Doctor of Nursing Practice Project

Evidence-Based Practice Change Proposal: Use of Simulation within Nursing Education to Assist Students to Meet Standardized Test Plan Components

by

Christina Liebrecht

Submitted as partial fulfillment of the requirements for the

Doctor of Nursing Practice Degree

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An Abstract of

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Medication errors within the United States healthcare system have been identified as a persistent issue contributing to extended hospital stays, increased healthcare costs, poorer patient outcomes including death, and lack of trust in the healthcare system. Medication errors can occur at any point in the medication process with nurses playing a crucial role in protecting patient safety during the steps of medication administration and monitoring for drug effects. Study findings indicate that less experienced nurses and student nurses are more likely to make mistakes, citing insufficient or ineffective preparation to administer medications safely. Evidence supports the use of simulation in nursing education to strengthen critical skills, confidence, and competence

in nursing students and graduate nurses through the provision of a safe learning environment that protects patient safety, promotes active learning, presents specific and comparable patient situations, and supports error detection and response. The six step Model for Evidence-Based Practice Change was used to guide this evidence-based practice change project. In order to identify potential areas of change within existing simulation curriculum within a Bachelor of Science in Nursing (BSN) program at a mid-size, public university in Northwest Ohio, current simulation objectives and components were mapped against NCLEX test plan categories and content sub-categories. Based on this analysis which identified several sub-categories that were not addressed or only partially addressed, a simulation scenario focused specifically on safe medication administration principles and practices was developed and implemented. Results of this pilot study identified improved student satisfaction and self-confidence in learning following participation in a simulation experience which incorporated key principles of safe medication administration. The impact of participation in a safe medication administration simulation experience on standardized testing performance warrants further testing.

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In a recent report, safety experts calculated that more than 250,000 deaths occur annually due to medical error which translates to 9.5 percent of all deaths each year in the United States (US) (Johns Hopkins Medicine, 2016). Examples of preventable deaths due to medical error include healthcare-acquired infection, missed diagnosis, and adverse drug events (ADEs). Despite comprehensive training in the classroom and laboratory environments, both actual and potential medication errors are regularly committed by nurses and nursing students within the clinical setting. Several studies support the use of human patient simulation experiences to help students improve clinical decision making, confidence, and skill competence.

Identification of the Problem

Overview of the Problem

According to a 2001 Institute of Medicine report, 98,000 patient deaths occur annually due to preventable medical error within our healthcare system (IOM, 2001). One example of a medical error is medication error which includes adverse drug events (ADEs). Medication errors account for 380,000 to 450,000 preventable errors within hospitals annually with an additional 800,000 ADEs occurring within long term care settings (IOM, 2006). Taking into consideration underestimates, reporting omissions, and outpatient medication errors, at least 1.5 million ADEs occur in the US annually. Medication errors can occur at any point in the medication process including the steps of obtaining, prescribing, dispensing, and administering medications as well as monitoring for medication effects. Nurses play a crucial role in protecting patient safety during the steps of medication administration and monitoring for drug effects. Medication administration represents a high-risk nursing activity with 78% of nurses stating making a

medication error at some time in their nursing career (Johnson & Young, 2011). Study findings indicate that less experienced nurses and student nurses are more likely to make mistakes (Henneman et al., 2010). Other results found that nurses receive insufficient or ineffective preparation to identify, communicate, and resolve medication errors. In one study by Henneman et al. (2010), all of the student nurse subjects committed some type of error within a simulated setting. In the clinical setting, nursing students administer medications to patients under the supervision of a clinical instructor (Dolansky, Druschel, Helba, & Courtney, 2013). The majority of nursing student medication errors are considered potential as the clinical instructor interceded prior to an actual error occurring. According to Dolansky et al., factors which lead to nursing and nursing student medication errors include environmental distractions, personal factors, unit culture and communication issues, and ineffective education. Despite comprehensive training in the classroom, laboratory, and clinical areas, both actual and potential medication errors continue to occur in the clinical setting putting patients at risk.

Several studies support the use of simulation in nursing education to strengthen the development of critical skills, confidence, and competence in nursing students and graduate nurses (Handley & Dodge, 2013). The use of simulation technology provides opportunities for students to build skills and knowledge within a safe learning environment that protects patient safety, promotes active learning, presents specific and comparable patient situations, and supports error detection and response (Medley & Horne, 2005). Simulation provides the opportunity for participants to identify actual and potential errors and learn from these mistakes. However, there is minimal evidence that supports the transfer of knowledge and skills acquired within a simulated learning environment to actual clinical practice (Sears, Goldsworthy, & Goodman, 2010). Sears et al. (2010) suggest that simulation in nursing education may contribute

to a reduction in medication errors among novice nurses. Evidence from one recent, large-scale study suggests that simulation curriculum within nursing education programs supports the development of comprehensive nursing knowledge, successful NCLEX performance, and clinical competency (Hayden, Smiley, Alexander, Kardong-Edgren, & Jeffries, 2014). Apart from these findings, there is a general lack of evidence supporting the impact of simulation experiences within nursing education programs on standardized testing and overall readiness to practice.

Recently published study findings from the National Council of State Boards of Nursing (NCSBN) provided substantial evidence that high fidelity simulation (HFS) using best practice principles supports the development of clinical competence, critical thinking, and preparedness to practice skills in nursing students (Hayden, Smiley, Alexander, Kardong-Edgren, & Jeffries, 2014). Significant study findings identified effectiveness of both traditional clinical and simulation experiences leading to positive student outcomes. Best practices in HFS technology use include incorporation of standardized terminology, professional attitude and behavior of scenario participants, clear objectives at participant's level, multiple methods of facilitation, proficient simulation facilitators, debriefing process, and summative evaluation of simulation experiences (International Association for Clinical Simulation & Learning (INACSL) Board of Directors, 2013). Eleven best practice criteria for simulation design have been identified (Lioce et al., 2015). These criteria support high quality simulation design which includes a thorough needs assessment; clear and measurable objectives; a consistent format of simulation; a clinical scenario that includes situation, clinical progression, cues, time frames, scripting, and identification of critical actions; a high level of fidelity; well-trained facilitators; a structured and planned briefing process; quality debriefing to enrich the learning process; evaluation of scenario

experience; preparation by the participants; and pilot testing of simulation-based learning experiences.

Importance of Addressing Issue

Actual and potential medication errors (APME) committed by nurses as well as nursing students directly impact patient safety and outcomes. Annually, medication errors result in unnecessary patient deaths, prolonged hospital stays, worse patient outcomes, and increased healthcare costs (Institute of Medicine, 2000). In-hospital medication errors are estimated to cost $3.5 billion each year. Depending on the type of error and specific medication involved, patient harm can be serious and potentially fatal (Karavasiliadou & Athanasakis, 2014). Furthermore, study results estimate that one of every 131 outpatient deaths and one of 854 inpatient deaths are attributable to medication errors (Wittich, Burkle, & Lanier, 2014). Nurses with inadequate and insufficient knowledge, including nursing students and graduate nurses, are major causes of medication errors (Zimmerman & House, 2016). Reports estimate that only 41% of graduate nurses were proficient in medication administration and only 28% had knowledge of pharmacologic implications (Advisory Board Company, 2008). This higher rate of medication errors may be due to a range of issues including a preparation to practice gap, limited clinical experiences, and lack of qualified nursing faculty or clinical sites.

The National Council Licensure Examination (NCLEX) provides baseline assessment of the knowledge, competence, and readiness to practice of graduate nurses in order to protect public health, safety, and welfare (National Council of State Boards of Nursing (NCSBN), 2015). Exam content is based on four major client need areas including: Safe and Effective Care Environment with sub-categories of Management of Care and Safety and Infection Control; Health Promotion and Maintenance; Psychosocial Integrity; and Physiological Integrity with the

sub-categories of Basic Care and Comfort, Pharmacological and Parenteral Therapies, Reduction of Risk Potential, and Physiological Adaptation. The national first-time pass rate for baccalaureate-prepared graduate nurses was 87.49% in 2015 and 84.93% in 2014 (NCSBN, 2015; NCSBN, 2014). The Ohio first-time pass rate for baccalaureate-prepared nurses was 78.55% in 2015 and 77.18% in 2014 (Ohio Board of Nursing (OBN), 2016). This represents a substantial number of graduate nurses who fail to demonstrate the baseline knowledge and competence necessary to provide safe patient care including safe medication administration. The Assessment Technologies Institute (ATI) comprehensive predictor proctored examination provides a reliable prediction of student success on the NCLEX examination. Study findings reported by ATI in 2010 indicated an overall predictive reliability of 87.5% for successful passing of the NCLEX (ATI, 2010).

Identification of Gaps within Simulation Curriculum

In order to identify potential areas of change within existing simulation curriculum within a Bachelor of Science in Nursing (BSN) program at a mid-size, public university in Northwest Ohio, current simulation objectives and components were mapped against NCLEX test plan categories and content sub-categories. The purpose of this mapping process was to identify gaps in student knowledge related to NCLEX test plan components and recognize concepts that were missing from or minimally incorporated into existing simulation curriculum. This analysis identified several sub-categories that were not addressed or only partially addressed. For example, content within the sub-category of pharmacological and parenteral therapies that was not fully addressed included adverse effects/contraindications/side effects/interactions, dosage calculation, and medication administration. In addition, simulation content related to the sub-

category of management of care including performance/quality improvement was missing. Appendix A provides an overview of the mapping outcomes.

Clinical Question

Newly graduated nurses who fail to demonstrate the minimum level of knowledge, competence, and readiness to practice may be more at risk for committing a medical error such as a medication error contributing to extended hospital stays, additional resource utilization, lower patient satisfaction rates, and poorer patient outcomes (Agyemang & While, 2010). In addition, a significant number of potential medication errors are committed by student nurses in the clinical setting as reported by their clinical instructors. These medication errors can be categorized as: 1) failing to identify the patient prior to administration of medication; 2)selecting an incorrect medication; 3) dispensing an incorrect medication concentration; 4) calculating an inaccurate dose; 5) preparing medication in an unsafe manner; 6) failing to identify medication allergies; and 7) administering medications using incorrect technique (Schneidereith, 2014). The purpose of this project is to evaluate the impact of participation in a safe medication administration (SMA) simulation on undergraduate nursing student self-confidence in learning and performance on standardized testing related to pharmacological and parenteral therapies.

Using the “PICOT” format, a clinical question was developed to guide the evidence search. P refers to the population of interest, I represents the issue of interest or intervention, C refers to the comparison or control intervention, O corresponds with the outcome of interest, and T represents the time involved to measure the outcome (Melnyk & Fineout-Overholt, 2015). The proposed clinical question to guide the evidence search for this project is: In junior-level nursing students in an Advanced Fundamentals of Nursing clinical course (P), how does participation in a safe medication administration (SMA) simulation (I), compared to non-participation in an

SMA simulation experience (C), affect student self-confidence in learning and performance on critical components of a standardized nursing examination (O) following participation in the simulation experience (T)?

Model for Evidence-Based Practice (EBP) Change

Identification of Evidence-Based Practice Model

A conceptual model provides an organized framework to guide integration of evidence-based practice changes (Melnyk & Fineout-Overholt, 2015). The model used to guide this project implementation is the six-step Model for Evidence-Based Practice Change. In step one of this model, the need for change is assessed including identification of stakeholders, collection of internal data about current practice, comparison of internal and external data, and identification of the problem (Rosswurm & Larrabee, 1999). In step two, the problem is defined in standardized language, potential interventions and activities are identified, and outcome indicators are selected. In step three, the best research evidence is identified, prioritized, and synthesized. In step four, a change in practice is designed including identification of needed resources, development of the implementation process, and definition of outcomes. In step five, the change is implemented as a pilot study and evaluated for effectiveness. Based on evaluation, the decision is made to adapt, adopt, or reject the practice change. In step six, the practice change is fully integrated and maintained as a standard of practice including communication of the practice change with all stakeholders, education of impacted staff, and ongoing monitoring of change outcomes.

Rationale for Selection of Model for Evidence-Based Practice Change

This model was selected as it provides clear and concise organization of model concepts and is easy to follow in schematic diagrams (Gawlinski & Rutledge, 2008). Model concepts are

comprehensive and applicable within the nursing education setting and with various populations such as nursing students. This model also incorporates principles of quality improvement, use of team work tools, and evidence-based translation strategies (Melnyk & Fineout-Overholt, 2015).

Model Fit with Evidence-Based Project

The Model for Evidence-Based Practice Change provided an effective fit with this EBP project. In the first step, the need for a change in teaching practice related to medication administration knowledge and skills was assessed, current teaching practices were reviewed, the problem of poor performance on standardized nursing examinations and real and potential medication errors in the clinical setting was identified, and a relevant PICOT question was developed. In the second step, the literature review was planned and conducted to determine the best evidence available based on the concepts identified in the PICOT question. In the third step, the literature was critically analyzed to identify evidence supporting the importance of effective medication administration teaching, the benefit of simulation to support this teaching, and common causes of medication errors. In the fourth step, the practice change related to medication administration education was defined, resources necessary to implement the change were identified, and evaluation and implementation plans were developed. In step five, the change in teaching practice were implemented and evaluated as a pilot study. In the final step, the teaching practice change was integrated into practice and maintained as standard practice. Results of the project will be disseminated.

Theoretical Framework

Kolb's Experiential Learning Theory proposes that learning is a continuous process and that learning experiences must meet the needs of all types of learners (Lisko & O'Dell, 2010). According to Kolb, knowledge is created by transforming experience into practical application.

Learning is enriched through active participation in applicable experiences that foster problem solving, decision making, and active reflection. This theory provides a useful framework for the use of simulation-based learning experiences which allow learners to apply nursing knowledge in caring for simulated patients within a safe learning environment. This knowledge application leads to further acquisition of applied knowledge which is reflected in safer patient care delivery in the clinical setting.

Evaluation of Evidence in Literature

Literature Review

A search of the literature was conducted using the Cochrane Library, Cumulated Index to Nursing and Allied Health Literature (CINAHL), and PubMED databases and the keyword "medication errors" with the Boolean connectors AND with keywords "simulation" OR "medication simulation" and AND "nursing students" OR "student nurses". Subject heading search was conducted using the terms "simulation", "medication errors", and "computer simulation". The initial search resulted in 10,755 hits in CINAHL using the keyword "medication errors". When the search was limited to peer-reviewed, academic journals within the last five years and the Boolean connectors AND with keywords "simulation" OR "medication simulation" and AND "nursing students" OR "student nurses" were applied, 139 articles were abstracted. Grey literature was also searched with three related doctoral dissertation studies identified. Articles that did not include human subjects, were non-English language, were not related to the PICOT question, or were repeated were excluded. Inclusion criteria were publication within the last five years and peer-reviewed articles from academic journals. After applying inclusion and exclusion criteria, 12 articles were maintained for critical appraisal and evaluation. Several articles that did not meet inclusion criteria were identified to

provide background information. Appendix B provides an overview of the first phase of the database search and data abstraction process.

Characteristics of Studies

Evidence that is reliable and accurate is necessary to support practice change that is applicable, efficient, and leads to desired outcomes (Melnyk & Fineout-Overholt, 2015). The highest level of evidence, Level 1, includes quantitative research designs such as systematic review or meta-analysis of randomized controlled trials (Stillwell, Fineout-Overholt, Melnyk, & Williamson, 2010). Level II evidence comprises randomized, control trials. Level III includes controlled trials without randomization. Level IV includes case-control or cohort studies. Level V contains systematic review of qualitative or descriptive studies. Level VI includes qualitative or descriptive studies. Level VII consists of expert opinion or consensus. Kept articles were evaluated based on the hierarchy of evidence for intervention questions and ability to answer the PICOT question. Appendix C provides an overview of article characteristics as well as inclusion and exclusion rationale.

Appraisal and Synthesis

The critical appraisal process involves evaluation of the strength, limitations, and value to practice of study evidence (Melnyk & Fineout-Overholt, 2015). Ten of the retained studies were critically appraised and evidence from each study was synthesized. Using the Rapid Critical Appraisal template questions as developed by Fineout-Overholt & Melnyk (2015), an evaluation table was developed for each study identifying the evidence by level and quality, conceptual framework and purpose, research design and methodology, sample and setting, major variables, measurement of variables, data analysis, and study findings. Strengths and weaknesses of each

study were identified and a conclusion was developed based on the quality of the evidence. Appendix D provides critical appraisal evaluation tables for each article.

Ten of the 12 articles were critically appraised. Evidence from these ten articles is synthesized as shown in appendix E. Levels of evidence included level II for the three randomized, controlled trials; level III for an experimental study, a prospective study, and an uncontrolled cohort study; level IV for two non-experimental pilot studies; and levels V through VII for two integrative reviews. Only one study by Sears et al. (2010) fully addressed the effect of simulation-based experience on the number of APME committed by nursing students in the clinical setting. This study did have significant findings that support the use of SBE to decrease the number of APME by nursing students in the clinical setting. The integrative review by Shearer (2013), which included the study by Sears et al. (2010), also identified a study that looked at the effect of SBE on APME in the clinical setting in relation to patient identification. These study results identified fewer omissions by student nurses who participated in SBEs in checking two patient identifiers prior to administering medications in the clinical setting. A study by Ford et al. (2010) identified that intensive care unit (ICU) and cardiac care unit (CCU) nurses who participated in SBE had fewer clinical medication errors. Studies by Shearer (2013), Scudmore (2013), and Zahara-Such (2013) provided evidence supporting the use of SBE to decrease the number of APME in the simulation setting.

A study by Campbell (2013) identified an increase in the rate of APME by nursing students in the simulation and clinical setting however study evidence had inter-rater reliability concerns. A study by Schneidereith (2014) identified that nursing students commit more APME in the simulated setting as they progress through a nursing education (NE) program suggesting that the consistent use of SBE might be beneficial to address this decline in skills. Overall,

evidence is supportive of the use of SBE in NE to decrease the number of APME and improve safe medication administration practices by nursing students in the clinical setting.

Proposed Recommendations for Practice

Statement of Proposed Recommendations

Evidence identified from literature review and critical appraisal processes support knowledge and skill development related to safe medication administration by nursing students and practicing nurses in the clinical as well as simulation settings following simulation-based learning experiences. Recommendations for practice change include the addition of safe medication administration simulation into simulation curriculum. Proposed implementation steps include the following:

- Obtain Institutional Review Board Approval and informed consent
- Compare current simulation objectives and components to NCLEX test plan categories and content sub-categories and analyze gaps in content
- Identify appropriate instrument for outcome measurement
- Develop safe medication administration (SMA) simulation scenario based on INACSL recommendations
- Train clinical laboratory assistants on accurate and consistent implementation of SMA simulation scenario
- Pilot use of SMA simulation into junior-level, advanced fundamentals of nursing skills laboratory simulation experience
- Assess student experience through use of National League for Nursing (NLN) Student Satisfaction and Self-Confidence in Learning instrument following each educational debriefing session

- Assess Fall 2016 Assessment Technologies Institute (ATI) Fundamentals proctored examination aggregate results within Pharmacological and Parenteral Therapies content area following simulation and compare to Summer 2016 results
- Based on results, incorporate use of SMA simulation into junior-level course within the nursing education program
- Develop and implement a simulation curriculum plan based on NCLEX test plan components
- Monitor ongoing effectiveness of evidence-based practice change

Internal and External Evidence

External sources from literature review provide significant evidence that the use of SBE reduces the rate of APME committed by nursing students and graduate nurses in the clinical setting (Ford et al, 2010; Sears et al., 2010; Shearer, 2013). In addition, evidence supports the use of SBE in nursing education to reduce the incidence of APME in the simulation setting (Scudmore, 2013; Shearer, 2013; Zahara-Such, 2013). Internal evidence includes simulation-based learning experiences in nursing education have been shown to reinforce pharmacologic knowledge, improve healthcare team communication skills, strengthen psychomotor skill competence, and develop clinical decision making skills (Medley & Horne, 2005).

Patient Preferences and Values for Recommendation

From a caring perspective, consideration of patient preferences and values is essential to patient-centered, evidence-based decision making (Melnyk & Fineout-Overholt, 2015). Patients and families value and expect the provision of safe, competent nursing care including medication administration free from actual or potential error. It is the professional and ethical responsibility of nurses, and nursing students, to protect patient safety during all care delivery including

medication administration and monitoring for medication effects. Identifying and implementing the most effective methods to strengthen safe medication administration practices in nurses and nursing students promotes optimal patient safety outcomes.

Human Subjects Concerns

Institutional Review Board (IRB) approval was procured prior to obtaining informed consent, measuring data, or implementing any practice changes. All data will remain confidential and anonymous. For this practice change project, the risks and benefits of study participation, impact on outcomes, and potential knowledge to be gained were identified (Melnyk & Fineout-Overholt, 2015). For the pilot study of this proposed practice change, nursing students enrolled in the Advanced Fundamentals of Nursing course participated in an SMA simulation experience as a course requirement. Anticipated outcomes of this intervention included increased student self-confidence in learning and improved performance on standardized nursing examination within the content area of pharmacological and parenteral therapies. Evidence gained from this study has the potential to further substantiate the effectiveness of simulation-based learning experiences within nursing education to improve nursing student knowledge and competence related to safe medication administration. In addition, this increased safe medication administration knowledge and competence can be reflected in improved patient safety outcomes within the clinical setting. The benefits outweigh the risks related to this proposed practice change.

Action Plan

Setting and Population

Medication errors can occur at any point in the medication process including the steps of obtaining, prescribing, dispensing, and administering medications as well as monitoring for

medication effects (Institute of Medicine, 2006). Medication-related errors pose an ongoing threat to patient safety and outcomes in all healthcare settings. Despite comprehensive training in the classroom, laboratory, and clinical settings, APME committed by nurses and nursing students occur in the clinical setting putting patients at risk. It is imperative that more effective methods of nursing education related to safe medication administration be implemented. Nursing education programs should implement the use of high-fidelity, simulation-based learning experiences which incorporate medication administration experiences to more effectively prepare students to administer medications safely in the clinical setting. Initial implementation of this project occurred within a bachelor in the science of nursing (BSN) program at a mid-size, public university in Northwest Ohio. The initial population was junior-level nursing students enrolled in an advanced fundamentals of nursing course.

Stakeholders

A key component of developing and implementing any change in process requires identification and engagement of stakeholders (Melnyk & Fineout-Overholt, 2015). Active stakeholders who played a key role in the development and progression of this proposed practice change include faculty teaching fundamentals of nursing courses, teaching assistants teaching within skills laboratories, simulation technicians within simulated environments, and nursing administrators. Each of these active stakeholders were an integral component of the implementation team. Passive stakeholders are those people who are not actively involved in the project but could promote or hinder its success (Fineout-Overholt, Williamson, Gallagher-Ford, Melnyk, & Stillwell, 2011). For this project, passive stakeholders included nursing students, patients within the clinical setting, nursing faculty not involved in advanced fundamentals of nursing coursework or laboratory instruction, nursing advisory board members, college

administration, and clinical site administrators or staff. Nursing students can view simulation-based learning experiences as either valuable or non-valuable thereby affecting the quality and fidelity of the experiences. Patients in the clinical setting can be directly affected by the impact of simulation-based experiences on safe care provided by nursing students. Nursing faculty who are not involved in advanced fundamentals of nursing coursework or laboratory instruction can support or deny the increased departmental costs and resources necessary to implement this project. Nursing advisory board members, college administration, and clinical site administration and staff can determine the value and impact of safer clinical care delivery by nursing students as a positive indicator of program success, achievement of outcomes, and program reputation.

Barriers to Implementation

Four barriers to implementation of this project have been identified. One barrier to project implementation was inadequate knowledge and skills related to effective use of simulation technology in nursing education (Miller & Bull, 2013). Many nurse educators are uncomfortable or unfamiliar with how to run high-fidelity simulators and scenario programs in a smooth, realistic manner. A second barrier was the substantial time necessary to set up a realistic simulation program and setting as well as train faculty and simulation laboratory personnel. Currently, the Director of the Learning Resource Center identifies and schedules all simulation experiences in collaboration with lead course faculty. Simulation experiences are taught by Clinical Laboratory Assistants (CLAs). The significant financial investment required to purchase simulation equipment and programs, develop an appropriate and realistic simulation setting, train faculty and personnel to program and run scenarios effectively, and conduct ongoing monitoring of the effectiveness of simulation-based experiences presented a third barrier (Miller & Bull,

2013). A final barrier was resistance to change. Traditionally, nurse educators have taught medication administration skills to students in the classroom, laboratory, and clinical settings using the rights method of ensuring right time, medication, dosage, patient, and route (Schneidereith, 2014). Some research shows that adherence to verifying these rights may taper off as a student progresses through a nursing education program. The use of simulation-based experiences may help to reinforce learning and application of this knowledge and skill development. However, many nurse educators are resistant to changing how medication administration skills are traditionally taught and reinforced.

Facilitators to Implementation

Identification of strategies and support systems to overcome anticipated barriers can help to facilitate implementation of potential practice changes (Melnyk & Fineout-Overholt, 2015). A key facilitator to this project was the Director of the Learning Resource Center who is a strong proponent of evidence-based practice, innovation in nursing education, and the use of simulation technology. High-fidelity simulation technology and National League of Nursing (NLN) programming that was already in place and currently utilized to some degree in several of the nursing courses was a second facilitator. A third facilitator was college administrators who support the use of innovative teaching learning techniques and promote the use of simulation technology within the nursing program. Improved clinical outcomes, in the form of fewer medication errors and satisfied clinical site administrators, could reflect positively on nursing program outcomes and reputation. Project implementation could also be facilitated by periodic training sessions offered by the simulation technology provider as well as nursing faculty members with simulation technology experience. Increasing the knowledge and skills related to use of simulation technology can help to overcome one of the key barriers to implementation of

this project. Formative and summative evaluation of the impact of simulation-based experiences on student self-confidence in learning and performance on standardized testing can provide incentive and support for the ongoing incorporation of SMA simulation to the existing simulation curriculum. Financial cost for the development of safe medication administration simulation scenario and additional addendums to current simulation scenarios was minimal due to current simulation setting and programming that was in place.

Implications for Evidence-Based Practice Change

The strength of recommendation refers to the degree of confidence that the desirable effects of an intervention such as reduced morbidity and mortality, improved quality of life, decreased burden of treatment, and reduced use of resources outweigh the negative effects (Guyatt et al., 2008a). The GRADE system determines strength of recommendation based on four key factors. The first determinant is the balance between desirable and undesirable effects of the intervention. A strong recommendation would be given on the basis of a large difference between the advantages and disadvantages of an intervention. A second determinant is the quality of evidence based on study rigor, consistency of results, absence of study limitations, directness of evidence, precision, and freedom from bias. A strong recommendation would be based on consistent, high quality, bias-free evidence. A third determinant for a strong recommendation grade is minimal variance in values and preferences related to the recommendation risks or benefits. Minimal variance in values and preferences and high level of certainty related to the intervention would warrant a strong recommendation. A final determining factor is the use of resources or overall cost. An intervention with a high cost might warrant a weak recommendation grade. Recommendations one and four were given strong recommendation scores based on the significant benefit of decreased rates of medication errors

in the clinical setting, average QOE scores of B, high public value and preference for safe care delivery, and minimal cost of the intervention. Recommendation two was given a strong recommendation score based on high scores in all four areas. Although the average QOE score for recommendation three was a C, it was given a strong recommendation score based on significant difference between desirable and undesirable effects, high value and preference for safe patient care, and minimal cost. Table 1 provides an overview of the strength of evidence for recommendation.

Table 1

Strength of Recommendation Table

Recommendation	**Strength of Evidence for Recommendation**	**Reference in Support of Recommendation**
1. Incorporate Safe Medication Administration simulation into clinical course within a nursing education program.	Strong	Sears et al., Hayden et al., Shearer, Zahara-Such
2. Train clinical laboratory assistants to run SMA simulation following best practice guidelines related to SBL.	Strong	Hayden et al.
3. Assess nursing student learning in the simulation setting using NLN Student Satisfaction and Self-Confidence in Learning Instrument.	Strong	Schneidereith, Scudmore, Goodstone & Goodstone, Handley & Dodge, Hayden et al.
4. Assess student learning using a standardized examination (ATI).	Strong	Assessment Technologies Institute, 2010
5. Develop and implement simulation curriculum plan based on NCLEX test plan components.	Strong	Hayden et al.

ATI=Assessment Technologies Institute; NCLEX=National Council Licensure Examination; NLN=National League for Nursing; SBL=Simulation-Based Learning; SMA=Safe Medication Administration

Safe Medication Administration Simulation Pilot Study

Safe Medication Administration (SMA) Simulation Scenario

Based on review of the evidence identifying medication error as a high-risk patient safety concern as well as lack of preparation of nursing students and graduate nurses to prevent, identify, and respond appropriately to medication errors, a simulation scenario focused specifically on safe medication administration principles and practices was developed. The author-developed Safe Medication Administration (SMA) simulation scenario incorporated seven of the primary causes of medication errors identified in the literature. These potential ADEs included wrong patient, wrong medication, incorrect route, inaccurate dose, inaccurate calculation, medication allergy, and unexpected patient response.

Simulation development and implementation was based upon International Association for Clinical Simulation & Learning (INACSL) recommendations for high quality simulation design including the use of a consistent format and a realistic clinical scenario that included situation, clinical progression, cues, time frames, scripting, and identification of critical actions (INACSL Standards Committee, 2016). Clear and measurable objectives, a high level of fidelity, well-trained facilitators, a pre-briefing process, an educational debriefing process, and evaluation of the scenario experience were incorporated into the simulation experience. Appendix F provides an overview of the SMA simulation scenario.

Sample

The pilot study for this project occurred within a Bachelor of Science in Nursing (BSN) program at a mid-size, public university in Northwest Ohio. The participants included summer 2016 cohort of junior-level nursing students and fall 2016 cohort of junior-level nursing students enrolled in an advanced fundamentals of nursing course, total n=131. The Summer 2016 cohort

(n=62) consisted of 84% females and 16% males. Of this cohort, 86% identified their ethnicity as Caucasian and 14% identified as non-Caucasian. The Fall 2016 cohort (n=69) consisted of 91% females and 9% males. Of this cohort, 87% identified their ethnicity as Caucasian and 13% identified as non-Caucasian. For both cohorts, students had previously completed four nursing courses covering nursing across the lifespan, basic fundamentals of nursing, basic pathopharmacology, and nursing research.

Procedure

Students in the Fall 2016 cohort served as the experimental group and participated in the newly developed Safe Medication Administration (SMA) simulation experience. Students in the Summer 2016 cohort served as the control group and did not participate in the simulation. Prior to the simulation experiences for the Fall 2016 cohort, five clinical laboratory assistants were trained by the student researcher on the SMA simulation objectives, preparation, administration, and scheduling using INACSL principles for effective simulation administration. Students in the Fall 2016 cohort were assigned to groups of four to five students per simulation group. The SMA simulations were run over the course of two days within two rooms of the university-based simulation center. High-fidelity simulation mannequins were used to replicate the simulation scenario, patient responses, and physiological reactions. A short pre-briefing was provided to each group of students. During the simulation, students used a paper medication administration record (MAR) to administer scheduled and non-scheduled medications. Responses of the patient, health care providers, pharmacists, and hospital personnel as well as administration of the scenarios were provided by the clinical laboratory associates. Each simulation ran for 25 minutes followed by a 15 minute educational debriefing session conducted by the student researcher. Each debriefing session included two simulation groups of students. During the

debriefing sessions, student thoughts and feelings about the simulation experience were explored, potential and actual medication errors were identified, potential and actual safety measures were discussed, and the purpose and process of incident reporting was reviewed. Following the debriefing session, students completed a post-simulation survey aimed at assessing their level of satisfaction with the simulation experience as well as their confidence level.

At the end of the semester, students in the Fall 2016 cohort took a course-required ATI Fundamentals of Nursing proctored examination. Results from the ATI proctored examination were then compared with the results of the control group (Summer 2016) cohorts' ATI proctored examination. Specifically, the Pharmacological and Parenteral Therapies content areas were compared.

Methods of Evaluation

NLN student satisfaction and self-confidence in learning instrument. Evaluation of outcomes is a key component in identifying the impact of any practice change (Melnyk & Fineout-Overholt, 2015). A wide range of qualitative evidence exist supporting student satisfaction with simulation technology and its effect on the development of student self-confidence and competence (Hayden, Smiley, Alexander, Kardong-Edgren, & Jeffries, 2014; Handley & Dodge, 2013; Medley & Horne, 2005; Sears et al., 2010). For this pilot study, outcome measures that quantify student satisfaction and self-confidence in learning were measured to evaluate the effect of simulation-based learning experiences within a nursing education program.

One outcome measure for this project was the National League for Nursing (NLN) Student Satisfaction and Self-Confidence in Learning instrument (NLN, 2016). This 13-item instrument is designed to measure student satisfaction (five items) with the simulation activity

and self-confidence in learning (eight items) using a five-point Likert scale (Franklin, Burns, & Lee, 2014; Jeffries & Rizzolo, 2006). Reliability for this tool from previous research is established with a Cronbach's alpha of 0.94 for the satisfaction subscale and 0.87 for the self-confidence subscale (Jeffries & Rizzolo, 2006). Content and face validity of this instrument was established through extensive literature review, independent expert opinion, and student panel preview of the questionnaire survey (Omer, 2016). Permission to use this instrument for non-commercial use was granted with retention of the NLN copyright statement. This instrument is provided in Appendix G. Permission to use this instrument is provided in Appendix H. Following each debriefing session, students voluntarily completed this anonymous NLN Student Satisfaction and Self-Confidence in Learning survey.

ATI fundamentals of nursing proctored examination. A second outcome measure was student performance on a standardized examination within the content area of physiological integrity with a focus on pharmacological and parenteral therapies using the Assessment Technologies Institute (ATI) Fundamentals of Nursing proctored examination. This 60-question, proctored examination assesses student nurse knowledge and comprehension within several major content areas including Pharmacological and Parenteral Therapies (ATI, 2010). This specific content area includes questions related to dosage calculation, medication administration, and parenteral/intravenous therapies. Students enrolled within the Advanced Fundamentals of Nursing course were required to take this standardized examination at the end of the course as a course requirement. For this pilot study, after approval from the university's IRB, aggregate results from the Pharmacological and Parenteral Therapies content areas of the Fall 2016 cohort were compared to aggregate results of the Summer 2016 cohort.

Method of Analysis

NLN student satisfaction and self-confidence in learning instrument. The SPSS (Statistical Package of Social Sciences) 23 program was used to evaluate the data derived from the NLN Student Satisfaction and Self-Confidence in Learning instrument. Descriptive statistics including median, range, and interquartile percentages were calculated for each item on the survey for the group.

ATI fundamentals of nursing proctored examination. Inference for two independent proportions was utilized to calculate the difference in the ATI Fundamentals of Nursing proctored exam cohort results for the Summer 2016 and Fall 2016 cohorts. Because this study was focused on medication administration errors, calculations were performed for the pharmacologic content areas of dosage calculation and medication administration. These content areas consisted of two questions in each category for the Summer 2016 cohort. The Fall 2016 cohort exam consisted of one dosage calculation question and three medication administration questions.

Results

NLN student satisfaction and self-confidence in learning instrument. Of the Fall 2016 cohort (n=69) who participated in the SMA simulation scenario, over 94.3% of the students agreed or strongly agreed that they were satisfied with the learning that occurred during the simulation experience. All of the students found the SMA simulation experience to be a helpful and effective teaching method that incorporated a variety of learning materials and activities that promoted learning. Over 96.5% of the participants agreed or strongly agreed that the SMA simulation experience improved their level of self-confidence in learning. All of the students felt confident that the simulation experience helped to develop skills and knowledge necessary to perform tasks in the clinical setting. A smaller percentage (85.8%) of the participants felt confident in mastery of the content of the simulation activity. For the final survey question,

51.4% of the students felt that it was the instructor's responsibility to tell the learners of the simulation activity content during class time. Overall reliability for this tool was established with a Cronbach's alpha of 0.84 for this pilot study. All survey items and results are listed in Table 2.

Table 2

Student satisfaction and self-confidence in learning survey (n=69)

	SD	D	U	A	SA	M
Satisfaction with current learning						
1. The teaching methods used in this simulation were helpful and effective.	0	0	0	24 (34%)	46 (66%)	4.66
2. The simulation provided me with a variety of learning materials and activities to promote my learning of safe medication administration.	0	0	0	23 (33%)	47 (67%)	4.67
3. I enjoyed how my instructor taught the simulation.	0	0	8 (11%)	19 (27%)	43 (62%)	4.5
4. The teaching materials used in this simulation were motivating and helped me to learn.	0	0	4 (6%)	16 (23%)	50 (71%)	4.66
5. The way my instructor(s) taught the simulation was suitable to the way I learn.	0	0	8 (11%)	22 (31%)	40 (58%)	4.46
Self-confidence in learning						
6. I am confident that I am mastering the content of the simulation activity that my instructors presented to me.	0	0	10 (14%)	44 (63%)	16 (23%)	4.09
7. I am confident that this simulation covered critical content necessary for the mastery of medical surgical curriculum.	0	0	1 (1%)	15 (22%)	54 (77%)	4.76
8. I am confident that I am developing the skills and obtaining the required knowledge from this simulation to perform necessary tasks in a clinical setting.	0	0	0	20 (29%)	50 (71%)	4.71
9. My instructors used helpful resources to teach the simulation.	0	0	1 (1%)	26 (37%)	43 (62%)	4.6
10. It is my responsibility as the student to learn what I need to know from this simulation activity.	0	0	0	16 (23%)	54 (77%)	4.77
11. I know how to get help when I do not understand the concepts covered in the simulation.	0	0	3 (4%)	21 (30%)	46 (66%)	4.61
12. I know how to use simulation activities to learn critical aspects of these skills.	0	0	2 (3%)	24 (34%)	44 (63%)	4.6
13. It is the instructor's responsibility to tell me what I need to learn of the simulation activity content during class time.	2 (3%)	10 (14%)	22 (31%)	16 (23%)	20 (29%)	3.6

A=agree; D=disagree; M=mean; SA=strongly agree; SD=strongly disagree; U=undecided

ATI fundamentals of nursing proctored examination. Cohort performance on the standardized ATI Fundamentals of Nursing proctored examination for overall pharmacologic content was 79.00% for the Summer 2016 cohort and 79.50% for the Fall 2016 SMA cohort

which participated in the SMA simulation experience (Z_{data}=-.07048; p=0.47). Performance on the sub-content area of dosage calculation was 92.75% for the Summer 2016 cohort and 78.30% for the Fall 2016 SMA cohort (Z_{data}=2.32148; p=0.01). Performance on the sub-content area of medication administration was 87.10% for the Summer 2016 cohort compared to 88.90% for the Fall 2016 SMA cohort (Z_{data}=-.31709; p=0.38). Proctored Fundamentals of Nursing examination results for both cohorts are provided in Table 3.

Table 3

ATI Fundamentals Proctored Exam

Pharmacologic Content area	Summer 2016 Cohort Results (n=62)	Fall 2016 SMA Cohort Results (n=69)	Z score	Level of Significance
Overall	79.00%	79.50%	-0.07048	0.47
Dosage Calculation	92.75%	78.30%	2.32148	0.01*
Medication Administration	87.10%	88.90%	-0.031709	0.38

*Statistically significant p< 0.05

Discussion

According to Bandura (1977), self-efficacy is defined as the self-perception that one has the capability to perform in a certain manner to achieve a goal or complete a task competently. Increased self-efficacy may improve levels of self-confidence in learning. Following participation in the SMA simulation experience, the majority of students demonstrated a high level of self-confidence and satisfaction in learning. Most SMA participants felt satisfied with the learning that occurred during the simulation experience and found it to be a helpful and effective teaching method that incorporated a variety of learning materials and activities that promoted learning. Most of the SMA simulation participants found that the SMA simulation experience improved their overall level of satisfaction and self-confidence in learning. All of the

students felt confident that the simulation experience helped to develop skills and knowledge necessary to perform tasks in the clinical setting. The majority of participants felt confident in mastery of the content of the simulation activity. Any lack of satisfaction in learning and self-confidence in learning may have been due to the lack of prior simulation learning experience other than a brief orientation to the simulation setting and process. The variance in responses to the final survey item related to the instructor's responsibility to inform students of the simulation learning needs may have also been due to lack of prior simulation experience as well as lack of familiarity with the evaluation instrument questions.

Overall, the SMA simulation learning experience provided an opportunity for students to administer medications safely including committing actual and potential medication errors free from risk to patient safety. Throughout the SMA simulation scenario, students were allowed to make medication errors without being stopped by the instructor. During the debriefing session, students were able to recognize actual and potential medication errors incorporated within the scenario, determine nursing interventions to minimize error risk, and review appropriate responses when a medication error does occur. Through this simulated learning experience, students were able to expand their knowledge by "learning from their mistakes" without causing patient harm (Campbell, 2013). Repetition of critical skills is necessary for student nurses and graduate nurses to perfect psychomotor skills. In addition, successful math calculation techniques reinforced within a realistic simulated setting and scenario supports student nurse confidence, critical thinking skills, and ability to problem solve (Zahara-Such, 2013). Evidence suggests that repetition of safe medication administration skills through the use of regular and varied simulation learning experiences can help to reinforce SMA practices within the clinical setting by nursing students (Schneidereith, 2014). The skills and knowledge related to safe

medication administration gained within this safe learning environment can be repeatedly practiced and then applied to successful performance on standardized testing as well as safe medication administration practices within the actual clinical setting leading to improved patient safety.

According to the NLN, nursing judgment involves the synthesis of nursing science and knowledge from other disciplines in the provision of safe, quality care delivery within the practice setting (National League for Nursing, 2010). While active learning strategies such as simulation have been shown to promote knowledge development, retention, and application, student expectations continue to include a desire to be explicitly guided through the learning process. This concept was supported in student responses to question #13 in this study as well as in the literature (Franklin et al., 2014). Students feel more comfortable with being instructed on the details of what will happen and want the content provided to them in the course. Realistically, an instructor cannot cover every situation, scenario, and intervention making the practice of independent thinking a priority. Using simulation experiences, nurse educators can nurture nursing student accountability for their own learning. In the simulation setting, nursing instructors provide safe, realistic venues to promote engagement while empowering students to independently think. This requires the student to rely on their own nursing judgment to work their way through simulated patient situations. Allowing students to function independently within a controlled, simulated patient setting promotes the delivery of safe, competent patient care in the clinical setting.

Although not a significant finding, cohort performance on the standardized ATI Fundamentals of Nursing proctored examination for overall pharmacologic content increased slightly for the cohort participating in the SMA simulation experience. Evidence suggests that

dosage calculations which manipulate the known weight or volume strength in order to find the required weight or volume strength are often error-prone (Wright, 2008). These dosage calculations require additional calculation steps and involve converting between different units of measurement. The statistically significant decline in performance on the sub-content area of dosage calculation was likely due to the difficulty of the dosage calculation incorporated into the applicable questions. For the 2016 Summer cohort, the ATI questions were based on basic dosage calculation for a parenteral medication and an oral medication. For the 2016 Fall SMA cohort, the ATI question was based on a weight-based dosage calculation change for a parenteral medication. Performance on the sub-content area of medication administration improved slightly, but not significantly, for the cohort participating in the SMA simulation experience. Repeated participation in SMA simulations might have a more significant impact on this sub-content area (Schneidereith, 2014). Future studies are necessary to compare standardized testing over multiple cohorts following SMA simulation participation as well as the effect of repeated SMA simulation experience.

Principles of Kolb's Experiential Learning Theory support the transformation of practical application of problem solving, decision making, and active reflection gained through participation in this SMA simulated learning experience into improved safe medication administration knowledge and skills demonstrated by nursing students. Within the actual clinical setting, improved SMA practices by nursing students and graduate nurses have a positive impact on patient safety and outcomes (Hayden, Smiley, Alexander, Kardong-Edgren, & Jeffries, 2014; Sears et al., 2010). For this pilot study, psychomotor performance was not directly assessed. Future studies evaluating the impact of participation in a SMA simulation experience on the number of actual and potential medication errors committed by nursing students in the

simulation as well as the clinical practice setting would be beneficial in assessing this direct effect and actual change in clinical practice performance.

Based on the literature review and findings from the pilot study, changes to the simulation curriculum within the Bachelor of Science in Nursing (BSN) program at a mid-size, public university in Northwest Ohio were implemented. These ongoing changes include incorporation of SMA simulation into the advanced fundamentals of nursing course as well as the development and implementation of a more comprehensive simulation curriculum plan based on NCLEX test plan components. Additions to existing simulation scenarios as well as the incorporation of new scenarios will further support student learning of key concepts identified through the NCLEX test plan mapping process. Refer to appendix I for additions to simulation curriculum.

Limitations

One limitation identified in this pilot project was the lack of substantial prior simulation experience other than a brief orientation to the simulation setting. This may have contributed to student confusion and lack of confidence in locating supplies and equipment within the simulation setting, effectively communicating with health care team members in a timely manner, and identifying actual assessment findings on the mannequin. Although students had participated in a prior orientation to the simulation setting, comprehensive orientation to the simulation setting and resources as well as more extensive experience within the simulated learning setting may have improved student performance during the SMA simulation scenario.

A second limitation was the variance in question difficulty within the pharmacological sub-content area on the ATI standardized test between cohorts. For the drug calculation content area, cohort scores were much higher for a simple dosage calculation as opposed to a more

complex, weight-based dosage calculation. This may have skewed the results in favor of the cohort (Summer 2016) with the more simple calculation.

A third limitation was the variance in the number of questions included for each sub-content area on the ATI Fundamentals proctored test between the two cohorts. The difference in the instrument used to assess the knowledge outcome between the two groups may result in a threat to the internal validity of the testing process (Polit, 2010). The Summer 2016 cohort pharmacological overall content area included two dosage calculation and two medication administration questions. The ATI Fundamentals proctored test given to the Fall 2016 cohort included one dosage calculation question and three medication administration questions. This variance may have skewed the results. Variance in the ATI examinations between cohorts introduced risk to the internal validity of the study. Differences in the question content, the number of sub-content questions, and the difficulty of the sub-content questions introduced confounding factors which may have impacted the study results rather than the intervention causing the difference in outcomes.

A fourth limitation was the use of one setting for the study which limited the generalizability of the results. Generalization carries the implications of the findings from the sample to a larger population (Burns & Grove, 2016). Findings of the study were not as robust as they would have been with the use of multiple sites.

Future Simulation Curriculum Recommendations

A final project step is the development of recommendations for simulation curriculum additions or modifications based on gaps between simulation curriculum and NCLEX test plan components identified through the mapping process. One future recommendation is the addition of a SMA simulation to address the sub-categories of Pharmacological and Parenteral Therapies

(all content areas); Management of Care (Advocacy, Establishing Priorities, Information Technology, and Performance Improvement content areas); and Safety and Infection Control (Accident/Error/Injury Prevention and Reporting of Incident). A second recommendation is the addition of a simulation incorporating a community-wide flood disaster response. This simulation could target several NCLEX test plan content areas that have not been addressed including Safe and Effective Environment (Concepts of Management, Confidentiality/Information Security, Assignment/Delegation, Ethical Practice, and Referrals); Safety and Infection Control (Emergency Response Plan, Handling of Infectious Materials, Home Safety, and Security Plan); and Psychosocial Integrity (Chemical and other Dependencies, Crisis Intervention, Grief and Loss, and Stress Management). Additions to current simulations could be used to incorporate missing content related to Ergonomic Principles, Case Management, Information Technology, Aging Process, Laboratory Values, Assistive Devices, Rest and Sleep, Potential for Complications from Diagnostic and Surgical Procedures and Health Alterations, and other key concept areas. Proposed simulation recommendations are outlined in Appendix I. Throughout this process, the project lead worked closely with the Director of the Learning Resource Center and Simulation (LRC) and LRC team to implement the pilot study as well as several proposed changes to the existing simulation curriculum.

Role of the Doctor of Nursing Practice (DNP): DNP Essentials

The Doctor of Practice (DNP) plays a critical role in the application of evidence-based practice to simulation curriculum development, implementation, and dissemination. Essential characteristics of the doctorally-prepared nurse focus on key areas of advanced nursing practice (American Association of Colleges of Nursing (AACN), 2006). Essential one, Scientific Underpinnings for Practice, integrates nursing science with knowledge from other disciplines as

well as science-based theories and concepts as the basis for best nursing practice. This project was built upon Kolb's Experiential Learning Theory and integrates knowledge from multiple health care and education disciplines. Essential three, Clinical Scholarship and Analytical Methods for Evidence-Based Practice, was supported through the use of Rosswurm and Larrabee's Model for Evidence-Based Practice Change. Utilizing this framework, the DNP performs an extensive literature review to analyze and identify best evidence to support the development, integration, and evaluation of simulation curriculum changes. Essential eight, Advanced Nursing Practice, was supported through the use of clinical judgment, systems thinking, and accountability in designing, delivering, and evaluating evidence-based practices to identify and address patient safety risks. Improvements in patient safety and quality outcomes were supported through the development and application of effective teaching learning principles and practices within nursing education.

Conclusion

In order to address the ongoing issue of lack of preparation related to safe medication administration by nursing students and graduate nurses in the clinical setting, steps one through four of the Model for Evidence-Based Practice Change as developed by Rosswurm and Larrabee (1999) were used as a guide. After identifying the need for a practice change related to how safe medication administration skills are developed and reinforced in nursing students, a comprehensive literature review was conducted to evaluate existing evidence supporting the use of simulation-based learning experiences to improve nursing student self-confidence in learning and performance on standardized examination related to pharmacological and parenteral therapies. Following critical appraisal and synthesis of this evidence, recommendations for practice and an action plan including identification of active and passive stakeholders and

anticipated barriers and facilitators to plan implementation were developed. Potential concerns of protection of human subjects in relation to this proposed practice change were identified and addressed.

A pilot study evaluating the impact of participation in a SMA simulation experience on nursing student satisfaction and self-confidence in learning as well as performance on standardized testing was implemented. Results of this pilot study identified improved student satisfaction and self-confidence in learning following participation in a simulation experience which incorporated key principles of safe medication administration. Although this study did not show significant impact on standardized testing performance following SMA simulation participation, it did identify the need for further studies using equivalent standardized testing as well as direct evaluation of simulation impact on the number of actual and potential medication errors committed by nursing students in the simulation and clinical settings following SMA simulation participation. Overall, this practice change based on rigorous literature review and supporting internal and external evidence has the potential to directly improve patient safety and outcomes in the clinical setting through improved nursing student knowledge and competence related to safe medication administration.

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Appendix A

NCLEX-RN Test Plan Category	**Content Sub-Category**		**IS**	**DM**	**CHF**	**PAN**	**PAS**	**PH**	**CH**	**EOL**	
Safe and Effective Care Environment	**Management of Care**										
	Related content:										
	-Advance Directives/Self-Determination/Life									C	
	Planning										
	-Advocacy				C		C	C	C	C	
	-Case Management								C		
	-Client Rights								C	C	
	-Collaboration with Interdisciplinary Team				C	C	C	C		C	
	-Concepts of Management										
	-Confidentiality/Information Security										
	-Continuity of Care					C			C		
	-Assignment, Delegation, and Supervision										
	-Establishing Priorities			C	C	C	C	C	C	C	
	-Ethical Practice								C	C	
	-Informed Consent										
	-Information Technology										
	-Legal Rights and Responsibilities								C	C	
	-Organ Donation										
	-Performance Improvement (Quality										
	Improvement)										
	-Referrals								C		

NCLEX-RN Test Plan Category	**Content Sub-Category**		**IS**	**DM**	**CHF**	**PAN**	**PAS**	**PH**	**CH**	**EOL**	
	Safety and Infection Control										
	Related content:										
	-Accident/Error/Injury Prevention			C	C	C	C		C		
	-Emergency Response Plan										
	-Ergonomic Principles										
	-Handling Hazardous and Infectious Materials										
	-Home Safety								C		
	-Reporting of Incident/Event/Irregular										
	Occurrence/Variance										
	-Safe Use of Equipment					C	C				
	-Security Plan										
	-Standard Precautions/Transmission-Based			C	C	C	C				
	Precautions/Surgical Asepsis										
	-Use of Restraints/Safety Devices										
Health Promotion and Maintenance	Related content:										
	-Aging Process										
	-Ante/Intra/Postpartum and Newborn Care							C	C		
	-Developmental Stages and Transitions								C		
	-Health Promotion/Disease Prevention								C		
	-Health Screening								C		
	-High Risk Behaviors					C	C		C		
NCLEX-RN	**Content Sub-Category**		**IS**	**DM**	**CHF**	**PAN**	**PAS**	**PH**	**CH**	**EOL**	

Test Plan Category											
	-Lifestyle Choices					C	C		C		
	-Self-Care								C		
	-Techniques of Physical Assessment			C	C	C	C	C	C	C	
Psychosocial Integrity	Related content:										
	-Abuse/Neglect								C		
	-Behavioral Interventions								C		
	-Chemical and Other Dependencies/										
	Substance Use Disorder										
	-Coping Mechanisms								C	C	
	-Crisis Intervention								C	C	
	-Cultural Awareness/Cultural Influences on										
	Health										
	-End of Life Care									C	
	-Family Dynamics				C		C		C	C	
	-Grief and Loss									C	
	-Mental Health Concepts								C		
	-Religious and Spiritual Influences on Health										
	-Sensory/Perceptual Alterations										
	-Stress Management								C		
	-Support Systems				C		C		C	C	
	-Therapeutic Communication				C				C	C	
	-Therapeutic Environment			C	C	C				C	
NCLEX-RN Test Plan Category	**Content Sub-Category**		**IS**	**DM**	**CHF**	**PAN**	**PAS**	**PH**	**CH**	**EOL**	

Physiological Integrity	**Basic Care and Comfort**										
	Related content:										
	-Assistive Devices										
	-Elimination										
	-Mobility/Immobility										
	-Non-Pharmacological Comfort Interventions							C	C	C	
	-Nutrition and Oral Hydration								C	C	
	-Personal Hygiene								C		
	-Rest and Sleep								C		
	Pharmacological and Parenteral Therapies										
	Related content:										
	-Adverse Effects/Contraindications/			C	C	C	C	C	C		
	Side Effects/Interactions										
	-Blood and Blood Products										
	-Central Venous Access Devices										
	-Dosage Calculation				C		C				
	-Expected Actions/Outcomes			C	C	C	C	C			
	-Medication Administration			C	C	C	C	C			
	-Parenteral/Intravenous Therapies			C	C	C	C	C			
	-Pharmacological Pain Management							C			
	-Total Parenteral Nutrition										
NCLEX-RN Test Plan Category	**Content Sub-Category**		**IS**	**DM**	**CHF**	**PAN**	**PAS**	**PH**	**CH**	**EOL**	
	Reduction of Risk Potential										

	Related content:										
	-Changes/Abnormalities in Vital Signs			C	C	C	C	C	C	C	
	-Diagnostic Tests			C	C	C	C				
	-Laboratory Values				C		C				
	-Potential for Alterations in Body Systems			C	C	C	C	C		C	
	-Potential for Complications of Diagnostic										
	Tests/Treatments/Procedures										
	-Potential for Complications from Surgical							C			
	Procedures and Health Alterations										
	-System Specific Assessments			C	C	C	C	C	C	C	
	-Therapeutic Procedures			C	C	C	C	C	C		
	Physiological Adaptation										
	Related content:										
	-Alterations in Body Systems			C	C	C	C	C		C	
	-Fluids and Electrolyte Imbalances				C			C		C	
	-Hemodynamics				C		C	C		C	
	-Illness Management			C	C	C	C			C	
	-Medical Emergencies				C	C	C	C			
	-Pathophysiology				C	C	C	C	C		
	-Unexpected Response to Therapies			C				C			

C=Current Content; CH=Community Health Scenario; CHF=Congestive Heart Failure Scenario; DM=Diabetes Mellitus Scenario; EOL=End of Life Scenario; IS=Introduction to Simulation; P=Proposed Addition to Current Practice; PAN=Pediatric Anaphylactic Scenario; PAS=Pediatric Asthma Scenario; Postpartum Hemorrhage

Appendix B

Table 1

Database search and data abstraction

			Study Selections		
Date of search	**Keyword(s), subject headings, MeSH terms used**	**Database/ Source used**	**# of Hits**	**# Reviewed**	**# Keeper studies for critical appraisal & evaluation**
2/11/2015	"nursing students", "medication simulation", "medication errors"	Cochrane Library	0	0	0
2/11/2015	"student nurse", "simulation", "medication errors"	Cochrane Library	1	1	1
2/11/2015	"nursing students", "student nurse", "medication simulation", "simulation", "medication errors"	Cinahl Keyword	13	12	9
2/13/2015	"simulation", "medication errors"	Cinahl Keyword	84	5	1
2/13/2015	"simulation", "medication errors", "computer simulation"	Cinahl Subject Heading	26	3	1
2/11/2015	"nursing students", "student nurse", "medication simulation", "simulation", "medication errors"	MEDLINE/ PubMed	15	2	0

Appendix C

Characteristics of Studies Included and Excluded During Critical Appraisal			
Title	**Author(s) (year)**	**Included or Excluded**	**Included Rationale and/or Excluded Rationale**
The relationship between simulation in nursing education and medication safety. *Journal of Nursing Education*, *49*(1), 52-55.	Sears, Goldsworthy, & Goodman (2010)	Included	Inclusion rationale: Randomized Control Trial (RCT)=Level II evidence, Significant p value, N=54 subjects, Human subjects, Peer-reviewed, Academic journal, Within past 5 years, Applicable to PICOT question
Using simulations to identify nursing student behaviors: A longitudinal study of medication administration. *Journal of Nursing Education*, *53*(2), 89-92.	Schneidereith (2014)	Included	Inclusion rationale: Nonexperimental cohort study=Level IV, N=43, Significant results demonstrating decrease in performance at the senior level, Human subjects, peer-reviewed, Academic journal, Within past 5 years, Applicable to PICOT question
Teaching medication administration through innovative simulation. *Teaching and Learning in Nursing*, *9*, 64-68.	Ferguson, Delaney, & Hardy (2014)	Included	Inclusion rationale: Self report convenience study=Level VI, N=51, Human subjects, Peer-reviewed, Academic Journal, Within past 5 years, Applicable to PICOT question
Human patient simulation versus case study: Which teaching strategy is more effective in teaching nursing care for the hypoglycemic patient? *Teaching and Learning in Nursing*, *9*, 59-63.	Gibbs, Trotta, & Overbeck (2014)	Excluded	Exclusion rationale: Not applicable to PICOT question (unrelated to medication administration)
Impact of simulation on safe medication practice with diploma/A.D.N. students. *Teaching & Learning in Nursing*, *8*(4), 147-156.	Campbell (2013)	Included	Inclusion rationale: RCT=Level II evidence, N=15, Potential variability in rater perception identified, Human subjects, Peer-reviewed, Academic Journal, Within past 5 years, Applicable to PICOT question

Impact of simulation-based learning on medication error rates in critically ill patients. *Intensive Care Medicine*, *36*, 1526-1531.	Ford, Seybert, Smithburger, Kobulinsky, Samosky, & Kane-Gill (2010)	Included	Inclusion rationale: Non-randomized controlled trial=Level III, N=24, Significant p value related to decrease in med errors following simulation experiences, Human subjects, Peer-reviewed, Academic journal, Within past 5 years, Applicable to PICOT question
High-fidelity simulation and safety: An integrative review. *Journal of Nursing Education*, *52*(1), 39-45.	Shearer (2013)	Included	Inclusion rationale: Systematic review of qualitative studies=Level V, Peer-reviewed, Academic Journal, Within past 5 years, Applicable to PICOT question
Improving medication calculations of nursing students in simulation: An integrative review. *Clinical Simulation in Nursing*, *9*, e379-e383.	Zahara-Such (2013)	Included	Inclusion rationale: Systematic review of qualitative studies=Level V, 15 pertinent citations, Peer-reviewed, Academic Journal, Within past 5 years, Applicable to PICOT question
Said another way: Asking the right questions regarding the effectiveness of simulations. *Nursing Forum*, *45*(4), 246-252.	Goodman & Lamers (2010)	Excluded	Exclusion rationale: Not research study but rather a case study, Does not effectively address PICOT question
Clinical inference by nursing students and experienced nurses concerning harmful outcomes occurring after medication errors: A comparative study. *Journal of Professional Nursing*, *12*(5), 322-329.	Wolf, Ambrose, & Dreher (1996)	Excluded	Exclusion rationale: Not within 5 year limit, Does not effectively address PICOT question
Why nurses make medication errors: A simulation study. *Nurse Education Today*, *27*(4), 312-317.	Kazaoka, Ohtsuka , Ueno, & Mori (2007)	Excluded	Exclusion rationale: Not within 5 year limit, Does not effectively address PICOT question

Comparison of teaching strategies on teaching drug dosage calculation skills in fundamental nursing students. (Doctoral dissertation). Retrieved from CINAHL Plus with Full Text. (2011033210)	Huse (2010)	Included	Inclusion rationale: Quasi-experimental, cohort study=Level IV evidence, Significant results related to increase in confidence, Human subjects, Within past 5 years, Applicable to PICOT question
Using standardized simulation to improve student nurses' medication practices. (Doctoral dissertation). Retrieved from CINAHL Plus with Full Text. (2012461263)	Schmoll (2013)	Included	Inclusion rationale: Quantitative, quasi-experimental study=Level III evidence, No statistically significant difference found between use of simulation and traditional instruction, Human subjects, Within past 5 years, Applicable to PICOT question
A quantitative analysis of the effect of simulation on medication administration in nursing students. (Doctoral dissertation). Retrieved from CINAHL Plus with Full Text. (212461075)	Scudmore (2013)	Included	Inclusion rationale: Quantitative, quasi-experimental study=Level III evidence, Significant findings related to fewer medication errors by students following simulation participation, Human subjects, Within past 5 years, Applicable to PICOT question
Beyond the five rights: Improving patient safety in pediatric medication administration through simulation. *Clinical Simulation in Nursing*, *5*(5), 181-186.	Pauly-O'Neill (2009)	Excluded	Exclusion rationale: Beyond 5 year time frame
Drug selection errors in relation to medication labels: A simulation study. *Anaesthesia*, *62*(11), 1090-1094.	Garnerin et al. (2007)	Excluded	Exclusion rationale: Beyond 5 year time frame, Does not effectively address PICOT question (study not related to land-based simulation setting)

Retention of drug administration skills after intensive training. *Anaesthesia*, *63*(4), 379-384.	Wheeler et al. (2008)	Excluded	Exclusion rationale: Beyond 5 year time frame, Does not effectively address PICOT question (focused on addition of online teaching to simulation)
Creating a distraction simulation for safe medication administration. *Clinical Simulation in Nursing*, *10*(8), 406-411.	Thomas, McIntosh, & Allen (2014)	Included	Inclusion rationale: Non-randomized qualitative study=Level VI, Human subjects, Peer-reviewed, Academic journal, Within past 5 years, Applicable to PICOT question
Safety first: The role of simulation. *Neonatal Network*, *31*(5), 279-280.	Fraser (2012)	Excluded	Exclusion rationale: Editorial article
Patient safety simulation: Learning about safety never seemed more fun. *Journal for Nurses in Staff Development*, *20*(6), 247-254.	Paparella, Mariani, Layton, & Carpenter (2004)	Excluded	Exclusion rationale: Non-research study, Beyond 5 year time frame
Understanding of drug safety alerts: A simulation study. *International Journal of Medical Informatics*, *79* (5), 361-369.	Van der Sijs, Van Gelder, Vulto, Berg, & Aarts (2010)	Excluded	Exclusion rationale: Population focus=med students, Does not effectively address PICOT question (related to CPOE simulation)
Use of simulation to develop a medication administration safety assessment tool. *Clinical Simulation in Nursing*, *9*(12), 609-615.	Goodstone & Goodstone (2013)	Included	Inclusion rationale: Randomized Control Trial (RCT)=Level II evidence, N=14, Interrater reliability=0.83 to 0.90, Cronbach's alpha=0.90, Human subjects, Peer-reviewed, Academic journal, Within past 5 years, Applicable to PICOT question
Can simulated practice learning improve clinical competence? *British Journal of Nursing*, *22*(9), 529-535.	Handley & Dodge (2013)	Excluded	Exclusion rationale: Non-research study, Does not effectively address PICOT question (Review of simulation practices across several institutions)

Appendix D

Author(s), year, title	Conceptual Framework & Purpose	Design/ Method	Sample/ Setting	Major Variables Studied and Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Appraisal of Worth to Practice
Sears, K., Goldsworthy, S., & Goodman, W. (2010). The relationship between simulation in nursing education and medication safety. *Journal of Nursing Education, 49*(1), 52-55.	None Purpose: Effect of SBE on rate of APME	RCT Procedure: EG: 8 hrs of clinical time replaced by 8 hrs of SBE. CG: All hrs completed in clinical setting. APME rates for both groups then measured by clinical instructor in clinical setting.	N=54 2nd year NS n(EG)=24 •n(MEG)=10 •n(MSEG)=14 n(CG)=30 •n(MCG)=18 •n(MSCG)=12 Setting: BSN program in Canada Attrition: None	IV: Use of SBE DV: # of APME in clinical setting	APME: APME Report Survey Tool Author: Sears, K. Validity & Reliability data of instrument not provided	OR X^2	APME: OR for EG to commit APME=0.41 (a=0.05) X^2=significant (a<0.01)	Strengths: •Compelling evidence that collectively students generate fewer APME in the clinical setting with prior exposure to SBE •IR established through information sessions conducted with the clinical instructors completing the data collection instruments Weaknesses: •Recognized potential for inconsistent experiences between two different clinical settings •Recommendation to replicate study on larger scale Conclusion: Use of SBE decreases risk of APME in clinical setting

APME=actual and potential medication errors; CG=control group; CI=confidence interval; BSN=bachelor in science of nursing; DV=dependent variable; EG=experimental group; IR=inter-rater reliability; IV=independent variable; MCG-maternal control group; MEG=maternal experimental group; MSCG=medical surgical control group; MSEG=medical surgical experimental group; NNT=number needed to treat; NR=not reported; NS=nursing students; OR=odds ratio; RCT=randomized controlled trial; SBE=simulation-based experience; US=United States; X^2=Chi-Square

Author(s), year, title	Conceptual Framework & Purpose	Design/ Method	Sample/ Setting	Major Variables Studied & Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Appraisal of Worth to Practice
Campbell, C. (2013). Impact of simulation on safe medication practice with diploma/A.D.N. students. *Teaching & Learning in Nursing, 8*(4), 147-156.	Bandura Purpose: Safe MA practices in the clinical setting	RCT Procedure: EG: 4 weekly 90-min SBE focused on safe MA. CG: Supervised MA in clinical setting only Student competency during MA in the clinical setting then evaluated by clinical faculty.	N=27 2nd semester NS n(CG)=12 n(EG)=15 Setting: Diploma/ ADN program Attrition: 1 (Reason not provided)	IV: Use of SBE DV: Safe MA practices in clinical setting	Safe MA practices: Safe MA grading rubric Author-developed Validity & Reliability data not provided Subcategories •Check 2 PI prior to MA •Calculate correct dosage	Frequency	Check 2 PI: EG: 6.7% ER CG: 0% ER ARI=0.07 (7% higher risk of students in EG to miss checking 2 PI prior to MA) Calculation of correct medication dosage: EG: 13.3% ER CG: 0% ER ARI=0.07 (7% higher risk of students in EG to calculate dosage incorrectly)	Strengths: Identified increased student confidence and self-perceived ability to administer medications safely in the clinical setting. Weaknesses: •Significant threat to IR d/t variability in rater perceptions and no prior reliability testing of instrument •Small number of subjects •Convenience sample of ADN/Diploma nursing students therefore results may not be generalizable to students in other programs Conclusion: Results not supportive of the use of SBE to decrease APME in the clinical setting; Lack of reliability of study results

ADN=associate degree in nursing; APME=actual and potential medication errors; CG=control group; CI=confidence interval; DV=dependent variable; EG=experimental group; ER=error rate; IR=inter-rater reliability; IV=independent variable; MA=medication administration; ME=medication error; NNT=number needed to treat; NR=not reported; NS=nursing students; PI=patient identifiers; RCT=randomized controlled trial; SBE=simulation-based experience; US=United States

Author(s), year, title	Conceptual Framework & Purpose	Design/ Method	Sample/ Setting	Major Variables Studied & Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Appraisal of Worth to Practice
Shearer, J. (2013). High-fidelity simulation and safety: An integrative review. *Journal of Nursing Education*, *52*(1), 39-45.	Jeffries' Model for Designing, Implementing, and Evaluating Simulations used in NE Purpose: To evaluate existing evidence that NE using HFS improves patient safety outcomes, specifically skill performance.	•Whittemore & Knafl method of LR •Databases: CINAHL, Academic Onefile, Ovid Nursing Collection II, ScienceDirect , and Google Scholar •Inclusion criteria: English-language research articles, since 2007, use of HFS, nursing students or graduate nurses •Exclusion criteria: Non-HFS Lack of safety related outcomes •Matrix used to assign score to each study	NS at various stages of NE (and one study with graduate nurses) Relevant articles: n=166 Excluded: n=146 Met inclusion criteria: n=20 Total students: 1708	Use of SBE: HFS learning experience within NE program Safety outcomes: •APME: Actual or potential medication errors committed in the clinical or simulation setting	Jeffries' Framework for Simulation served as model for safety outcome of APME Data collection tools developed by researchers in this review included surveys, checklists, observation, and visual analog scale	Data from studies measuring safety with scores of 4 or higher were analyzed by outcomes and coded by scores into a matrix. Patterns were sought in the data including class level, nonsignificant or nonfavorable findings, and inconsistencies of findings.	Two studies provided evidence for effectiveness of SBE on safety outcome of decreasing APME •Radhakrish-nan et al.: Safety scores (PI) were higher for students in EG (p=0.001) •Sears et al.: CG had higher APME rates than the EG (p<0.001). Poisson distribution of error statistic used.	Integrative review of RCT, qualitative, descriptive, and quasi-experimental studies=Level V evidence Strengths: •Comprehensive LR done with various sources. •Inclusion & exclusion criteria clearly stated. •Two studies provided evidence for effectiveness of SBE on safety outcome of decreasing APME. Limitations: •Fidelity of SBE was assumed based on descriptions. •Level of education within program varied between studies and not always clearly defined. •Bias of publication of positive findings may have limited the search. Conclusion: Some support for the use of SBE in NE but further research and review needed to recommend as standard of practice.

APME=actual or potential medication error; CG=control group; CINAHL=Cumulative Index of Nursing and Allied Health Literature; EG=experimental group; HFS=high-fidelity simulation; LR=literature review; NE=nursing education; NS=nursing students; PI=patient identification; RCT=randomized controlled trial; SBE=simulation based experience

Author(s), year, title	Conceptual Framework & Purpose	Design/ Method	Sample/ Setting	Major Variables Studied and Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Appraisal of Worth to Practice
Scudmore, C. (2013). *A quantitative analysis of the effect of simulation on medication administration in nursing students*. (Doctoral dissertation). Retrieved from CINAHL Plus with Full Text. (212461075)	Kolb's Experiential Learning Theory Purpose: Effect of HFS on the rate of APME	Quantitative, Quasi-Experimental Study	N=22 2nd & 4th semester NS •n(4th)=4 •n(2nd)=18 Setting: ADN program in US Attrition: None	IV: Use of SBE DV: # of APME in simulation setting	APME: Skills Validation Checklist (completed by investigator)	Paired t-test comparing pre- and post-test data Power analysis	Mean ER (n=22) was 4.045; Decrease in # of APME after SBE Statistically significant ($p<.05$) change in # of APME due to use of SBE and not chance alone Power >0.80 supported significant effect size Confidence of 95%	Strengths: •Reliability and validity of instrument determined in previous study; Permission for use granted by author •IR provided by having only one evaluator Statistically significant results supporting the use of SBE to decrease the # of APME in the simulation setting Weakness: •Small sample size; Power analysis identified 60 as an appropriate sample size. •Convenience sample Conclusion: Use of SBE decreases risk of APME in simulation setting which may reflect as decreased APME rates in the clinical setting

ADN=associate degree in nursing; APME=actual and potential medication errors; ER=error rate; HFS=high-fidelity simulation; IR=inter-rater reliability; NS=nursing students; SBE=simulation-based experience

Author(s), year, title
Conceptual Framework & Purpose
Design/ Method
Sample/ Setting
Major Variables Studied and Definitions
Measurement of Major Variables
Data Analysis
Study Findings
Appraisal of Worth to Practice
Ford, D., Seybert, A., Smithburger, P., Kobulinsky, L., Samosky, J., & Kane-Gill, S. (2010). Impact of simulation-based learning on medication error rates in critically ill patients. *Intensive Care Medicine*, *36*, 1526-1531.
None

Purpose: Effect of SBE on rate of APME
Single site, parallel, controlled prospective study

N=24 nurses
n(EG)=12 n(CG)=12

Setting; Adult CCU and MICU

Attrition: None
IV: Use of SBE

DV: Rate of APME in clinical setting
APME: Direct observation of MA by 2 pharmacists
X^2

Fisher's Exact

Mann-Whitney *U* tests
CCU nurses (EG): APME rate decreased from 30.8% to 4% following SBE ($p<0.001$); Sustained APME was 6.2% ($p<0.001$)

MICU nurses (CG): APME rate statistically unchanged (20.8% to 22.7%) following lecture ($p=0.672$); Sustained APME rate 36.7% ($p=0.002$)
Strengths:
•Compelling evidence that collectively nurses generate fewer APME with SBE exposure
•IR established through training of 2 pharmacist observers; >99% consistency between observation results
•Data analysis completed by 2 pharmacists not involved in data collection

Weaknesses:

•Implementation of advanced infusion pumps after the baseline observation creates potential confounding factor
•Observers not blinded to intervention phase creating risk of data collection bias
•Unknown generalizability to NS population

Conclusion: Use of SBE decreases risk of APME
APME=actual and potential medication error; CCU=coronary care unit; CG=control group; EG=experimental group; IR=interrater reliability; MA=medication administration; MICU=medical intensive care unit; NS=nursing student; SBE=simulation-based experience; X^2=Chi-Square

Author(s), year, title
Conceptual Framework & Purpose
Design/ Method
Sample/ Setting
Major Variables Studied and Definitions
Measurement of Major Variables
Data Analysis
Study Findings
Appraisal of Worth to Practice

Zahara-Such, R. (2013). Improving medication calculations of nursing students in simulation: An integrative review. *Clinical Simulation in Nursing, 9*(9), e379-e383.
None

Purpose: To synthesize existing evidence related to effective NE strategies aimed at improving accuracy of math calculations and resulting in minimizing APME
•Integrative Review using Whittemore & Knafl method of LR
•Databases: CINAHL, ERIC, MEDLINE via PubMed, JBIConNect, Cochrane Collaboration & Library, & WWW
•Included: Use of key words or phrases (math calculation skills, dosage calculations, teaching student nurses math skills, simulation, simulation in NE), English-language, NE teaching methodologies r/t dosage calculation, published up to 2011
•Excluded: r/t staff or graduate nurses, staff education
•Rating System for Hierarchy of Evidence used
NS at various stages of NE

Relevant articles: n=83

Excluded: n=68

Met inclusion criteria: n=15

Use of SBE incorporating MC examples

Medication calculation accuracy in the simulation setting
Teaching strategies were analyzed and ranked according to quality of evidence
Patterns were sought in the data r/t most effective teaching strategies
SBE with real, practical problem solving provided best learning outcomes
Integrative review of nine descriptive, one pilot, one qualitative, one quasi-experimental, one theoretical, one dissertation, & one mixed methods study=Level V to VII evidence

Strengths:
•Consistent evidence supporting the use of high-fidelity SBE incorporating MC examples to improve MC skills leading to safe MA practices

Weaknesses:
•Small sample sizes of studies make generalization of results difficult
•Lack of random assignment in quasi-experimental study

Conclusion: Some support for use of SBE in NE but further research and review needed to recommend as standard of practice

APME=actual and potential medication errors; CINAHL=Cumulative Index to Nursing and Allied Health Literature; ERIC=Educational Resources Information Center; JBI ConNect=Joanna Briggs Institute Clinical Online Network of Evidence of Care and Therapeutics; LR=literature review; MA=medication administration; MC=medication calculation; NE=nursing education; NS=nursing students; r/t=related to; SBE=simulation-based experience; WWW=World Wide Web

Author(s), year, title
Conceptual Framework & Purpose
Design/ Method
Sample/ Setting
Major Variables Studied & Definitions
Measurement of Major Variables
Data Analysis
Study Findings
Appraisal of Worth to Practice

Schneidereith, T. (2014). Using simulations to identify nursing student behaviors: A longitudinal study of medication administration. *Journal of Nursing Education, 53*(2), 89-92.
Benner Novice to Expert Theory

Purpose: To establish a better understanding of safe medication practices as students move from novice to advanced beginner
Nonexperi-mental pilot study

Two-group repeated measures design
N=43 junior & senior level NS

Setting: BSN program in US

Attrition: None
IV: Use of SBE

DV: # of APME in simulation setting
APME: Rights Method Checklist completed by primary investigator
Frequency of correctly verified rights
No significant differences found between junior & senior classes r/t age (p=0.13), gender (p=0.67), & ethnicity (p=0.81)

•RR: No differences existed over time
•RT: JVR increased from 70% to 100%; SVR unchanged at 100%
•RM: JVR improved from 90% to 100%; SVR decreased from 100% to 91%
•RP: JVR decreased from 80% to 75% ($p>0.05$); SVR decreased from 70% to 9% ($p<0.05$)
•RD: JVR improved from 0% to 42% ($p<0.05$); SVR decreased from 90% to 45% ($p<0.05$)
•AR: JVR decreased from 50% to 40%; SVR decreased from 60% to 0%
Strengths:
•Consistency between junior & senior classes being studied
•Use of SBE suggestion as a method to improve safe medication administration behaviors as students advance through a NE program

Weaknesses:
•Compelling evidence suggesting that as students move through an NE program, verification of medication rights decreases.

Conclusion: Results not clearly supportive of the use of SBE to decrease APME in clinical setting

APME=actual and potential medicaton errors; AR=all five rights; BSN=bachelor in science of nursing; JVR=junior verification rate; NE=nursing education; NS=nursing students; RD=right dose; RM=right medication; RP=right patient; RR=right route; RT=right time; SBE=simulation-based experience; SVR=senior verification rate
Author(s), year, title

Conceptual Framework & Purpose
Design/ Method
Sample/ Setting

Major Variables Studied & Definitions
Measurement of Major Variables
Data Analysis
Study Findings
Appraisal of Worth to Practice
Hayden, J., Smiley, R., Alexander, M., Kardong-Edgren, S., & Jeffries, P. (2014). The NCSBN national simulation study: A longitudinal, randomized, controlled study replacing clinical hours with simulation in prelicensure nursing education. *Journal of Nursing Regulation, 5*(2), s1-s64. Retrieved from https://www.ncsbn.org/JNR_Simulation_Supplement.pdf
None

Purpose: To evaluate the effect of partial replacement of clinical hours with SBL on clinical competency and nursing knowledge
RCT

Procedure:
EG25: 25% of clinical hours replaced by SBL.

EG50: 50% of clinical hours replaced by SBL

CG: All hrs completed in clinical setting

Clinical competencies including SMA measured for all groups by clinical instructor in clinical setting
N=666 pre-licensure RN students

n(EG25)=288

n(EG50)=276

n(CG)=258

Setting: Multiple pre-licensure nursing programs throughout US

Attrition: 79% completion rate

IV: Use of SBL

DV: Clinical performance related to SMA

APME: Creighton Competency Evaluation Instrument

Author: Creighton College of Nursing Faculty

Validity & Reliability data of instrument established
Parametric and non-parametric testing

MANOVA
APME: Difference between CG, EG25, and EG50 groups not statistically signficant for NS
Strengths: •Compelling evidence that collectively students have consistent levels of clinical competence including SMA with traditional clinical hours or replacement of up to half of traditional clinical hours with SBL •Large sample size
•Multisite study ×Established validity and reliability of instruments

Conclusion: Use of SBL is as effective as traditional clinical practice
APME=actual or potential medication error; CG=control group; DV=dependent variable; IV=independent variable; MANOVA=multivariate analysis of variance; NS=nursing students; RCT=randomized controlled trial; SBL=simulation based learning; SMA=safe medication administration; US=United States

Author(s), year, title	Conceptual Framework & Purpose	Design/ Method	Sample/ Setting	Major Variables Studied and Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Appraisal of Worth to Practice

Goodstone, L., & Goodstone, M. (2013). Use of simulation to develop a medication administration safety assessment tool. *Clinical Simulation in Nursing, 9*(12), 609-615.	None Purpose: Use of SBL to develop a performance-based competency measure of SMA	Non-randomized, non-experimental pilot study Procedure: Students participated in SMA simulations while four independent nursing instructors observed medication administration	N=14 nursing students from PN, AND, and BSN programs Setting: Undergraduate NE program in US Attrition: None	IV: Use of SBL DV: # of APME in simulation setting	APME: MASAT Author: Goodstone & Goodstone Content validity of tool established; IR=0.83-0.9	RAI	APME: MASAT score for student sample ranged from 2.5 to 8.0 with an SD of 1.55	Strengths: •Compelling evidence that supporting the reliability and validity of the MASAT tool for use in the simulation as well as clinical settings *Provides a reliable tool to measure medication administration skill performance in nursing students Weaknesses : •Small sample size •Inconsistent characteristics of sample population Conclusion: Use of validated skills assessment tool is beneficial to evaluating nursing student SMA competency
IR=Inter-rater reliability; MASAT=Medication administration safety assessment tool; NE=Nursing education; RAI=Rater agreement index; SBL=Simulation-based learning; SD=Standard deviation; SMA=Safe medication administration; US=United States								

Author(s), year, title	Conceptual Framework & Purpose	Design/ Method	Sample/ Setting	Major Variables Studied and Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Appraisal of Worth to Practice

Pauly-O'Neill, S. (2009). Beyond the five rights: Improving patient safety in pediatric medication administration through simulation. *Clinical Simulation in Nursing, 5*(5), 181-186.	None Purpose: Effect of SBEL on rate of APME	Uncontrolled cohort study Procedure: NS were observed administering medications in the simulation setting Post-simulation medication administration observations were then completed.	N=20 second-semester, junior level NS Setting: Undergraduate BSN program in US Attrition: None	IV: Use of SBL DV: # of APME in simulation setting	APME: Pediatric Medication Adminstration Skills Validation Tool Author: Pauly-O'Neill Validity & Reliability data of instrument not provided	Comparison of pre- and post-intervention APME rates in the simulation setting	APME: Student adherance to selecting the right route, calculating the correct dose, completing pre-administration assessment, checking allergies, correctly diluting drug, and correctly setting IV pump improved from pre- to post-observations	Strengths: •Compelling evidence that collectively students generate fewer APME following SBL Weaknesses: •No validity or reliability data for measurement instrument *Recmmendation to replicate study on larger scale Conclusion: Use of SBL decreases risk of APME in simulation setting

APME=actual and potential medication errors; BSN=bachelor in science of nursing; IV=Intravenous; NS=Nursing students; SBL=Simulation-based learning; US=United States

Appendix E

Synthesis Table: Effect of Simulation-Based Experience on Rate of Medication Errors

	Author 1 Sears et al.	Author 2 Campbell	Author 3 Shearer	Author 4 Scudmore	Author 5 Ford et al.	Author 6 Zahara-Such	Author 7 Schneidereith	Author 8 Hayden et al.	Author 9 Goodstone & Goodstone	Author 10 Pauly-O'Neill
Rate of APME in Clinical Setting	□	□	□	N/A	□	N/A	N/A	↓	N/A	N/A
Rate of APME in Simulation Setting	N/A	N/A	□	□	N/A	□	□	□□□	↓	↓
Additional Supportive Information	N/A	□□Rate of PI □ Rate of accurate DC	□ Rate of PI	N/A	N/A	N/A	□□Rate of RM, RT, RP, & RD errors from JR to SR year	Impact on standardized testing same as clinical experience	N/A	□□□
Level of Evidence	II	II	V	III	III	V-VII	IV	II	IV	III
Sample	54 Student Nurses	27 Student Nurses	1708 Student Nurses & Graduate Nurses	22 Student Nurses	24 Nurses	Unknown	43 Student Nurses	666 Student Nurses	14 Student Nurses	20 Student Nurses
Study Design	RCT	RCT	Integrative Review	Quantitative, Quasi-Experimental Study	Parallel, Controlled, Prospective Study	Integrative Review	Nonexperi-mental Pilot Study	RCT	Non-experimental Pilot Study	Uncontrolled Cohort Study

APME=actual and potential medication errors; DC=dosage calculation; JR=junior; N/A=not applicable; PI=patient identification; RCT=randomized controlled trial; SR=senior; ↑=increased; ↓=decreased

Appendix F

Marie Johnson Age: 73 years Gender: Female

Diagnosis: Urinary Tract Infection (UTI)
Hx: Hypertension, GERD, Osteoarthritis
Height: 61 inches
Weight: 170#
Consent obtained: Yes

HCP: Dr. Jones
Advanced directives: Full code
Diet: Regular as tolerated
Isolation: None
Allergy: Tape, acetaminophen, betadine

Brief Summary: Patient lives with her husband, George, in a two story farmhouse in the country. Her husband states she has been acting "funny" for the last day and a half. He states that she has been holding her lower abdomen, complaining of pain when she urinates, and has to urinate more often. He states that her urine smells "really strong" and that she has had some episodes of "wetting herself" over the last few days. After calling her primary care provider, he was advised to bring her to the hospital to be directly admitted to the medical surgical unit. She arrived on the unit at 0630 and vital signs were obtained: Temp=99.5 (oral); Pulse=80/minute; Resp=22/minute; Bp=92/48; and pulse ox=94% on room air. An IV was initiated in her right lower arm. A urinary retention catheter was inserted and a urine specimen was obtained and sent to lab. Stat labwork has been drawn.

Preparation:

- Basic patient
- Meds: IV piggyback bag of Ceftazidime 2 grams/100 ml of NS (Have another piggyback bag of Ceftriaxone 2 grams/100 ml of NS on back up in the "pharmacy"), Vial of promethazine 50 mg/ml, Sterile normal saline syringe, Metoprolol 100 mg tablets, Pepcid 40 mg tablets, Tylenol 325 mg tablets
- Mannequin: Basic female patient with urinary catheter in place with small amount of milky, tan-green urine in drainage bag. IV of 0.9 NS running in her right lower arm. Cheeks flushed and clammy. Have wrong patient ID band on wrist (have correct ID band available to replace incorrect band). Allergy band with tape, acetaminophen, and betadine allergies listed. Set vital signs for first phase.
- Supplies available: Variety of needles and syringes, alcohol pads, gloves, incident report form.

Objectives:

- To identify common causes of actual and potential medication errors
- To demonstrate safe medication administration steps to minimize the risk of committing a medication error
- To describe the process and benefits of Incident Reporting

Admitting Physician Orders:

Date	Time	Order
11/10	*0700*	*Admit to 5 South*

Admitting dx: UTI
Code Status: Full Code
Diet: Regular as tolerated
Activity: Up with assistance
Labs: CBC, Chem 8 stat and every AM
Chest xray
Insert urinary retention catheter and obtain urine C&S specimen
IV of 0.9 NS at 100 ml/hr
Rocephin 2 grams IV daily
Metoprolol 100 mg PO daily
Pepcid 20 mg PO daily
Phenergan 12.5 mg IM every 6 hours prn for nausea
Tylenol 650 mg PO every 6 hours prn temp > 101

----------*Dr. Jones*

Scenario States:

Monitor Settings	Patient Actions	Student Actions	Instructor Cues
Initial state: Vital signs: • Ap=98/min • Bp=93/46 • RR=17/min • POx=95% (room air) Heart sounds are strong and regular. Pulses are 2+ in all extremities. Lung sounds clear. 10 minutes later:	Speech clear. Answers questions inappropriately; Asking frequently “where am I” and “who are you”. Patient drowsy and oriented to name only. Moaning and stating that it hurts. States “I feel sick to my stomach”; makes gagging sounds occasionally.	Review admitting orders. Wash hands. Introduce self. Identify patient using two patient identifiers; Note that wrong ID band on patient; Obtain correct ID band and place on patient. Obtain vital signs. Complete pain assessment. Complete head to toe assessment identifying any abnormal assessment findings. Note color and clarity of urine in drainage bag. Identify that Ceftazidime is the wrong medication. Call pharmacy to have Ceftriaxone sent up to the unit. Administer Ceftriaxone IV at 100 ml over 30-60	When student asks: Temp (oral)=100.8 PERRLA HG/PPP equal and weak. No edema noted. Skin flushed and clammy.

	minutes.	
	Correctly calculate dose of promethazine, dilute using sterile NS, draw up, and administer IM using correct sterile technique.	
	Note acetaminophen allergy and do not administer Tylenol; Call HCP for alternative order.	
	Hold metoprolol due to low blood pressure; State would recheck Bp in one hour; If still low, would notify HCP for parameters to hold.	
	Calculate correct dose of Pepcid and administer 1/2 tablet to patient.	
Several hours later:	Complete incident report if error occurred; Should also complete an Incident Report for potential error due to wrong medication being sent up from pharmacy.	If ceftazidime administered, have patient develop nausea and rash; Have next shift nurse note error and call pharmacy.
		If Tylenol administered, have patient develop further nausea and vomiting and a slight rash over her chest.
		If metoprolol administered, have patient's Bp drop and

patient complain of dizziness.

Nursing dx:

- Acute pain
- Impaired urinary elimination
- Hyperthermia
- Infection
- Acute confusion
- Risk for injury

Debriefing:

- What are your thoughts and/or feelings about how this overall simulation experience went?
- What potential and/or actual medication errors occurred?
    - Wrong patient: Incorrect ID band placed on patient
    - Wrong medication: Ceftazidime being sent up from pharmacy instead of ceftriaxone
    - Wrong route: Various routes of medication delivery ordered
    - Wrong dose: Calculation of correct dilution and dose required for promethazine
    - Wrong dose: Calculation of correct dose of Pepcid; need to cut tablet in half
    - Allergy: Tylenol ordered for patient with acetaminophen allergy
    - Patient response: Bp low prior to administering anti-hypertensive medication

- What safety measures were taken when preparing and administering medications?
    - Review the importance of always completing all of the medication checks (right medication, route, time, patient, and dose as well as allergies) at least three (3) times before administering medication
    - Review importance of Tall Man Lettering system to minimize risk of Look-Alike, Sound-Alike medications. Example: cefTRIAXone (Rocephin) vs. cefTAZidime (Fortaz)
        - Show students current list of common Look Alike-Sound Alike medications
    - Review importance of performing appropriate pre-administration assessment prior to administering certain medications. Example: Bp prior to giving an anti-hypertensive
    - Minimize distractions during medication administration as much as possible
    - Prepare medications in a designated location to keep focused on the task at hand

- If an actual or potential medication error occurs, an Incident Report (IR) should be completed. What are some of the key things to remember when completing an IR?
    - Incident Reports are not completed for punitive reasons but rather to address quality and safety issues and identify process or performance issues that need to be corrected.

- When completing an IR, be descriptive but objective.
- Incident Reports do not become a permanent part of the patient chart. Do not refer to the IR in the charting.
- The nurse involved in the incident should be the one to complete the form.

Documentation Form

Vital Signs:

Assessment Findings:

Medications administered:

Appendix G

Student Satisfaction and Self-Confidence in Learning

Instructions: This questionnaire is a series of statements about your personal attitudes about the instruction you receive during your simulation activity. Each item represents a statement about your attitude toward your satisfaction with learning and self-confidence in obtaining the 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

Satisfaction with Current Learning	**SD**	**D**	**UN**	**A**	**SA**
1. The teaching methods used in this simulation were helpful and effective.	○1	○2	○3	○4	○5
2. The simulation provided me with a variety of learning materials and activities to promote my learning the medical surgical curriculum.	○1	○2	○3	○4	○5
3. I enjoyed how my instructor taught the simulation.	○1	○2	○3	○4	○5
4. The teaching materials used in this simulation were motivating and helped me to learn.	○1	○2	○3	○4	○5
5. The way my instructor(s) taught the simulation was suitable to the way I learn.	○1	○2	○3	○4	○5
Self-confidence in Learning	**SD**	**D**	**UN**	**A**	**SA**
6. I am confident that I am mastering the content of the simulation activity that my instructors presented to me.	○1	○2	○3	○4	○5
7. I am confident that this simulation covered critical content necessary for the mastery of medical surgical curriculum.	○1	○2	○3	○4	○5
8. I am confident that I am developing the skills and obtaining the required knowledge from this simulation to perform necessary tasks in a clinical setting	○1	○2	○3	○4	○5
9. My instructors used helpful resources to teach the simulation.	○1	○2	○3	○4	○5
10. It is my responsibility as the student to learn what I need to know from this simulation activity.	○1	○2	○3	○4	○5
11. I know how to get help when I do not understand the concepts covered in the simulation.	○1	○2	○3	○4	○5
12. I know how to use simulation activities to learn critical aspects of these skills.	○1	○2	○3	○4	○5
13. It is the instructor's responsibility to tell me what I need to learn of the simulation activity content during class time..	○1	○2	○3	○4	○5

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Appendix H

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Tools and Instruments

Use of NLN Surveys and Research Instruments

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Appendix I

		Current Simulation Scenario								Proposed Simulation Scenario		
NCLEX-RN Test Plan Category	**Content Sub-Category**	**IS**	**DM**	**CHF**	**PAN**	**PAS**	**PH**	**CH**	**EOL**	**CLABSI**	**SMA**	**FLOOD**
Safe and Effective Care Environment	**Management of Care**											
	Related content:											
	-Advance Directives/Self-Determination/Life								C			
	Planning	.	.	.	.	.	.	.	.	.	.	.
	-Advocacy			C		C	C	C	C	P	P	P
	-Case Management							C	P			
	-Client Rights							C	C			P
	-Collaboration with Interdisciplinary Team			C	C	C	C		C	P	P	P
	-Concepts of Management											P
	-Confidentiality/Information Security											P
	-Continuity of Care				C			C	P	P	P	
	-Assignment, Delegation, and Supervision								P			P
	-Establishing Priorities		C	C	C	C	C	C	C	P	P	P
	-Ethical Practice							C	C			P
	-Informed Consent		P									
	-Information Technology										P	
	-Legal Rights and Responsibilities		P					C	C			P
	-Organ Donation								P			
	-Performance Improvement (Quality									P	P	
	Improvement)	.	.	.	.	.	.	.	.	.	.	.
	-Referrals		P	P				C				P
	Safety and Infection Control											
NCLEX-RN Test Plan Category	**Content Sub-Category**	**IS**	**DM**	**CHF**	**PAN**	**PAS**	**PH**	**CH**	**EOL**	**CLABSI**	**SMA**	**FLOOD**
	Related content:											

	-Accident/Error/Injury Prevention		C	C	C	C		C		P	P	P
	-Emergency Response Plan											P
	-Ergonomic Principles											P
	-Handling Hazardous and Infectious Materials									P		P
	-Home Safety							C				P
	-Reporting of Incident/Event/Irregular										P	
	Occurrence/Variance	.	.	.	.	.	.	.	.	.	.	.
	-Safe Use of Equipment				C	C				P	P	
	-Security Plan											P
	-Standard Precautions/Transmission-Based		C	C	C	C				P	P	P
	Precautions/Surgical Asepsis	.	.	.	.	.	.	.	.	.	.	.
	-Use of Restraints/Safety Devices										P	
Health Promotion and Maintenance	Related content:											
	-Aging Process									P		
	-Ante/Intra/Postpartum and Newborn Care						C	C				
	-Developmental Stages and Transitions							C				P
	-Health Promotion/Disease Prevention							C		P	P	P
	-Health Screening							C				P
	-High Risk Behaviors				C	C		C				P
	-Lifestyle Choices				C	C		C				P
	-Self-Care							C	P	P		P
	-Techniques of Physical Assessment		C	C	C	C	C	C	C	P	P	P
NCLEX-RN Test Plan Category	**Content Sub-Category**	**IS**	**DM**	**CHF**	**PAN**	**PAS**	**PH**	**CH**	**EOL**	**CLABSI**	**SMA**	**FLOOD**
Psychosocial Integrity	Related content:											
	-Abuse/Neglect							C	P			

	-Behavioral Interventions								C				P
	-Chemical and Other Dependencies/												P
	Substance Use Disorder		.	.	.	.	.	.	.	.	.	.	.
	-Coping Mechanisms								C	C			P
	-Crisis Intervention								C	C			P
	-Cultural Awareness/Cultural Influences on									P			P
	Health		.	.	.	.	.	.	.	.	.	.	.
	-End of Life Care									C			
	-Family Dynamics				C		C		C	C			P
	-Grief and Loss									C			P
	-Mental Health Concepts								C				P
	-Religious and Spiritual Influences on Health									P			P
	-Sensory/Perceptual Alterations									P			
	-Stress Management								C	P			P
	-Support Systems				C		C		C	C			P
	-Therapeutic Communication				C				C	C	P	P	P
	-Therapeutic Environment			C	C	C				C	P	P	P
NCLEX-RN Test Plan Category	**Content Sub-Category**		**IS**	**DM**	**CHF**	**PAN**	**PAS**	**PH**	**CH**	**EOL**	**CLABSI**	**SMA**	**FLOOD**
Physiological Integrity	**Basic Care and Comfort**												
	Related content:												
	-Assistive Devices												P
	-Elimination									P			
	-Mobility/Immobility									P			
	-Non-Pharmacological							C	C	C	P		

	Comfort Interventions												
	-Nutrition and Oral Hydration								C	C			
	-Personal Hygiene								C	P	P		P
	-Rest and Sleep								C	P			P
										P			
	Pharmacological and Parenteral Therapies												
	Related content:												
	-Adverse Effects/Contraindications/			C	C	C	C	C	C	P	P	P	
	Side Effects/Interactions		.	.	.	.	.	.	.	.	.	.	.
	-Blood and Blood Products							P					
	-Central Venous Access Devices										P		
	-Dosage Calculation				C		C			P	P	P	
	-Expected Actions/Outcomes			C	C	C	C	C		P	P	P	
	-Medication Administration			C	C	C	C	C		P	P	P	
	-Parenteral/Intravenous Therapies			C	C	C	C	C		P	P	P	
	-Pharmacological Pain Management							C		P			
NCLEX-RN Test Plan Category	**Content Sub-Category**		**IS**	**DM**	**CHF**	**PAN**	**PAS**	**PH**	**CH**	**EOL**	**CLABSI**	**SMA**	**FLOOD**
	-Total Parenteral Nutrition										P		
	Reduction of Risk Potential												
	Related content:												
	-Changes/Abnormalities in Vital Signs			C	C	C	C	C	C	C	P	P	
	-Diagnostic Tests			C	C	C	C				P		
	-Laboratory Values				C		C				P		
	-Potential for Alterations in			C	C	C	C	C		C	P	P	

	Body Systems												
	-Potential for Complications of Diagnostic				P								
	Tests/Treatments/Procedures		.	.	.	.	.	.	.	.	.	.	.
	-Potential for Complications from Surgical							C					
	Procedures and Health Alterations		.	.	.	.	.	.	.	.	.	.	.
	-System Specific Assessments			C	C	C	C	C	C	C	P	P	
	-Therapeutic Procedures			C	C	C	C	C	C	P	P		
	Physiological Adaptation												
	Related content:												
	-Alterations in Body Systems			C	C	C	C	C		C	P	P	
	-Fluids and Electrolyte Imbalances				C			C		C	P		
	-Hemodynamics				C		C	C		C			
	-Illness Management			C	C	C	C			C	P		
NCLEX-RN Test Plan Category	**Content Sub-Category**		**IS**	**DM**	**CHF**	**PAN**	**PAS**	**PH**	**CH**	**EOL**	**CLABSI**	**SMA**	**FLOOD**
	-Medical Emergencies				C	C	C	C			p		P
	-Pathophysiology				C	C	C	C	C	P	P	P	
	-Unexpected Response to Therapies			C				C			P	P	

C=Current Content; CH=Community Health Scenario; CHF=Congestive Heart Failure Scenario; CLABSI=Central Line Acquired Bloodstream Infection; DM=Diabetes Mellitus Scenario; EOL=End of Life Scenario; FLOOD=Community =-Wide Flood Disaster; IS=Introduction to Simulation; P=Proposed Addition to Current Practice; PAN=Pediatric Anaphylactic Scenario; PAS=Pediatric Asthma Scenario; PH=Postpartum Hemorrhage; SMA=Safe Medication Administration