times</td>
<td>3</td>
<td>8.8</td>
<td>12.5</td>
<td>45.8</td>
</tr>
<tr>
<td>Used 3 times</td>
<td>4</td>
<td>11.8</td>
<td>16.7</td>
<td>62.5</td>
</tr>
<tr>
<td>Used 4 times</td>
<td>4</td>
<td>11.8</td>
<td>16.7</td>
<td>79.2</td>
</tr>
<tr>
<td>Used 5 times</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used 6 times</td>
<td>1</td>
<td>2.9</td>
<td>4.2</td>
<td>83.3</td>
</tr>
<tr>
<td>Used 7 times</td>
<td>1</td>
<td>2.9</td>
<td>4.2</td>
<td>87.5</td>
</tr>
<tr>
<td>Used 8 times</td>
<td>1</td>
<td>2.9</td>
<td>4.2</td>
<td>91.7</td>
</tr>
<tr>
<td>Used 9 times</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used 10+ times</td>
<td>2</td>
<td>5.9</td>
<td>8.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>70.6</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
A visual inspection of workbooks revealed a wide range of actual use of the workbook. Students were instructed to bring the workbook to the posttest in the initial research information, were reminded by email via the clinical coordinator of the fourth and fifth semester clinical courses, and by word of mouth reminders from the researcher. Only nine students (33% of those who took the posttest) remembered to bring their workbooks for inspection during the posttest.

At the end of the posttest, the workbooks were returned to students. A list of the pages of activities used in the workbook, by individual student, is located in Table 19. Of the 59 pages in the workbook, 35 pages were counted as having interactive activities for student use. A percentage of the 35 activity pages worked is also provided in the Table 19.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Pages of Activities Worked</th>
<th>Percentage of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>4</td>
<td>6-34, 38-44</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>6,7,9-14, 16-17, 19-20, 24-27, 31-34, 38, 40-42</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>6-7, 10-11,22, 24-26, 40</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>6-7, 9-14, 16-17, 19-20, 22-23, 25-28, 31-35, 38, 40-42, 44</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>6-7, 9, 11-16</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>6-7, 11-12, 14, 16, 17, 20, 22-28,33-34</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

Helpfulness of Workbook for SAM Knowledge

To gather original student opinions on perceived helpfulness of the workbook, two open-ended questions were included on Part 2 of the SUPR instrument. The first open-ended question asked In your own words, how was the workbook helpful or not helpful in gaining safe medication knowledge? A sampling of direct quotes from 4th- and 5th-semester students follow.
A 5th-semester student noted the workbook “[h]elped reinforce what I already knew.” One stated, “Greatly organized. Very helpful resource,” and another, “Helpful → case studies. Not helpful → many different preceptors who I felt that I annoyed.” Another 5th-semester student wrote, “It was helpful, just hard to use during clinical (as far as asking preceptor questions).”

Fourth-semester student comments were similar and ranged from, “I was not able to use it” to “It was convenient. I didn’t have to search the internet because I had the book.” Other 4th semester responses were, “It emphasized what we are taught in class and how to apply in clinical” and “It was very helpful, I just wish I had more opportunities to use it.” Another wrote:

The workbook was great at reminding me all of the guidelines for SAM. I especially like that there were areas in which you could practice with your preceptor. Also, having the answers in the back really helped as a “quiz” factor, to really test my knowledge and gain a sense of how safe a nurse I could be.

Helpfulness of Workbook on SAM Self-confidence

The second open-ended question of the SUPR instrument, Part 2 asked, In your own words, how was the workbook helpful or not helpful in gaining self-confidence in the administration of medications? Responses from 5th-semester students were both positive and negative, as noted in these examples: “Confirmed what I knew was right!” and “Forgot to use, but looked helpful.” Most student respondents revealed the workbook did provide them help: “It did help me gain self-confidence because after I reviewed it I felt competent when my preceptor asked me a question and I know the answer” and “It helped me see that I could recall information quickly and helped with confidence during the shift.”

Fourth-semester respondents provided the following examples of positive comments: “The workbook just got me thinking more about safe medication administration” and “It gave me knowledge I didn’t know before I had it so that was helpful in growing my self-confidence.” One student noted, “I gained a lot of self-confidence in the administration of medications. The
scenarios were very vital,” while one stated, “Looking through it, I felt like I knew more than I thought I did.” Another responded with

It helped me gain self-confidence because, I feel that after I review all of the material it offers, I will be very prepared to go into the workforce. Of course, this would be supplemental to my knowledge of 5 semesters’ worth of nursing school. It is a very nice workbook to have as a reminder of good practice.

In summary, the general consensus from student responses was that the workbook was helpful, most felt in reviewing prior acquired information, though some gained new information from the resource. A perceived increase in self-confidence in SAM after use of the workbook was reported. There was a wide range of level of student/preceptor use of the workbook reported.

**Question 4.** What resources do pre-licensure baccalaureate nursing students use in today’s academic and clinical environment to increase safe medication administration knowledge?

The 4th- and 5th-semester students in this study had the same pharmacology professor during their 2nd semester of nursing school. Students purchased a medication book, sometimes referred to as a drug guide, in their 2nd semester. They were required to purchase the same textbooks and course resources in subsequent didactic and clinical courses in the curriculum (no changes in faculty have been made since their 2nd semester). Each student was required to look up medication information for their assigned patients in 2nd semester (Fundamentals), 3rd semester (medical-surgical and obstetrics), and in 4th semester (critical care and pediatrics). Fifth-semester students would also be required to look up medications for their assigned patients.

To understand which resources students reportedly have used, frequencies and percentages of student use of the 18 resources investigated in the checklist-style tool, Student Use of Pharmacology Resource (SUPR), Part 1, were calculated. These data are reported in Appendices I and J. Students were asked to identify on the SUPR checklist which required and non-required resources they have used in nursing school to assist them in learning safe
medication administration. Additionally, they were asked to rank first, second, and third which were most helpful. Appendix I presents data from reported use of required pharmacology resources, while Appendix J presents data from Student Use of (Non-required) Pharmacology Resources.

**Required Resources**

For required pharmacology resources, senior pre-licensure baccalaureate nursing students reported the most use of drug/medication book (n=25), simulation lab (n=18), homemade flash cards (n=13), NCLEX practice questions (n=13), and concept mapping (n=10). The resources most often ranked first (most useful) were drug/medication book (n = 8) and homemade flash cards (n=6). Resources most often ranked second most helpful were NCLEX practice questions (n=5) and drug/medication book (n=4). Concept mapping (n=3) and drug/medication book (n=2) were most often ranked third most useful required pharmacology resource.

**Non-required Resources**

Of the pharmacology resources not required for a nursing course, students reported the most use of homemade flash cards (n=18), study groups (n=17), other (not specifically nursing) websites (n= 14), NCLEX practice questions (n=14), and nursing web sites (n=13). The non-required pharmacology resource most often ranked first (most useful) was study groups (n=4). NCLEX practice questions were most often ranked second most helpful (n=5), while acronyms/ mnemonics (n=3) and study groups (n=3) were most often ranked third most helpful.

**Chapter Summary**

To investigate each of this study’s four research questions, data were analyzed and results reported in this chapter. Question 1 analysis revealed the mean of the experimental group’s SAM knowledge scores using the SAM workbook did not vary significantly from the mean of the
control group’s SAM knowledge who did not use the workbook. The mean of the experimental group’s SSSCL-SAM (total) self-confidence scores using the SAM workbook was found to be significantly higher ($p = .05$) than the mean of the control group’s SSSCL-SAM (total) self-confidence scores who attended critical care clinical without a workbook.

Question 2 results revealed a significant time x semester interaction when 4th and 5th semester total SAM scores were compared; 4th semester posttest scores were higher than 5th semester posttest scores. An analysis of the SAM Scale divided by the five medication right subscales showed no significant difference in means for Right Person, Right Drug, Right Dose, or Right Route. A significant time x semester interaction and main effect for time (pretest to posttest) was discovered for the subscale Right Time. Fourth semester scores increased over time while 5th semester Right Time knowledge scores decreased over time.

When 4th and 5th semester SSSCL-SAM (total) scores were compared, a significant main effect for semester with a small effect size was found; 4th semester scores were higher than 5th semester scores. When comparing SSSCL-SAM subscales, a significant main effect for semester on learning satisfaction was noted with a medium effect size: 4th semester scores were higher than 5th semester scores. Analysis of the SSSCL-SAM self-confidence subscale revealed a significant time x semester interaction with a small effect; 4th semester scores were higher and increased over time while 5th semester scores decreased over time.

Analysis of data to answer Research Question 3 revealed that the majority of students found the workbook helpful. The majority of students used the workbook during their clinical. There was a wide range of amount of reported workbook helpfulness and use. A common theme reported in narrative form was that the workbook was helpful and reinforced their SAM knowledge. However, several students found it inconvenient or cumbersome to use during
clinical. The majority of students reported increased perceived self-confidence after using the workbook.

Data to answer Research Question 4 showed that all 18 of the pharmacology resources listed on the checklist were used by at least one senior nursing student participant. The resources required (for a course) most often ranked first (most useful) were drug/medication book and homemade flash cards. Pharmacology resources not required for a course that were most often ranked first (most useful) were homemade flashcards and study groups. Caution should be used in interpreting or generalizing the results of this study since the sample size was small and, in most analyses, the effect size was small.
CHAPTER FIVE:
DISCUSSION

The purpose of this quasi-experimental pretest-posttest study was to determine the effectiveness of preceptor-supervised clinical instruction and an educational intervention (clinical workbook) on the knowledge of and level of self-confidence related to safe medication administration of senior baccalaureate pre-licensure nursing students in their final 2 semesters of study. A related purpose was to determine the extent to which the clinical workbook would be used and whether students perceived it as helpful. A third purpose of this study was to determine which currently available resources students perceived as most helpful in learning and applying safe medication administration knowledge. This chapter includes an overview of data findings, the findings in relation to existing research and theory, and a discussion of limitations. Recommendations for future research and application of findings are also discussed in this chapter.

Overview of Findings

Research Question 1

Findings will be reviewed in relation to each of the Research Questions. The first Research Question sought to determine which teaching/learning strategy was most effective in increasing scores on the knowledge (SAM Scale) and self-confidence (SSSCL-SAM) instruments used in the study. The intervention of a preceptorship critical care clinical with use of the researcher-developed safe administration of medication workbook did not increase the experimental group’s SAM Scale knowledge scores above scores of the control group who
attended critical care clinical without the workbook. A significant difference in group means was found, however, in level of perceived learning satisfaction and self-confidence (SSSCL-SAM total scores) in safe medication administration by students in the experimental group, who had access to the workbook during their critical care clinical preceptorship.

**Research Question 2**

The second Research Question sought to determine whether a 4th semester critical care clinical (with the workbook) or a 5th semester Capstone clinical (with the workbook), with approximately double the clinical hours, would increase student knowledge (SAM Scale) and self-confidence (SSSCL-SAM) scores. The following discussion of results will provide argument that the 4th semester critical care clinical with use of the workbook was more effective. A significant interaction was found between time and semester; pretest to posttest SAM Scale scores were influenced by the semester level of the student. Interestingly, 4th semester posttest scores were higher than 5th semester posttest scores.

When SAM Scale scores were further analyzed by subscales of the five rights of medication administration safety, a significant main effect of time was found for only one subscale: Right Time. Scores for this subscale were influenced pretest to posttest. Also, a significant interaction for time x semester was found. Scores for the Right Time subscale were influenced by the interaction of pretest to posttest and the semester level of the student. Fourth semester scores increased from pretest to posttest while 5th semester scores decreased.

The SSSCL-SAM instrument is comprised of two subscales related to safe medication administration: learning satisfaction and self-confidence. When 4th and 5th semester total (of both subscales) SSSCL-SAM scores were compared, a significant main effect for semester was
found: total scores were influenced by the semester level of the student. Fourth semester pretest and posttest total scores were higher than 5th semester scores.

For the subscale, learning satisfaction, a significant main effect for semester was found. Fourth semester learning satisfaction scores slightly decreased over time, and the 5th semester scores slightly increased over time. Fourth semester pretest and posttest scores were both higher than 5th semester scores for learning satisfaction.

A significant time x semester interaction was found for the self-confidence subscale. Fourth semester pretest and posttest self-confidence scores were higher than 5th semester pretest and posttest scores. Fourth semester scores trended up over time while 5th semester scores trended down over time. Student perceived self-confidence was influenced by the interaction of time and semester level.

Research Question 3

Research Question 3 sought to find out whether senior nursing students would find a workbook helpful or useful in learning safe medication administration during their preceptorship. The majority of study participants did use the workbook during their preceptor-based clinical. There was a wide range of level of workbook use reported by students. The majority of students responded that the workbook was helpful and reinforced SAM knowledge during their preceptorship. Perceived self-confidence increased after using the workbook for the majority of students according to narrative responses.

Research Question 4

Research Question 4 sought to explore which pharmacology resources current nursing students have used to increase safe medication administration knowledge. Required medication books (also referred to as drug guides, medication books, or drug books) and homemade flash
cards were most helpful to students. Of the pharmacology resources not required by a course, students reported homemade flash cards and study groups as most helpful in increasing safe medication knowledge.

**Findings in Relation to Existing Research**

Much has been written in the nursing education literature about medication administration safety. Many nursing studies evaluate student ability to give the right dose of medication. As important as the medication administration process is to patient safety, it was surprising to discover that there are very few tested instruments to measure a more comprehensive look at all five traditional rights of safe medication administration. This study adds to the literature by evaluating student knowledge and self-confidence of the five rights of medication administration knowledge in the context of the increasingly common teaching strategy of preceptorships. This study presented data that connected use of a SAM workbook with increased student self-confidence in SAM knowledge. Third, data from this study suggest that a critical care preceptorship with approximately half of the clinical hours of a capstone preceptorship was more effective increasing SAM knowledge and self-confidence than the capstone preceptorship.

**Research Questions 1 and 3**

A Safe Medication Administration (SAM) Workbook was developed, using a cognitive learning theory framework, as an intervention for this study. The workbook contained realistic, acute care case studies, resource information from the literature, and collaborative activities intended for use with clinical expert preceptors in carrying out SAM and error avoidance. The comparison explored in Research Question 1 was whether the SAM workbook made a significant difference in student SAM knowledge or self-confidence in SAM. Research Question
3 explored student perceptions of the usefulness and helpfulness of the workbook on SAM knowledge and self-confidence. Results from this study suggest student SAM learning satisfaction and self-confidence in SAM significantly increased, but SAM knowledge for students after use of the workbook did not significantly increase.

Very few studies measuring outcomes of nursing workbooks were found in recent nursing literature, and only one of those involved undergraduate nursing students. A workbook used in teaching information literacy to undergraduate nursing students received “positive verbal feedback” (Ryba & Pledger, 2016, p. 435). However, neither the workbook, nor knowledge testing after workbook use, were formally evaluated. Another undergraduate study compared the teaching strategies of print workbooks to electronic workbooks for a sample of 134 freshman seminar students (Gutierrez & Wang, 2001). Students preferred the electronic workbook. When evaluated, however, student performance was not significantly better (p>.05) for those using the electronic workbook than those using the print workbook (Gutierrez & Wang, 2001).

The results of this study are consistent with Bayne and Bindler (1997), who compared the effectiveness of different teaching strategies (classroom instruction, computer-assisted instruction, and a workbook) in a pretest-posttest control group study of registered nurses. In this study, as in Bayne and Bindler’s, the workbook group did not have higher test scores on the workbook content. Test scores for the classroom instruction group improved most. Nurses were most satisfied with the workbook teaching strategy; however, this did not correlate with improved test scores (Bayne & Bindler, 1997).

In contrast to this study, self-confidence (in providing bereavement care) among student midwives decreased after use of a workbook (Martin, Robb, & Forrest, 2016). There is a study that suggested improvement in student SAM knowledge post intervention; however, the teaching
strategy tested was a simulation and not a workbook. Unlike this study, a significant change in SAM Scale group means over time (pretest to posttest) was reported for an experimental group of undergraduate nursing students who received the teaching strategy of a medication administration simulation refresher course (Guntalib, 2015).

A portfolio workbook for graduate nursing students was developed as a student-centered educational strategy to integrate theory and clinical learning, reflective practice, as well as evaluate student progress (Jasper, 1995). Students found the workbook “easy to use, logical in format, and central to the management of their learning” (Jasper, 1995, p. 450), indicating learning satisfaction with this teaching strategy. The value of the workbook, according to Jasper (1995), was not the end product, but rather the process, and the “sufficiency of the knowledge base is tested via an examination” (p. 450). Exam scores on workbook content, unfortunately, were not reported by the author, and cannot be compared to results in this study.

Nursing preceptors reportedly found a workbook to be useful. A quick reference preceptorship training handbook was reportedly useful to 100% of preceptors of senior nursing students (Staykova et al., 2013, p. e32). In contrast, multiple students in this study reported their preceptors did not have time to utilize the SAM workbook. The researcher of the current study made a follow-up visit to one clinical facility on February 27, 2018, and spoke with a preceptor who had worked with students who took the workbook to clinical. The critical care preceptor reported use of the workbook with one student, but not the other, commenting they had “very little time to spend on the workbook.” She stated one student was confused about having to get a permission form signed related to the study; however, all student participants signed study consent prior to the clinical and the only permission form for the preceptor was the preceptor-university-healthcare facility contract.
Research Question 2

The fourth semester critical care preceptorship with use of the SAM workbook proved more effective than the 5th semester capstone preceptorship with SAM workbook in increasing senior nursing student SAM knowledge, SAM learning satisfaction, and self-confidence in SAM (which also increased pretest to posttest). The literature review in this study provided insight into the challenges and rewards of nursing preceptors and preceptorships, though many sources reviewed were not course specific. A source did note, in relation to training preceptors, that critical care nurses requested knowledge on teaching critical thinking as part of preparing for the preceptor role (Rogan, 2009).

In making sense of why the 4th-semester students had higher gains than 5th-semester students, a potential factor will be identified and discussed. Both student groups had preceptors. Preceptors aide students in linking the student’s existing knowledge with the culture and practices of the health care environment and profession, which allows the student to adapt their, according to Vygotsy, “knowledge-in-use and potential knowledge-for-use” (Hedegaard, 1996, in Spouse, 1998, p. 263). Ongoing situation coaching is necessary in order for students to understand the “changing relevance, and demands, resources, and constraints in a particular situation” (Benner et al., 2010, p. 83).

Why would students gain more SAM knowledge, learning satisfaction, and self-confidence in SAM in a 72-hour critical care clinical than in a 150-hour capstone clinical? One potential factor could involve the number of preceptors students work with in each of these preceptorships. Ordinarily, students in the critical care preceptorship have one, occasionally two or more preceptors during the rotation. Critical care students attend clinical on the days (or nights) their preceptor is assigned to work according to the hospital unit’s schedule. On the other
hand, it is not uncommon for students in the capstone clinical to have numerous preceptors during that rotation in which they are assigned to a clinical unit, typically not to one preceptor. Therefore, the capstone student arrives at the designated unit on their clinical day each week, and is precepted by an RN, who depending on which RNs are scheduled to work that day, may or may not be one they have worked with before. According to the capstone clinical coordinator, students in 5th semester work with an average of five preceptors during their preceptorship.

Preceptors need to excel at questioning students and encouraging reflection to increase student critical thinking and solving of problems that arise during practice (Rodriquez-Garcia, Medina-Moya, Gonzalez-Pasqual, & Cardenete-Reyes, 2018). The educational process must provide students the necessary knowledge and standards to help decrease medication errors in clinical practice (Papastrat & Wallace, 2003). It was anticipated that student use of the workbook would increase preceptor coaching and assist the student to develop clinical reasoning with regards to medication administration safety. This would present a challenge if the student worked with multiple preceptors.

As far as learning satisfaction in preceptorships, a “welcoming and affirming” culture on the clinical unit (Doyle et al., 2017, p. 30) has been identified as the most significant influential factor. Another study found participation to be the highest predictor for student satisfaction in the context of a clinical setting (Papathanasiou, Tsaras, & Sarafis, 2014). Students in preceptorships have reported “greater confidence, more meaningful feedback about their performance, decreased stress, and an increased ability to identify weaknesses, seek assistance, and reflect upon their nursing practice” (Kalischuk et al., 2013, p. 30). It is possible that 4th-semester students who worked primarily with one preceptor experienced greater learning satisfaction and meaningful feedback than 5th-semester students who worked with multiple preceptors (some
capstone students in the study had a different preceptor each clinical day). Another possible factor may have been that 4th semester students were focused on critical care nursing, while capstone students had broader course objectives in that synthesis course.

**Research Question 4**

It has been suggested that further investigation into which nursing education teaching and learning strategies are effective for pharmacology instruction, using a variety of research methodologies is needed (Sulosaari et al., 2015) is needed (Dilles et al., 2011; Sulosaari et al., 2015). Furthermore, it has been noted that a “lack of opportunities and preceptor direction in the clinical context are still barriers to fuller integration and consolidation of pharmacology knowledge” (Honey & Lim, 2008). This study has attempted to contribute to the body of knowledge related to teaching and learning strategies that impact SAM knowledge. Research Question 4 surveyed senior nursing students for their perceptions of which teaching and learning resources they found most helpful in gaining SAM.

Data from the SUPR survey revealed agreement with some recent studies. The most highly rated pharmacology resources by students in the study were medication/drug books, homemade flash cards, and study groups. Hanson (2016) stated that improved pharmacology instruction has incorporated active teaching and learning strategies. Interacting with the medication information by transcribing it onto flash cards and using this to quiz ones’ self to learn medication information could be considered a type of active learning. Certainly, interacting with other students in study groups would be an active strategy. Other pharmacology resource choices listed on the SUPR that were active learning strategies, however, were not top-rated by students: simulation lab, pharmacology software or games, and Quizlet are examples.
Data analysis of the SUPR revealed that the resources students found most helpful were basically low-technological resources. This is in contrast to trends in nursing education to incorporate a growing list of often expensive, technological teaching strategies. Admittedly, the data from this Research Question concern student perceptions about useful resources, which were not directly linked with data from academic learning outcomes. A review of recent nursing literature found that incorporation of technology into nursing pharmacological instruction generally yields increased student retention and application of pharmacology knowledge (Devi et al., 2010; Thompson & Bonnel, 2008).

**Implications for Theory**

The cognitive learning theories of constructivism, social constructivism, and situated cognition informed the development of this study. The sociocultural view of learning espoused by Vygotsky held that a student’s development cannot be separated from his/her social experiences (Jaramillo, 1996). Similarly, learning in context involves more than the physical place where learning takes place, but also involves the social interaction between the student and teacher, the demonstration of the tools of the trade and how to solve practice problems (Brown et al., 1989). This framework is in line with current literature by nursing education leaders: “Teaching strategies, such as situated cognition and thinking in action, are essential in classrooms, simulation laboratories, and clinical settings” (Benner et al., 2010, p. 31).

This researcher was interested in how student SAM knowledge and self-confidence were affected by the teaching strategies evaluated. As a link between knowledge and action, self-efficacy can be described as an “operative competence,” an integration of not only cognitive, but social and behavioral skills to manage one’s changing situation (Bandura, 1982, p. 122). Relatedly, a person’s self-perceptions act as “cognitive mediators” of action (Bandura, 1982, p.
When people lack confidence in their ability to sufficiently control their actions, they often weaken their efforts in situations they perceive as beyond their capabilities (Bandura, 1982); this could have patient safety implications with nursing students administering medications. As an example, a correlation between self-efficacy, mathematical ability, and performance on dosage calculation ability has been noted (Cloete, 2015). When students have increased self-confidence in their skill ability, the likelihood of understanding the skills as important and implementing them into their nursing care increases (Clark et al., 2004). Thus, though the SAM workbook used in preceptorships did not significantly increase knowledge scores, the increase in self-confidence could have a positive impact on patient safety.

An important aim of both interventions for this study, the clinical workbook and preceptorships, was to help nursing students connect theory to practice. A practice-theory gap between pharmacology knowledge and clinical practice has been described in nursing literature. This gap in pharmacology knowledge has implications related to clinical decision-making ability which can impact patient safety. A safe medication administration workbook, based upon activities from theory and clinical practice, was suggested in the literature for use during nursing clinical experiences where pharmacology knowledge was applied (Honey & Lim, 2008). As far as clinical experiences go, preceptorships have been identified as most effective in readying students for independent practice (Hickey, 2010).

The clinical workbook used in an authentic setting with an expert clinician mentor provided a rich environment for students to interact, observe, and learn to solve problems with their teacher. Preceptorships provide students with an opportunity to grow in self-confidence within the practice setting (Billay & Myrick, 2007). An evaluation of student SAM knowledge
and self-confidence was carried out before and after these interventions in order to determine a significant change.

This framework supported the predictive hypotheses: (a) nursing students in preceptorships which incorporated a clinical workbook would demonstrate knowledge gains in safe medication administration, and (b) nursing students in preceptorships which incorporated a clinical workbook would demonstrate greater gains in safe medication administration knowledge than students in a preceptorship without a clinical workbook.

The first predictive hypothesis was supported for 4th-semester students, but rejected for 5th-semester students. Both 4th- and 5th-semester students were involved in active learning strategies applying safe medication administration knowledge in the context of authentic nursing situations. Study results that showed students in critical care preceptorships with a workbook gained SAM knowledge support social constructivist and social cognitive theory, while results that showed students in Capstone preceptorships with workbooks regressed in SAM knowledge, do not.

A discussion of a possible reason for a lack of knowledge gains was presented in the last section and did not discount the study’s theoretical framework, but rather highlighted the impact of practical factors related to student-preceptor scheduling. Students working with the same preceptor during their rotations may have had advantages over those with numerous preceptors. Consistency may have afforded preceptors with more opportunities to assess the “inner and outer boundaries of students’ knowledge, their need for scaffolded support” (Spouse, 1998, p. 264), to decrease the zone of proximal development and provide the “help needed to make links between theory and practice” (Spouse, 1998, p. 264).
The second predictive hypothesis was not supported by study results: data analysis did not show significant knowledge gains for students with a workbook compared to those without a workbook. The intent of the workbook was for students to connect SAM theory to practice in collaboration with an expert clinical nurse preceptor in an authentic clinical setting. Though knowledge gains were not seen, learning satisfaction and self-confidence in SAM did significantly increase among students in preceptorships with the workbook over students in preceptorships without the workbook. Students in preceptorships have reported more hands-on skill practice which builds student confidence (Hendricks et al., 2013). Students with a one-on-one preceptor may have more opportunities to apply pharmacology information through practicing medication administration.

**Findings That Support Null Hypothesis**

The null hypothesis for the study was that preceptorships and use of a clinical workbook across the duration of a clinical rotation would have no effect on SAM scores or self-confidence scores on senior baccalaureate nursing students. The null hypothesis was supported for one condition: the Safe Administration of Medications (SAM) Workbook for senior nursing students in preceptorships, alone, did not positively influence student knowledge scores. The null hypothesis was rejected, however, for the other condition: SSSCL-SAM scores revealed increased self-confidence with use of the SAM workbook. Further, the null hypothesis was rejected for the condition of 4th-semester students gaining SAM knowledge, learning satisfaction, and self-confidence is SAM during their preceptorship plus use of workbook.

**Limitations**

Limitations of research studies may affect the validity of the results. An important limitation of this study was a small sample size. A decreasing cohort size affected availability of
participants. Each cohort started with 64 students in their 1st semester of nursing school, and had diminished to 36 5th-semester and 61 4th-semester students. When subtracting my own 4th-semester students from the pool of potential participants, there were 45 4th-semester students. Therefore, at the start of the semester, there were 81 potential participants. As the semester progressed, two students (who happened to be in the study and took the pretest) withdrew from their didactic and clinical courses due to academic performance. A total of 34 students (42% of potential participants) agreed to participate. It became clear to the researcher that both 4th- and 5th-semester students were sensitive to time constraints from course requirements and wary of adding extra tasks that were not requirements of their courses.

Of the participants who took the pretest, 13 (94%) of 5th-semester students and 14 (70%) of 4th-semester students took the posttest. During the last week of the semester when the posttest was given, 4th-semester students were concerned with passing the didactic portion of the critical care course. Fifth semester students noted they had one remaining exam after the posttest which was not one they were anxious about; they were much more relaxed and concerned with plans related to graduation.

The small sample size affects the generalizability of study findings. The power analysis carried out early in the study found that 34 students would need to participate. A repeated power analysis revealed 38 students were needed to have statistical power of at least .80 to discover a difference of .05 between group means. A total of only 27 participants completed the study.

Another limitation of the study that could have affected participation rates and generalizability of study findings was the length of the SAM Scale. The SAM Scale was used for both pretest and posttest. The length of this tool may have affected whether students desired to take the posttest. Students may not have wanted to spend time repeating the 70-item exam. This
would be in agreement with a recommendation from a prior evaluation of the SAM scale that shortening the exam may be advantageous (Gonzales, 2011). Though provided with the incentives of a gift card and snack, 30% of 4th-semester participants chose not to take the posttest.

Another factor related to the SAM Scale that could have reduced posttest participation may have been that the instrument contained dosage calculation problems. Since the recent nursing program implementation of a 100% passing score requirement for dosage competency in clinical courses, dosage calculations have been a sensitive topic. Students may have wanted to avoid spending time calculating dosages that were not required for a course.

Further reflection of the study design brought the researcher to ponder whether a different approach to educating preceptors about the clinical workbook may have yielded greater interest, collaboration, and use of the workbook during clinical time. Visiting each preceptor was not feasible with the researcher’s work responsibilities, as the preceptors were spread out amongst multiple clinical facilities, with varied schedules, on both day and night shifts. An informative letter about the study and encouragement to collaborate with the student regarding the workbook was inserted into each workbook. The researcher provided in-person instructions to students, as each finished their pretest, to present the letter to their preceptor and discuss use of the workbook. Several students provided feedback that their preceptor was too busy to spend time with them using the workbook; perhaps a personal call or email would have increased participation.

**Recommendations for Future Research**

The literature review for this study and search for instruments to evaluate the basic five rights of safe medication administration bore witness to the need for additional validated
instruments for nurse researchers. In nursing education, it has been noted that there is not a standardized method for evaluating the safe administration of medications (Gonzales, 2011). The SAM Scale was the only efficient tool found to date to measure the five rights of safe medication administration. A critique of this tool has been its 70-item length and the approximate 1 hour needed for administering the exam (Gonzales, 2011). This author also recommends an abbreviated SAM scale, one with items that are more discriminating. Other instruments, such as the MASAT, however, required evaluation of small groups of students at a time in simulation lab, which is time-intensive for nursing faculty (Goodstone & Goodstone, 2013). One of the five 2016-2019 NLN Research Priorities in Nursing Education that relate to research methodology concerns research instruments. New instruments for nursing education research need to be developed and tested in order to measure learning outcomes and link them to patient care outcomes (NLN, 2016).

A second recommendation for future research would be to determine if the number of preceptors a student worked with during their preceptorship correlated with their level of SAM knowledge and self-confidence in SAM. This study’s design could be replicated with the addition of a researcher-developed set of questions addressing how many preceptors the student worked with. A mixed-methods study, adding focus group interviews with students and or preceptors, to this study design may yield further insight into the impact of multiple preceptors on student learning and self-confidence.

The third recommendation for a future study would be to evaluate the effectiveness of an online SAM preceptor resource site that included information about the SAM workbook. Would the development and use of such an online preceptor resource increase use of the workbook in preceptorships? An online resource center for preceptors to access information about their roles
and responsibilities and other mentoring helps has been recommended in the literature (Kalischuk, et al., 2013). A three-part online preceptor training module on medication error reduction strategies revealed a significant difference in pretest to posttest knowledge scores, with 95% of preceptors reporting subsequent use of at least one of the strategies in practice (Harris, 2014, p. 406). It would be interesting to investigate if an online SAM resource site would affect student SAM knowledge or self-confidence scores.

**Implications for Nursing Education**

Tasks related to medication administration comprise a significant amount of a registered nurse’s time. To carry out medication management safely, nurses must possess an adequate knowledge base about each of the drugs they administer and be able to apply that knowledge in the specific context of their patient’s situation (Dolansky et al., 2013). The ultimate goal of pharmacology instruction to undergraduate nursing students is the safe administration of medications to patients and the avoidance of medication errors. This is a noble and needed goal in light of significant findings from an IOM study which concluded there are 1.5 million preventable adverse drug events annually in the United States (IOM, 2016).

This study contributed to the body of nursing education knowledge by testing a researcher developed concise safe medication administration clinical workbook for use in preceptorships. The study provided testing of the only validated, efficient, comprehensive research instrument, the SAM Scale, found in the literature to evaluate student knowledge of the traditional five rights of medication administration. An additional contribution was that of highlighting the need for evaluating outcomes of preceptorships and the impact the number of preceptors may have on student learning outcomes. Though further evaluation is needed, nurse educators may consider selecting preceptorships with fewer rather than greater numbers of
preceptors per student. The study also highlighted a need to investigate why students would regress in knowledge of administering medications at the “Right Time” during senior level preceptorships.

This study also contributed the finding that SAM clinical workbooks were a teaching strategy that students used as clinical time permitted. The workbooks were perceived to be helpful in the clinical setting. Students found concise workbooks were good tools for reviewing important content. The review of workbook content increased their self-confidence in the information studied.

**Conclusion**

Nurse educators must respond to the IOM findings that unacceptable levels of preventable adverse drug events occur annually in US hospitals (IOM, 2016). A 2010 call for nurse educators to reform nursing education included learning in context, development of clinical reasoning, and learning how to respond to patient condition changes as important themes (Benner et al., 2010). Additional research is needed to identify evidence-based teaching strategies in order to educate future nurses to provide safe patient care.

The purpose of this study was to evaluate the effectiveness of the teaching strategies of preceptorships and a SAM clinical workbook. A related purpose was to evaluate the extent to which students would use the clinical workbook and perceive it as helpful. Third, this study sought to determine which currently available resources students perceived as most helpful in learning SAM knowledge.

The small sample size (n=28) limited the generalizability of study findings. The results of data analysis revealed nearly all effect sizes were small. The researcher recommends a larger sample size for future replications of this study.
REFERENCES


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APPENDIX A

EVALUATION OF KNOWLEDGE OF SAFE MEDICATION ADMINISTRATION OF PRE-LICENSURE BACCALAUREATE SENIOR NURSING STUDENTS IN A PRECEPTOR-BASED CLINICAL
APPENDIX B

STUDENT SATISFACTION AND SELF-CONFIDENCE IN LEARNING SAFE MEDICATION ADMINISTRATION (SAM)
**Instructions:** This questionnaire is a series of statements about your personal attitudes about the instruction you receive during your instructed clinical or preceptorship. Each item represents a statement about your attitude toward your satisfaction with learning and self-confidence in obtaining the SAM instruction you need. There are no right or wrong answers. You will probably agree with some of the statements and disagree with others. Please indicate your own personal feelings about each statement below by marking the numbers that best describe your attitude or beliefs. Please be truthful and describe your attitude as it really is, not what you would like for it to be. This is anonymous with the results being compiled as a group, not individually.

Mark:
1 = STRONGLY DISAGREE with the statement
2 = DISAGREE with the statement
3 = UNDECIDED - you neither agree or disagree with the statement
4 = AGREE with the statement
5 = STRONGLY AGREE with the statement

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<tr>
<th>Satisfaction with Current Learning</th>
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<td>1. The teaching methods used by my preceptor were helpful and effective.</td>
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<td>2. The clinical rotation provided me with a variety of learning materials and activities to promote my learning safe medication administration (SAM).</td>
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<tr>
<td>3. I enjoyed how my preceptor taught medication administration.</td>
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<td>o 2</td>
<td>o 3</td>
<td>o 4</td>
<td>o 5</td>
</tr>
<tr>
<td>4. The medication administration teaching activities used in this clinical were motivating and helped me to learn.</td>
<td>o 1</td>
<td>o 2</td>
<td>o 3</td>
<td>o 4</td>
<td>o 5</td>
</tr>
<tr>
<td>5. The way my preceptor(s) taught medication administration was suitable to the way I learn.</td>
<td>o 1</td>
<td>o 2</td>
<td>o 3</td>
<td>o 4</td>
<td>o 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Self-confidence in Learning</th>
<th>SD</th>
<th>D</th>
<th>U</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. I am confident that I am mastering safe medication administration (SAM) that my instructor or preceptor presented to me.</td>
<td>o 1</td>
<td>o 2</td>
<td>o 3</td>
<td>o 4</td>
<td>o 5</td>
</tr>
<tr>
<td>7. I am confident that this clinical rotation covered essential content necessary for the mastery of safe medication administration.</td>
<td>o 1</td>
<td>o 2</td>
<td>o 3</td>
<td>o 4</td>
<td>o 5</td>
</tr>
<tr>
<td>8. I am confident that I am developing the skills and obtaining the required knowledge from this clinical rotation to perform necessary SAM tasks in a clinical setting</td>
<td>o 1</td>
<td>o 2</td>
<td>o 3</td>
<td>o 4</td>
<td>o 5</td>
</tr>
<tr>
<td>9. My instructor or preceptor used available resources to teach safe medication administration.</td>
<td>o 1</td>
<td>o 2</td>
<td>o 3</td>
<td>o 4</td>
<td>o 5</td>
</tr>
<tr>
<td>10. It is my responsibility as the student to learn what I need to know about SAM from this clinical rotation.</td>
<td>o 1</td>
<td>o 2</td>
<td>o 3</td>
<td>o 4</td>
<td>o 5</td>
</tr>
<tr>
<td>11. I know how to get help when I do not understand the SAM concepts covered in the clinical rotation.</td>
<td>○ 1</td>
<td>○ 2</td>
<td>○ 3</td>
<td>○ 4</td>
<td>○ 5</td>
</tr>
<tr>
<td>12. I know how to use clinical activities to learn critical aspects of SAM skills.</td>
<td>○ 1</td>
<td>○ 2</td>
<td>○ 3</td>
<td>○ 4</td>
<td>○ 5</td>
</tr>
<tr>
<td>13. It is the faculty's responsibility to tell me what I need to learn of SAM content during clinical meetings</td>
<td>○ 1</td>
<td>○ 2</td>
<td>○ 3</td>
<td>○ 4</td>
<td>○ 5</td>
</tr>
</tbody>
</table>

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Revised December 22, 2004
APPENDIX C

SURVEY OF USE OF PHARMACOLOGY RESOURCES
Place a checkmark beside each type of resource you have used (while in nursing school) to assist you in learning any aspect of pharmacology and medication management such as drug information, dosage calculation, the rights of safe medication administration. Then rank the top 3 (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>) resources that have been most helpful in learning med admin.

<table>
<thead>
<tr>
<th>Resources Used</th>
<th>Required in a Course</th>
<th>Rank Top 1, 2, 3</th>
<th>Not Required in a Course</th>
<th>Rank Top 1, 2, 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased Flash Cards</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homemade Flash Cards</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Search Nursing Web Sources</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Search Other Web Sources</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You Tube Videos</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacology Software</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacology Games</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCLEX Practice Questions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concept Mapping Drug Information</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacology Audio recordings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acronyms / Mneumonics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quizlet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Search Academic Journals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nursing Apps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simulation Lab</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Survey of Use of Pharmacology Resources

Part 2

Questions Related to the Use of the Clinical Workbook

Please respond to the following inquiries related to the usefulness of the clinical workbook:

1) On a scale of 0 to 10, how was the workbook helpful or useful in learning safe medication knowledge in clinical?

<table>
<thead>
<tr>
<th>Not helpful</th>
<th>Very helpful</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

2) How many times during your clinical rotation did you use the workbook?

<table>
<thead>
<tr>
<th>Did not use</th>
<th>Used 10 or more times</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

3) In your own words, how was the workbook helpful or not helpful in gaining safe medication knowledge?

4) In your own words, how was the workbook helpful or not helpful in gaining self-confidence in the administration of medications?
APPENDIX D

OVERVIEW OF RESEARCH DESIGN
<table>
<thead>
<tr>
<th>Requested of Participant</th>
<th>Groups</th>
<th>Start of semester Instruments</th>
<th>Interventions</th>
<th>End of semester Instruments</th>
<th>Research Questions Addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agree to participate</td>
<td>Control group 5th semester students</td>
<td>Brief descriptive data form Pretest *SAM Scale (45 mins) **SSSCL - SAM (questions 1-13)</td>
<td>Preceptor-based critical care clinical prior semester (no workbook)</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Time (45 mins)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Experimental group 4th semester students</td>
<td>Preceptor-based critical care clinical &amp; SAM clinical workbook</td>
<td>Posttest: *SAM Scale (45 mins) **SSSCL - SAM (questions 1-13):</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th and 5th semester students</td>
<td>Brief descriptive data form Pretests: SAM Scale to detect med errors (awareness of 5 rights &amp; what is safe and what is not) (45 mins) **SSSCL - SAM (questions 1-13)</td>
<td>Preceptor-based clinical &amp; SAM clinical workbook</td>
<td>Posttest: *SAM Scale (45 mins) **SSSCL - SAM (questions 1-13): to detect change in self-confidence in SAM ability</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approx 5 mins to answer questions</td>
<td>4th and 5th semester students</td>
<td>Turn in workbook upon completion of preceptorship</td>
<td>Student Use of Pharmacology Resources (SUPR) (part)</td>
<td></td>
<td>3. To what extent would students take advantage of and use a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

*SAM Scale
**SSSCL - SAM
2) Likert and open-ended questions on Workbook use during rotation & if found helpful workbook to increase safe med admin knowledge base?

| Approx 5 mins time to fill out Checklist | 4th and 5th semester students | Researcher-developed SUPR (part 1) Checklist of resources used by student | 4. What other resources have students used to increase safe med admin beyond course requirements? |
APPENDIX E

RESEARCH LETTER OF INVITATION
Evaluation of Safe Medication Administration Knowledge of Pre-licensure Baccalaureate 
Senior Nursing Students in Preceptorships

Dear Student,

My name is Lisa Kay Murphree. I am a doctoral student in the Education Department at the University of Alabama. I am involved in a research study as part of the requirements of my degree in Instructional Leadership for Nurse Educators, and I would like to invite you to participate.

I am studying undergraduate nursing student medication administration knowledge. If you decide to participate, you will be asked to complete a brief demographic survey, a pretest and posttest related to medication administration, a pretest and posttest related to self-confidence in medication administration, and a brief use of pharmacology resources questionnaire. The survey and pretests (at beginning of semester) should last about 45 – 60 minutes and the posttests and questionnaire (near end of semester) should last about 45 – 60 minutes. These would take place in the nursing building.

Your participation is voluntary. You do not have to be in this study if you do not want to and you may stop being in the study at any time. You do not have to answer any study questions that you are not comfortable answering. Participating, not participating, or withdrawing from the study will not affect your course grades in any way.

You may benefit directly by participating in this research study by finding it helpful to review safe medication administration knowledge, and/or feel good about knowing you participated in research that may benefit future nursing students pharmacology education experience. You will receive a snack at the pretest and a gift card, chocolate bar, and thank you card at the end of the posttest as reimbursement for your time.

Participation is private. Participants will be randomly assigned a study number for filling out the study instruments (surveys, etc.), for privacy and to avoid study bias. Study information will be kept in a secure location at Middle Tennessee State University. The results of the research study may be published or presented at professional meetings, but your identity will remain private. Please do not write your name or other personal identifiers on any study materials, other than the consent form. I have been given permission to briefly review this information with your class in one of your course orientations.

Myself or committee members will be glad to answer any questions you have about the research study. You may contact me at 615-243-4881 or lkmurphree@crimson.ua.edu.

Thank you for considering participation. You will be asked to fill out a consent form if you are willing to participate.

With sincere regards,

Lisa Kay Murphree

Office: Rm 229, CKNB, MTSU

615-243-4881 lkmurphree@crimson.ua.edu
Patient Example (Case Study for Right Route chapter)

Mr. Cho is a 78 year old man admitted from home for fever, urinary tract infection (UTI), and sepsis. He is awake, non-verbal, and follows occasional commands. He has residual weakness of his right extremities from a past cerebral vascular accident (CVA). He has a history of aspiration pneumonia, a failed swallowing study, and a percutaneous gastrostomy tube (PEG) placed one month ago.

At 1000 when preparing to administer Mr. Cho’s medications, the nurse noted the following medications due on the Medication Administration Record (MAR): metoprolol succinate (Toprol XL) 50 mg PO; diltiazem hcl (Cardizem CD 240 mg) PO, and aspirin 81 mg EC PO.

When the nurse questioned the caregivers (patient’s spouse and an adult child), they insisted the medications be given as listed and on time, as this has been their dutiful practice at home since discharge from the hospital one month ago.

Questions:

1. Should the nurse question the administration of the ordered medications?
   Which ones?

2. Since the family insists, and has diligently administered these medications, should the nurse carry out their wishes and give them as listed?

3. Would administering these medications be an error?

4. What is the potential outcome of opening the cardizem capsule, dissolving it and the other medications in water and administering them via the PEG tube?

5. What actions should the nurse take in order to follow the five rights of safe medication?
Clinical Collaboration (for Right Time chapter)

- Choose a patient on your unit today and review the patient’s MAR with your preceptor.
- Discuss the decision making process of determining how to administer their medications on time, and what factors will affect this process.
- List an example from your discussion: ____________________________________________________________

- Ask your preceptor which of the following factors commonly affect giving medications on time:
  - ______ waiting on lab values to be reported
  - ______ prioritizing tasks of high acuity patient
  - ______ workload with other patients assigned
  - ______ availability of medication from pharmacy
  - ______ waiting on prescriber clarification of order
  - ______ need to further monitor patient before administering medication (BP or HR too low, for example)
  - ______ other health provider busy with patient (PT, RT, wound care)

- Ask your preceptor how they decide the following: if the patient’s medications are due at 0800, 0900, 1000, 1130, and 1300, how do they decide which ones they can group and administer together?

- What is the procedure on your unit when a dose is omitted?
  - ______ Do nurses have to document the reason the dose was missed?
  - ______ Does the nurse have to notify the prescriber for any medication missed or just for certain ones?
  - ______ Do nurses have to fill out an incident report for a missed dose?
Connect to Prior Learning (for Right Dose chapter)

Exercise 1

- Complete the chart filling in the equivalent amount in the Conversion column.

### Common Conversions and Abbreviations

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Conversion</th>
<th>Abbreviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 tsp</td>
<td>mL</td>
<td>teaspoon → milliliters</td>
</tr>
<tr>
<td>1 Tbsp</td>
<td>mL</td>
<td>tablespoon → milliliters</td>
</tr>
<tr>
<td>1 oz</td>
<td>mL</td>
<td>ounce → milliliters</td>
</tr>
<tr>
<td>1 c</td>
<td>oz</td>
<td>cup → ounces</td>
</tr>
<tr>
<td>1 L</td>
<td>mL</td>
<td>Liter → milliliters</td>
</tr>
<tr>
<td>1 lb</td>
<td>oz</td>
<td>pound → ounces</td>
</tr>
<tr>
<td>1 mg</td>
<td>mcg</td>
<td>milligrams → micrograms</td>
</tr>
<tr>
<td>1 g</td>
<td>mg</td>
<td>gram → milligrams</td>
</tr>
<tr>
<td>1 kg</td>
<td>G</td>
<td>kilograms → grams</td>
</tr>
<tr>
<td>1 kg</td>
<td>lbs</td>
<td>KIlogram → pounds</td>
</tr>
<tr>
<td>1 unit</td>
<td>mu</td>
<td>units → milliunits</td>
</tr>
<tr>
<td>1 gr</td>
<td>mg</td>
<td>grains → milligrams</td>
</tr>
</tbody>
</table>
APPENDIX G

DEMOGRAPHIC SURVEY
Evaluation of Safe Medication Administration Knowledge of Pre-licensure Baccalaureate
Senior Nursing Students in Preceptorships

Research Number # __________

Age: Circle one  20-29    30-39    40-49    50-59

Gender __________

Race __________

Do you have a prior college degree? ___________________________Yes____No_____ 

Do you have college credit for an algebra course? _____________Yes_____No_____ 

Do you have college credit for a dosage calculation course? ______Yes____No_____ 

Do you have current or prior work experience in a hospital setting? __Yes_____No_____
APPENDIX H

UNIVERSITY OF ALABAMA
CONSENT TO BE IN A RESEARCH STUDY
You are being asked to be in a research study. This study is called “Evaluation of Safe Medication Administration Knowledge of Pre-licensure Baccalaureate Senior Nursing Students in Preceptorships”.

**Institution:** University of Alabama

This study is being done by Lisa Kay Murphree. She is a graduate student in the College of Education at the University of Alabama.

**What is this study about?** This study will examine the extent to which a preceptorship and a clinical workbook have an effect on undergraduate nursing student safe medication administration knowledge.

**Why is this study important—What good will the results do?**
The findings will help nursing educators better understand the effectiveness of teaching strategies on undergraduate student safe medication administration knowledge.

**Why have I been asked to take part in this study?**
You are enrolled in either a fourth or fifth semester undergraduate nursing clinical preceptorship and are not a student in the researcher’s critical care clinical group.

**How many other people will be in this study?**
The investigator hopes to enroll 60-80 students at the beginning of the fall 2017 semester.

**What will I be asked to do in this study?**
The research study duration is one academic semester. At the beginning of the semester, all participants will be asked to answer pretest questions and brief demographic questions.
Participants will be asked to use a clinical workbook during their usual critical care or capstone preceptorship clinical. Following your critical care or capstone preceptorship, you will be asked to answer posttest questions, fill out a brief checklist and questions, and turn in the workbook. The workbook will be returned for you to keep.

**How much time will I spend being in this study?**
For participants to answer the pretest questions should take about 45-60 minutes. Time spent using the clinical workbook will vary according to available time during the preceptorship to carry out activities in the clinical workbook. The clinical workbook activities take a few minutes each. For participants to answer the posttest questions should take about 45-60 minutes.

**Will being in this study cost me anything?**
The only cost to you from this study is your time.

**Will I be compensated for being in this study?**
In appreciation of your time, you will receive a snack during the pretest, and a chocolate bar, a thank you card, and a $10 gift card to a local business when the posttest is completed.
What are the risks (problems or dangers) from being this study?
The chief risk to you is that you may find the time spent participating in this study is inconvenient. You may be inconvenienced for a total of about two hours while filling out paper and pencil study materials. You may be inconvenienced by taking a workbook to your critical care or capstone clinical experience.

What are the benefits of being in this study?
A possible direct benefit to you would be that you find it pleasant or helpful to review safe medication administration information. You may also feel good about knowing that you have helped nursing educators examine teaching strategies to improve safe medication administration knowledge.

How will my privacy be protected?
The only identification on pretest and posttest materials or clinical workbook will be a participant study number, which will only be known to you, not the researcher. Data from the study will be entered for analysis using the participant study number only. Data will not be shared with any course professors.

How will my confidentiality be protected?
The only place where your name appears in connection with this study is on this informed consent. The consent forms will be kept in a locked file cabinet in Lisa Kay Murphree’s office, which is locked when she is not there. At the beginning of the study, a number will be assigned to each student according to semester enrolled, in order to analyze data. The number will be on the student copy of the consent form. The researcher will not have a list of student names matched with study numbers.

For the researcher’s dissertation, data from this study will be used; however, participants will be identified only as “senior baccalaureate nursing students from a southeastern university” and only group data will be used. No one will be able to recognize you.

What are the alternatives to being in this study?
The only alternative is not to participate.

What are my rights as a participant?
Being in this study is totally voluntary. It is your free choice. You may choose not to be in it at all. If you start the study, you can stop at any time. However, if you do not compete the posttest, you will not receive the gift card. Not participating or stopping participation will have no effect on your nursing courses or relationship with the university.

The University of Alabama Institutional Review Board is a committee that looks out for the ethical treatment of people in research studies. They may review the study records if they wish. This is to be sure that people in research studies are being treated fairly and that the study is being carried out as planned.
Who do I call if I have questions or problems?

If you should have any questions about this research study or possible injury, please feel free to contact me at 615-243-4881 or lkmurphree@crimson.ua.edu or my UA faculty advisor, Dr. Wright at 205-348-1401 or vwright@ua.edu if you have study related questions or problems.

If you have any questions about your rights as a research participant, you may call Ms. Tana Myles, the Research Compliance Officer of the University of Alabama at 205-348-8461 or toll-free at 1-877-820-3066. If you have complaints or concerns about this study, file them through the UA IRB outreach website at http://osp.ua.edu/site/PRCO_Welcome.html.

After you participate, you are encouraged to complete the short Survey for Research Participants online at this website or you may ask the investigator for a copy of it and mail it to the University Office for Research Compliance, Box 870127, 358 Rose Administration Building, Tuscaloosa, AL 35487-0127.

I have read this consent form. I have had a chance to ask questions. I agree to take part in it. I will receive a copy of this consent form to keep.

Signature of Research Participant

Date

Signature of Investigator

Date
July 24, 2017

Lisa Kay Murphree, MSN, RN, CMSRN
Department of ELPTS
College of Education
University of Alabama
Box 870302

Re: IRB # EX-17-CM-045 “Evaluation of Safe Medication Administration Knowledge of Pre-licensure Baccalaureate Senior Nursing Students in Preceptorships”

Dear Ms. Murphree:

The University of Alabama Institutional Review Board has granted approval for your proposed research. Your protocol has been given exempt approval according to 45 CFR part 46.101(b)(1) as outlined below:

1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

Your application will expire on July 23, 2018. If your research will continue beyond this date, complete the relevant portions of Continuing Review and Closure Form. If you wish to modify the application, complete the Modification of an Approved Protocol Form. When the study closes, complete the appropriate portions of FORM: Continuing Review and Closure.

Please use reproductions of the IRB approved informed consent form to obtain consent from your participants.

Should you need to submit any further correspondence regarding this proposal, please include the assigned IRB application number.

Good luck with your research.

Sincerely,

[Signature]

Director & Research Compliance Officer
Office for Research Compliance

358 Rose Administration Building | Box 870127 | Tuscaloosa, AL 35487-0127
205-348-8461 | Fax 205-348-7189 | Toll Free 1-877-820-3066
APPENDIX I

STUDENT USE OF (REQUIRED) PHARMACOLOGY RESOURCES
### Student Use of (Required) Pharmacology Resources

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased Flash Cards</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not use</td>
<td>26</td>
<td>76.5</td>
<td>96.3</td>
<td>96.3</td>
</tr>
<tr>
<td>Used, no rank</td>
<td>1</td>
<td>2.9</td>
<td>3.7</td>
<td>100</td>
</tr>
<tr>
<td>Used, ranked #3</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used, ranked #2</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used, ranked #1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homemade Flash Cards</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not use</td>
<td>14</td>
<td>41.2</td>
<td>51.9</td>
<td>51.9</td>
</tr>
<tr>
<td>Used, no rank</td>
<td>3</td>
<td>8.8</td>
<td>11.1</td>
<td>63</td>
</tr>
<tr>
<td>Used, ranked #3</td>
<td>1</td>
<td>2.9</td>
<td>3.7</td>
<td>66.7</td>
</tr>
<tr>
<td>Used, ranked #2</td>
<td>3</td>
<td>8.8</td>
<td>11.1</td>
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APPENDIX J

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