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Safe medication administration

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SAFE MEDICATION ADMINISTRATION

by

Kelly Jodel Gonzales

An Abstract

Of a thesis submitted in partial fulfillment
of the requirements for the Doctor of
Philosophy degree in Nursing
in the Graduate College of
The University of Iowa

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Thesis Supervisor: Associate Professor Elizabeth Swanson

ABSTRACT

The purpose of this body of work was to address medication errors and safe medication administration practices in relation to practicing nurses and nursing students via several different approaches. These different approaches will be presented as three separate papers but interrelated themes. The specific purpose for each paper and the corresponding research questions were addressed individually in each chapter. The approach used in the first paper was a systematic literature search of medication administration errors and the pediatric population; five themes emerged including the incidence rate of medication administration errors, specific medications involved in medication administration errors and classification of the errors, why medication administration errors occur, medication error reporting, and interventions to reduce medication errors. The approach used in the second paper included a systematic literature review and implementation of a survey, both focusing on the assessment strategies for safe medication administration with practicing nurses and nursing students. Results of both the review and the survey indicated a lack of a comprehensive assessment of safe medication administration. The approach used in the third paper was a research study to conduct a psychometric evaluation of the Safe Medication Administration (SAM) Scale with baccalaureate nursing students. Results provided evidence of the validity and reliability of the SAM Scale. This body of work exposed a gap in nursing and demonstrates the importance of having a standardized assessment of safe medication administration with evidence of validity and reliability to demonstrate competency in this area.

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CERTIFICATE OF APPROVAL

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PH.D. THESIS

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To the patients whose lives have been tragically cut short due to a medication error; may the health care profession continue to work so that medication errors cease to exist.

Ask yourself, “Can I give more?” The answer is usually, “Yes.”

Paul Tergat, Kenyan Professional Marathoner

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ABSTRACT

The purpose of this body of work was to address medication errors and safe medication administration practices in relation to practicing nurses and nursing students via several different approaches. These different approaches will be presented as three separate papers but interrelated themes. The specific purpose for each paper and the corresponding research questions were addressed individually in each chapter. The approach used in the first paper was a systematic literature search of medication administration errors and the pediatric population; five themes emerged including the incidence rate of medication administration errors, specific medications involved in medication administration errors and classification of the errors, why medication administration errors occur, medication error reporting, and interventions to reduce medication errors. The approach used in the second paper included a systematic literature review and implementation of a survey, both focusing on the assessment strategies for safe medication administration with practicing nurses and nursing students. Results of both the review and the survey indicated a lack of a comprehensive assessment of safe medication administration. The approach used in the third paper was a research study to conduct a psychometric evaluation of the Safe Medication Administration (SAM) Scale with baccalaureate nursing students. Results provided evidence of the validity and reliability of the SAM Scale. This body of work exposed a gap in nursing and demonstrates the importance of having a standardized assessment of safe medication administration with evidence of validity and reliability to demonstrate competency in this area.

TABLE OF CONTENTS

LIST OF TABLES

Table

LIST OF FIGURES

Figure

CHAPTER I

INTRODUCTION

Safety is a concern in many professions, including health care. It has been estimated that between 44,000 to 98,000 people die each year due to medical errors that could have been prevented (Kohn, Corrigan & Donaldson, 2000). Preventing medical errors and promoting patient safety and quality is currently a focus of many organizations, including the Institute of Medicine (IOM) and the Joint Commission (Kohn et al., 2000; AACN, 2008).

Patient safety is also a concern in nursing education. It is a basic assumption of the American Association of Colleges of Nursing (AACN) that the baccalaureate graduate is prepared to promote safe, quality patient care (AACN, 2008). AACN has taken several actions to convey the importance of promoting safe, quality care and has defined specific standards, or competencies, for nursing education (Cronenwett et al., 2007). However, deciding what to teach, how to teach, and how to assess learning of the competencies remains an issue for many faculty members. In an attempt to address the issue, Quality and Safety Education for Nurses (QSEN) was formed to identify these gaps in nursing education and implement a curriculum that includes quality and safety (Cronenwett et al., 2007). QSEN defines safety as minimizing the risk of harm to patients and providers through both system effectiveness and individual performance.

The most common breach in safety that occurs in hospital settings are medication errors (The Joint Commission, 2008). It has been estimated that 7000 deaths occur annually across all patient populations due to medication errors (Kohn et al., 2000). The National Coordinating Council for Medication Errors Reporting and Prevention (NCC

MERP) takes the stance that there is no acceptable incidence rate for medication errors, and that the goal should be to continually improve health care systems so that medication errors are prevented (NCC MERP, 2002). Thus, interventions are needed to decrease medication errors and improve patient safety through safe medication administration.

Overview of the Relationship of the Three Papers

This body of work addresses medication errors and safe medication administration practices in relation to practicing nurses and nursing students through three separate papers presented here. Paper I (Chapter II) presents a systematic literature search on medication administration errors in the pediatric population. Medication errors are especially concerning with the pediatric population because they are potentially more harmful and have a higher incidence rate in the pediatric population than in the adult population (The Joint Commission, 2008). This first paper focuses on medication errors that impact the practice of nurses, and while there are implications for nursing education, this is not the focus of the second chapter. The intent of this chapter is to disseminate the information that medication errors have a high prevalence in the pediatric population and subsequently are very harmful.

Paper II (Chapter III) presents a systematic review of instruments found in the literature that assess an individual's knowledge of safe medication administration. Instruments that were included have been used with either practicing nurses or nursing students. Results of a descriptive survey designed and conducted by the researcher of baccalaureate nursing programs part of AACN are also presented. The goal of the survey was to learn how baccalaureate nursing programs are assessing for the knowledge and competency of safe medication administration. Chapter three is very timely as assessment

of learning safety is currently an issue in nursing and nursing education, and is a focus of QSEN. Assessment of safe medication administration, one aspect of safety, is needed in order to verify that nurses and nursing students are prepared to give safe, quality care.

Paper III (Chapter IV) presents empirical evidence of validity and reliability of one instrument used in assessing safe medication administration that was identified in the literature: the Safe Administration of Medication (SAM) Scale. The SAM Scale was developed to objectively measure performance of the safe administration of medication of *student* nurses. Its development was based on the five rights of safe medication administration and a review of the literature on common medication errors made by *practicing* nurses (Ryan, 2007). The SAM Scale is comprised of five case studies, two of which are on a pediatric patient. For the purpose of this work, the SAM Scale will be administered to nursing students; however the scale also has utility for practicing nurses. This chapter is significant as it will attempt to provide additional evidence of validity and reliability on the SAM Scale and present findings of its utility in future research studies. The importance of this cannot be understated. There is a need for strategies designed to effectively and efficiently teach safe medication administration. However, suggested teaching strategies cannot be concluded as effective unless their effect is measured using a valid and reliable measurement for assessing safe medication administration. While medication errors and safe medication administration are different concepts, they are related since the evaluation of medication errors can be used to inform the basis for both assessments of learning and teaching strategies for safe medication administration.

Purpose and Aims

The purpose of this body of work was to address medication errors and safe medication administration practices in relation to practicing nurses and nursing students. The specific aims were to:

a. Examine current nursing literature related to medication administration errors in the pediatric inpatient population through a systematic literature search
b. Assess selected nursing education programs for methods and strategies used for evaluating safe medication administration
c. Provide validity and reliability evidence on the SAM Scale

Significance

Patient safety, specifically safe medication administration and preventing medication errors is an important concern that is threaded throughout each chapter, and is applicable to practicing nurses and nursing students. Nurses play a major role in reducing medication errors. The literature has found that nursing is the profession most likely to catch a medication error, not pharmacy (Kohn et al., 2000). Nurses frequently administer medications in inpatient healthcare settings, thus they are the last line of defense to safeguard against medication errors as administration is the last part of the medication process (Dowdell, 2004). Safe medication administration and medication errors are the conceptual framework that forms the basis of this body of work and will be discussed in the next section.

Conceptual Framework

Patient safety is a global issue affecting healthcare. As previously stated, many patient deaths occur each year that have been attributed to preventable medical errors

(Kohn et al., 2000). Much of the literature has focused on patient safety from an organizational level and very little attention has been given to patient safety on an individual level. A dimensional concept analysis of patient safety culture in nursing found the main dimension to be nurses' shared values, beliefs, and behavioral norms toward patient safety (Feng, Bobay & Weiss, 2008). Sub-dimensions found include a system sub-dimension, a personal sub-dimension and a task-associated sub-dimension (Feng et al., 2008).

Two attributes of patient safety culture that were found in the person sub-dimension are personal commitment and personal competence (Feng et al., 2008). Personal competence refers to the knowledge, skills and information that are needed to provide safe patient care. In addition, it involves flexibility and vigilance and a critical determinant to patient safety. Personal commitment refers to nurses' individual decisions that are made that reflect both an attitude and active engagement towards patient safety (Feng et al., 2008).

One model found in the literature related to patient safety that is specific to individual nurses and builds upon personal commitment is the patient risk detection theory. The patient risk detection theory is a multi-paradigmatic model that identifies both organization and individual attributes that affect the nurses' ability to detect patient risk signals (Despins, Scott-Cawiezell & Rouder, 2010). Patient risk detection theory states that nurses' signal sensitivity is a learned process that is influenced by internal factors as well as by the physical and organizational environment in which they work. Internal factors that impact risk detection include behavior and cognitive skills (Despins

et al., 2010). These factors are analogous to the attributes identified in the person sub-dimension previously discussed by Feng et al. (2008).

The patient risk detection theory integrates two theoretical frameworks, signal detection theory and high reliability theory (Despins et al., 2010). Signal detection theory explains how individuals differentiate risk signals from other background stimuli. A key concept of signal detection theory is *sensitivity*, or the ability to successfully distinguish signals from other stimuli. Another important aspect of signal detection is *detection bias*, which is the willingness to acknowledge a stimulus as a signal.

High reliability theory states that errors can be prevented through organizational design and management (Despins et al., 2010). High reliability organizations maintain safety as their first priority and utilize procedures that allow them to remain sensitive to errors, unexpected events, and subtle cues that are indicators of larger system failures. While high reliability theory is part of the patient risk detection theory, this body of work will focus primarily on internal factors of the nurse and not on the organization environment. The patient risk detection theory is based on the idea that identification of potential medical errors occurs primarily at the level of the individual nurse, and can be used as a basis for teaching the concepts of patient safety and medical errors to nursing students (Despins et al., 2010).

Medication errors are the most common medical error (The Joint Commission, 2008). Similar to how medical errors are viewed, it is commonly believed that medication errors occur as a result of either human error or a system flaw (AAP, 2003). The majority of errors do not result from individual recklessness, but rather from faulty systems, processes, and conditions that lead people to make mistakes or fail to prevent

them (Kohn et al., 2000). When an error occurs, blaming the individual does very little to make the system safer. When individuals are blamed, a potential teaching moment is lost and the potential for others to learn from the mistake is often eliminated. Instead, when an error occurs, individuals should not be blamed but rather the system should be evaluated for possible ways to improve it, and ultimately decreasing occurrences of medication errors. The goal is to have a health system where it is harder to do something *wrong*, and easier to do something *right* (Kohn et al., 2000).

The United States Food and Drug Administration (FDA) identified the most common types of fatal medication errors between 1993-1998 as wrong dose (40.9% of errors), wrong medication (16% of errors) and wrong route of administration (9.5% of errors) (Phillips et al., 2001). The FDA reports that fatal medication errors account for 10% of reported medication errors.

In 1995, the United States Pharmacopeia (USP) formed The National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP, 2009). The NCC MERP is an independent body comprised of many national organizations (e.g. American Nurses Association, The Joint Commission, National Council of State Boards of Nursing, and Institute for Safe Medication Practices) that addresses the causes of medication errors and promotes the safe use of medications. In 1999, they issued recommendations to enhance the accuracy of medication administration in the inpatient setting (NCC MERP, 1999). Included in these recommendations is a series of checks that has come to be known as the "five rights." While initially five checks were recommended, this has since been expanded to now include: the right medication, in the right dose, to the right person, by the right route using the right dosage

form, at the right time, *with the right documentation*. It is recommended that these checks are done immediately prior to medication administration to ensure safe administration (NCC MERP, 1999)

Another recommendation by the NCC MERP is the use of integrated automated systems (such as computerized medication administration record) to increase the accuracy of administration and reduce transcription errors (1999). Lastly, NCC MERP recommends that anyone who administers medications has easily accessible product information as close to the point of use as possible; and is knowledgeable about the medication including indication, precautions, contraindications, expected outcome, potential adverse reactions and interactions with food or other medications, and action to take in the event of an adverse reaction or interaction (NCC MERP, 1999). While the NCC MERP issued more recommendations than are included here, these recommendations are discussed because they encompass the important components of safe medication administration, and can lead to a decrease in medication errors. In addition, they are relevant due to the direct connection to the conceptual basis upon which the SAM Scale was developed. Table 1 includes a comprehensive list of the NCC MERP's recommendations for safe medication administration.

It has been found that potential medication errors are more commonly detected and intercepted in the early stages of medication processing (prescribing and preparing the medication) (Dowdell, 2004; Stratton, Blegen, Pepper, & Vaughn, 2004). This is due to the system checks that are in place, including computerized prescribing that automatically checks for potential medication interactions (Dowdell, 2004; Stratton et al., 2004). Medication errors originating in later stages of the medication process,

specifically medication administration errors, have fewer systems checks in place and often go undetected (Stratton et al., 2004). This supports the results of another study that found that the likelihood of preventing a medication error from reaching the patient declined in the later stages of the medication process (Antonow, Smith & Silver, 2000). In the Antonow study, it was found that 76% of errors were prevented from reaching the patient during the ordering/prescribing phase, 70% were prevented during the transcription/verification phase, and 61% were prevented during the dispensing /delivery phase and just 40% of the medication errors were prevented during the administration phase. Because nurses are the last line of defense to protect against medication errors, it is important that practicing nurses and nursing students are knowledgeable about medication errors and are competent in the practice of safe medication administration.

Unfortunately, few formalized system checks are in place for safe *administration* of medications as previously stated (Stratton et al., 2004). While there are recommendations for the safe administration of medications, these may be left to the discretion of the nurse or the facility. Some medications may require two nurses to verify the correct dose prior to administration, such as anti-coagulants, narcotics and benzodiazepines; however this varies according to hospital policy (Thomas, 2005). Near misses of medication errors occur far more frequently than actual medication errors. Unfortunately, near misses of medication errors often go unreported, both in the hospital setting with practicing nurses and in nursing education with student nurses. This decreases the likelihood of a system change that may be necessary to prevent a near miss or actual medication error in the future. This also prevents the possible learning that is

gained from the sharing of others' experiences with near misses and actual medication errors (Thomas, 2005).

Summary

Patient safety is a healthcare concern that has recently gotten much attention. This body of work draws from components of the patient risk detection theory and the concept of patient safety and safe medication administration. The study is applicable to both practicing nurses and nursing students, and is the first step in a program of research to identify a valid and reliable instrument for measuring safe medication administration. With the identification of psychometrically sound instruments, the ultimate goal of this program of research is to use the instrument to assess the effectiveness of strategies for teaching safe medication administration. The next chapter will present the findings from a systematic literature review on medication administration errors.

Table 1. NCC MERP Recommendations to Enhance Safe Medication Administration

• Clarify orders that cause concern
• Perform the following immediately prior to medication administration: the right medication, in the right dose, to the right person, by the right route using the right dosage form, at the right time, with the right documentation
• Provide adequate training regarding medication administration devices, including verifying that users demonstrate competency regarding the device
• Use an electronic infusion control devise that prevents free-flow upon removal of the set
• Use an integrated automated system to facilitate review of prescriptions, increase the accuracy of administration and reduce transcription errors
• Ensure that those who administer medications have adequate access to patient information as close to the point of use as possible
• Ensure that those who administer medications have easily accessible product information as close to the point of use as possible
• Administer only medications that are properly labeled and that the label is read a total of three times including: when reaching for or preparing the medication, immediately prior to administering the medication, and when discarding the container or returning it to its storage location
• Discuss with the patient and/or caregiver the name, purpose and effects of the medication at the time of administration
• Monitor the patient for therapeutic and/or adverse medication effects
• Consider the role of the work environment when assessing patient safety
• Collect and analyze data with regards to actual and potential errors of administration
• Provide initial and ongoing training for staff regarding accepted standards of practice related to accurate medication administration
• Establish policies and procedures for the medication administration process

Source: National Coordinating Council for Medication Error Reporting and Prevention. (1999, June 29). *Recommendations to enhance accuracy of administration of medications.* Retrieved March 29, 2009 from http://www.nccmerp.org/council/council1999-06-29.html

CHAPTER II

MEDICATION ADMINISTRATION ERRORS AND THE PEDIATRIC POPULATION: A SYSTEMATIC REVIEW OF THE LITERATURE

Abstract

Medication errors are the most common error that occurs in hospital settings (The Joint Commission, 2008). There are a variety of factors that make the pediatric population more susceptible to medication errors, and potential complications resulting from medication administration. These include the availability of different dosage forms of the same medication, incorrect dosing, lack of standardized dosing regimen, and organ system maturity. The purpose of this paper is to examine current nursing literature related to medication administration errors in the pediatric inpatient population. First, an overview of safe medication administration practices and a definition of medication errors will be provided. Then, a systematic review on medication administration errors in the inpatient pediatric population will be presented. When reviewing the articles elicited under the conditions of the systematic review, several themes emerged. The five themes noted were: incidence rate of medication administration errors; specific medications involved in medication administration errors and classification of the errors; why medication administration errors occur; medication error reporting; and interventions to reduce medication errors.

Background

Medication errors are potentially more harmful and have a higher incidence rate in the pediatric population than in the adult population (The Joint Commission, 2008). Within the literature, a debate continues as to the extent to which medication errors contribute to patient morbidity and mortality in the pediatric population, as much of the research has examined the adult population (Holdsworth, 2003). The National Coordinating Council for Medication Errors Reporting and Prevention (NCC MERP) takes the stance that there is no acceptable incidence rate for medication errors, and that the goal should be to continually improve health care systems so that medication errors are prevented (NCC MERP, 2009). Thus, interventions are needed to decrease medication errors and improve patient safety through safe medication practices. In particular, preventing medication errors is an important part of ensuring safe and quality patient care in the pediatric population. The purpose of this paper is to examine current nursing literature related to medication administration errors in the pediatric inpatient population.

The stages of the medication process include ordering/prescribing, transcribing/verifying, dispensing/delivering and administering; medication errors with pediatric patients have occurred at every stage of the process (Antonow et al., 2000). Medication administration has been defined from the Nursing Interventions Classification (NIC) as preparing, giving and evaluating effectiveness of prescription and nonprescription medications (Bulecheck, Butcher & Dochterman; 2008). This paper will address the final phase of the medication process, medication administration, since this is the phase that falls under the scope of practice of an inpatient “bedside” nurse.

A medication error is defined as any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer (NCC MERP, 2009). An adverse drug event (AD) is an injury that results from a medication or from the lack of an intended medication (Holdsworth et al., 2003). It is important to note that not all medication errors cause an ADE.

As noted earlier, medication errors occur more frequently in the pediatric inpatient population than in the adult population. Ferranti and colleagues (2008) found medication errors to be three times higher in pediatrics than in adult populations. Antonow and colleagues (2000) found in a review of the literature that of 200 consecutive prescribing errors in a tertiary care teaching hospital, 69.5% involved pediatric patients.

There are a variety of factors that make the pediatric population more susceptible to medication errors, and potential complications resulting from medication administration. One source of potential error lies in the availability of different dosage forms of the same medication. Many medications for children come in various liquid concentrations, and multiple medication formulations may lead to dosing errors (Payne, Smith, Newkirk & Hicks, 2007). For pediatrics, incorrect dosing is the most commonly reported medication error (AAP, 2003). There are few standardized dosing regimens for children as compared to adults. Instead, most pediatric medication dosing is based upon body weight, which requires a dosage calculation, and can lead to an error. This is believed to be the reason why children are at greater risk for adverse drug events than adults. Children vary in weight, body surface area, and organ system maturity; all of

which affect their ability to metabolize and excrete medications (AAP, 2003). Furthermore, children are often unable to adequately communicate when they are experiencing an adverse effect and have a limited internal physiologic capacity to buffer medication errors in comparison to adults (Payne et al., 2007).

Because the literature suggests that medication errors occur more frequently and are more concerning in the pediatric population, a systematic review of medication administration errors and the pediatric population is warranted. The goal of the systematic review is to search for practice-based articles, systematic reviews, and/or research articles on medication errors in the inpatient pediatric population, including frequency of occurrence, types of administration errors that occur and possible causes of medication errors in this age group.

Method for Systematic Literature Review

CINAHL and MEDLINE were reviewed for articles published between January 1999 and April 2009, to capture articles that were published since the landmark report "To err is human" by the Institute of Medicine (Kohn et al., 2000). MeSH terms used initially for the systematic review were "medication errors" and the search was limited to English-language publications in nursing journals that were specific to the pediatric population (0-18 years of age). The rationale behind limiting the search to nursing journals was that nurses are often the ones who administer medications, so it was believed that this would capture all articles related to medication errors that occurred during administration. This resulted in 232 articles from CINAHL and 109 articles from MEDLINE. The abstracts of all of the articles were reviewed and articles were omitted if they were only related to one specific medication, were only about medications and not

related to medication administration or medication errors, were editorials, were about TPN or intravenous fluid administration, were about *medical* errors and not medication errors, or were entirely based upon outpatient clinical sites or home administration of medication by parents or primary caregivers. Additionally, duplicate articles found in both CINAHL and MEDLINE were extracted first from CINAHL and omitted from MEDLINE. This resulted in four articles from CINAHL and one article from MEDLINE being selected for inclusion.

After careful review by the researcher of the 232 articles initially identified, only five articles selected for inclusion, and the decision was made to expand the search in two ways. First, the MeSH search terms added were "safety" and "safety management" along with "medication errors." This search was limited to English-language publications that were specific to the pediatric population (0-18 years of age) and were published between January 1999 and April 2009 using MEDLINE. This was done because medication errors are often classified as a breach in patient safety, and literature on medication errors is often found under the umbrella term "safety." Secondly, journals other than nursing were included in this search. It was felt that pertinent research articles may be embedded in quality and safety journals, or in journals from related disciplines. This additional search resulted in 1392 articles. The titles and abstracts were reviewed for every article, and articles were omitted if they did not relate to medication safety, including medication administration or medication errors, or if they did not pertain to administration of medication. As expected, this search did result in a number of articles that were not pertinent to the topic, such as articles on safety regarding a specific piece of medical equipment and articles on safety topics related to the pediatric population, such as safety

when crossing the street, but not medication safety. After the 1392 articles were reviewed and non-related articles were omitted, an additional five articles were selected for inclusion. What follows is the review of ten articles relating to medication administration errors and the inpatient pediatric population. The summary of each article is listed in Table Two. A discussion of the articles follows.

Results of the Systematic Review

Of the ten articles that were included in this systematic review, five were from nursing journals. This shows that journals from other disciplines are reporting on pediatric medication errors that impact the inpatient pediatric nurse. Five of the articles included are research articles, two are case studies, two are literature reviews and/or practice-based, and one is a systematic review. The five research articles represent lower levels of evidence; two used descriptive surveys with pediatric nurses, one used a retrospective review of medication-related events detected by computer surveillance and voluntary reporting, one used a prospective review of medical records and staff interviews, and one was a pre and post-intervention cross-sectional study. Higher levels of evidence related to medication administration were not found in the literature.

The systematic review by Ghaleb et al. (2006) reviewed 32 studies that were published between 1983 and 2005. There was only one article overlap between Ghaleb et al. systematic review and that conducted by the researcher: Antonow, Smith and Silver (2000). While other articles are included through Ghaleb et al. (2006), Antonow and colleagues' article was looked at independently because it included an analysis of which stage of the medication process that an error occurred, and also examined factors for medication error underreporting.

Ghaleb et al. (2006) systematic review focuses mainly on the incidence of medication errors in the pediatric population and identifies common errors; the goal of this researcher was to go beyond that to discover additional information that has implications for the inpatient pediatric nurse, including why the medication administration errors occur and how they can be prevented. Additionally, the researcher was interested to learn of any additional articles that had been published since 2005 when Ghaleb's systematic review ended.

When reviewing the articles elicited under the conditions of the systematic review as previously specified, several themes emerged. The five themes noted were: incidence rate of medication administration errors; specific medications involved in medication administration errors and classification of the errors; why medication administration errors occur; medication error reporting; and interventions to reduce medication errors. What follows is a discussion of these themes and the specific findings from the systematic review articles.

Incidence Rate of Medication Errors

Many differences were found with regard to how the articles obtained and reported the incidence rate of medication errors. Holdsworth and colleagues (2003) designed a study to determine the incidence and causes of ADEs and potential ADEs in hospitalized children, and examined the consequences of those events. The reported ADE frequency was 6 per 100 admissions, and 7.5 per 1000 patient-days; the reported potential ADE frequency was 8 per every 100 admissions, and 9.3 per 1000 patient-days. Of the ADEs that occurred in this study, 24% were judged to be serious or life threatening (Holdworth et al., 2003). Stratton and colleagues surveyed a convenience

sample of pediatric and adult hospital nurses regarding their perceptions of the proportion of medication errors reported on their units (Stratton et al., 2004). The medication errors rates they found per 1000 patient-days were 14.8 on the pediatric unit as compared to 5.66 on the adult unit. This is higher than the results found by Holdsworth et al., and may be explained by the differences in their study design including their sampling method.

Ghaleb and colleagues (2006) conducted a systematic review that examined the incidence rate of medication errors and categorized their results according to whether the incidence rate was obtained from chart review studies, spontaneous reporting studies or observation studies. Of the three studies included that were obtained via chart review that were specific to medication administration errors, the incidence rates were 0.15% doses administered were errant (Marino (2000) as reported in Ghaleb et al., 2006) and 23.5% administration error rate (Fontan (2003) as reported in Ghaleb et al., 2006). The third study reviewed found that 3.9% of the 10% of patients subjected to errors were subjected to medication administration errors (Kozer (2002) as reported in Ghaleb et al., 2006). Differences in study designs and reporting method makes it difficult to interpret and compare the information obtained by Ghaleb et al., which they also found to be true and discussed in their review.

Of the two medication administration error studies included by Ghaleb et al. (2006) that were obtained via spontaneous reporting, the incidence rates were 14.7 incidents per 100 admissions and 13.4 incidents per 1000 patient days. Also included were eight studies that used observation to detect drug administration errors. The observation studies found that reported drug administration error rates varied between 0.6% and 27% of administrations. This included studies where the observation was

disguised and undisguised, which may explain the vast differences in observed medication administration error rates (Ghaleb et al., 2006). Another study surveyed nurses and found that 40.3% of the respondents indicated they had observed a medication error in at least one stage of the process during the previous week (Antonow et al., 2000). While it would be ideal to give an exact incidence rate for medication administration errors in the inpatient pediatric population, that is difficult due to differences in reporting. It was shown that some incidence rates are reported per 100 admissions, per 1000 patient days, and even as percentages of total administrations.

Types of Medications Involved and Classification of Errors

Ghaleb and colleagues (2006) review found that antibiotics and sedatives were the most commonly reported drug classes associated with errors in the pediatric population. Another pediatric study found that opiates and antibiotics accounted for more adverse events than any other drug classes (Holdsworth et al., 2003). These researchers also found that these were the two most commonly prescribed drug classes in children in their study. They also found in their literature review that these two drug classes accounted for most ADEs among hospitalized adults (Holdsworth et al., 2003).

One case study reported an overdose of noradrenaline given to a 3 month old infant, with the dose given being seven times the recommended dose (De Wildt, Verzijden, Anker & de Hoog; 2007). Another case study reported an overdose of digoxin given to a 14 month old, with the dose given being ten times the recommended dose (Dowdell, 2004). While the specific medications in the above mentioned case studies were not found to be frequent sources of medication error in any of the other studies reviewed, it is important to note that in both case studies the medication error is classified

as an overdose, with seven to ten times the necessary dose being given. This supports information obtained regarding classification of errors found in other studies. Ghaleb and colleagues (2006) found in their systematic review that dosing errors were the most common type of error, often involving 10 times the actual dose required.

In another study, the most common type of error that was found with actual ADEs was inadequate dosage of an opioid analgesic for pediatric patients with post-operative pain (Holdsworth et al., 2003). The most common type of error that was found with potential ADEs was a failure to acknowledge or process antibiotic discontinuation orders. In the study, it was evident that new orders were prioritized and given adequate attention, however, discontinuation orders were not (Holdsworth et al., 2003).

Otero and colleagues (2008) obtained the types of medication administration errors both before and after an intervention that was designed to help decrease rates of errors (Otero, Leyton, Mariani & Cernadas; 2008). Both before and after the intervention, the most common medication administration error was omission (failing to administer the medication) followed by incorrect dosing and then incorrect infusion rate (Otero et al., 2008). This study supports other study findings of the types of medication administration errors that occur.

In summary, it was found that antibiotics, sedatives and opioids accounted for the vast majority of the medications involved in medication administration errors. Medication administration errors were often due to dosing error and errors of omission.

Why Errors Occur

One study asked nurses to select the two most important reasons that medication errors occur out of 14 potential reasons that excluded transcription errors and physician

handwriting (Stratton et al., 2004). The pediatric nurse respondents most frequently identified distractions and interruptions (50%), RN-to-patient ratios (37%), volumes of medications administered (35%) and not double-checking doses (28%) (Stratton et al., 2004). In a review of the literature, Lefrak (2002) found communication, confirmation bias, handwriting, drugs with similar names, trailing zeros and decimal points, dose calculations and lack of knowledge to be a cause of medication administration errors.

As previously mentioned, a case study was reviewed that involved a medication administration error: intravenous digoxin was administered to a 14 month old that was ten times the safe dose (Dowdell, 2004). It was found that the medication error was a result of a couple of different factors. The major factor was that the nurse who administered the digoxin was an adult ICU nurse who was floated to the PICU. The nurse was unfamiliar with the policies of the PICU, and lacked the experience in working with critically ill pediatric patients. The nurse did not check the dosage calculation, nor did she check with another PICU nurse prior to administration. Additionally, pharmacy played a role and it was found that there was no procedure to double check dangerous pediatric drugs prior to delivery (Dowdell, 2004). This case study showed that the medication error did not originate with the individual who ultimately committed the error, but also that the individual did not catch the error. This case study demonstrates the importance of having a system of formalized checks in place that help to identify medication errors and prevent them from reaching the patient.

Unfortunately, the use of technology does not always guarantee patient safety, either. One case report found in the literature was on the use of a handheld computer that was used to calculate drug dosage for a three month old patient who had signs of sepsis

(De Wildt et al., 2007). It was discovered that the incorrect concentration of noradrenaline had been calculated using a preprogrammed spreadsheet on a handheld computer. After the medication error was caught and corrected, further investigation into the spreadsheet and the handheld computer took place. It was found that the spreadsheet's formula for calculation was in a cell that was not "locked", and accidentally the patient's weight had overwritten the concentration of noradrenaline for infusion, which had resulted in a 7 fold dose increase. This case report highlights that while computer programs can be used to calculate drug concentrations, human error may not be entirely eliminated. Suggestions from this case report include double-checking calculations, and possibly having pre-printed charts that eliminate the need for calculations (De Wildt et al., 2007).

Holdsworth et al. (2003) found that ADEs and potential ADEs were more likely to occur among children with longer hospital stays and greater medication exposure. They also found that children with ADEs and potential ADEs were both less likely to be routinely discharged and more likely to be transferred to another institution and/or a home health agency than were children with no ADEs. The researchers found that children who developed or had the potential to develop these events represented more complicated cases in terms of severity of illness, especially related to medication exposure. They concluded that an ADE may be a consequence of disease severity among hospitalized patients, rather than a significant factor that directly contributes to patient morbidity (Holdsworth et al., 2003). The conclusions of Holdsworth and colleagues was not substantiated in any other the other study findings.

This theme sought to understand why medication administration errors occur. The results of this theme indicated that distractions, interruptions, communication, dose calculations and lack of knowledge were a common cause of medication administration errors.

Medication Error Reporting

One study found that pediatric nurses estimated that only 67% of medication errors on their patient care units are actually reported (Stratton et al., 2004). This study asked for reasons as to why medication errors were underreported, and both individual/personal and management-related reasons were selected by the participants, suggesting the need to develop a unit/hospital culture supportive of error reporting (Stratton et al., 2004). Another study compared survey results with written incident reports and found that of the 89 medication errors observed by the nurses, the respondents indicated that only 17 of the medication errors resulted in completion of an incident report (Antonow et al., 2000).

While Antonow and colleagues (2000) found that the likelihood of preventing a medication error from reaching the patient *declined* in the later stages of the medication process as previously mentioned, the likelihood of a formal written incident report *increased* in the later stages of the medication process. It was found that out of the medication errors that were not prevented and actually reached the patient, just 38% of the medication errors that occurred during the ordering/prescribing phase were reported, 36% of the medication errors that occurred during the transcription/verification phase were reported, 47% of the medication errors that occurred during the dispensing/delivery

phase were reported, and 65% of the medication errors that occurred during the administration phase were reported (Antonow et al., 2000).

A study by Ferranti and colleagues (2008) compared a voluntary safety reporting system and a computerized ADE surveillance system with regards to frequency of rates of ADEs (Ferranti et al., 2008). It was found that the incidence of ADEs was comparable with an overall rate of 1.8 ADEs per 1000 patient days with the voluntary reporting and 1.6 ADEs per 1000 patient days with the computerized system. While the incidence of ADEs were not statistically significant between the two systems, the researchers found that the voluntary system provided greater insight into system failures, such as drug omission, administration errors, and lapses in clinical monitoring. These types of errors are not easily detected by automated techniques, emphasizing the need for an approach that incorporates the strengths of each method so that detection of ADEs in the pediatric population can be maximized.

A review of the literature suggested that attention should be placed on "near miss" medication errors (Lefrak, 2002). A near miss is an event that did not cause harm to a patient, but that had the potential to cause harm. Near misses have a high likelihood of happening again if they are not reported, and if the cause of the near miss is not corrected. It is suggested that near miss medication errors be reported in the same manner as medication errors (Lefrak, 2002).

A culture of change is needed with regard to reporting systems for medication errors (Cadwell, 2008). Reporting systems need to be non-punitive so that individuals feel comfortable reporting medication errors. Additionally, an analysis of each reported

error and potential errors need to occur so that the underlying cause of the error within the context of the entire system can be altered (Cadwell, 2008).

To summarize, this theme found that medication errors tend to be under-reported, often due to fear of punishment. It was also found that voluntary reporting provided greater insight into system failures that lead to the error. Additionally, it is recommended that near-misses are reported.

Interventions to Reduce Medication Errors

Of all the studies, only one study looked at interventions to reduce medication administration errors. As previously described, this study was a pre-intervention and post-intervention design that compared medication administration error rates (Otero et al., 2008). The intervention was the implementation of the "10 steps to reduce medication errors" checklist that included providing a plastic pocket card that was provided to the nurses, and additional copies were placed where medications were routinely administered. A decrease in medication administration errors was observed after the intervention, with a pre-intervention error rate of 17.3% and a post-intervention error rate of 9.2%.

Ghaleb and colleagues (2006) summarized the suggestions they found in their systematic review to prevent medication administration errors, which include checking the name and dose of the medication and verifying the patient identity prior to administration. Additionally, it is advised to double-check with the provider should anything arise that causes concern, including unusual volumes or doses, or concerns from the parent and/or patient (Ghaleb et al., 2006).

This theme found that the interventions to reduce medication errors are similar to current recommendations for safe medication administration practices. Additionally, the suggestions by Ghaleb and colleagues (2006), as well as the intervention checklist (Otero et al., 2008) are in accordance with the recommendations found in Table 1 by NCC MERP (1999).

Summary

Medication administration errors are a serious concern for the pediatric population. This chapter presented an overview of medication errors and safe medication administration practices. Additional information was presented regarding the pediatric population and specific factors that make this population for susceptible to medication errors. A systematic review of the literature on medication administration errors in the pediatric population was presented. From the review, five themes emerged including the incidence rate of medication administration errors, specific medications involved in medication administration errors and classification of the errors, why medication administration errors occur, medication error reporting, and interventions to reduce medication errors.

Differences in study design made it difficult to compare the articles with regards to some of the themes. However, it was apparent that medication administration errors do occur in the pediatric population, regardless of the exact incidence rate. As previously stated, the NCC MERP believes that there is no acceptable incidence rate for medication errors. Errors in dosage were found to be a common reason as to why medication errors occur. There was some discrepancy with regard to medication error reporting, as it was found that medication errors are underreported but the extent of this varied. Systems

used to report medication errors also varied. It was found that the more detailed the information reported on the medication error, the more potential impact it had on leading to a system change to prevent such errors from occurring again. It is recommended that reporting systems be non-punitive so that nurses aren't afraid to report errors. Additionally, more emphasis should be placed on "near miss" medication errors, as these occur frequently but are rarely reported and may provide greater insight into system flaws. Lastly, interventions found to reduce medication administration errors were congruent with current recommendations for safe medication administration. This calls into question if the current recommendations are being followed uniformly. Implications for future research and practice include a formalized system check for safe medication administration be developed and utilized. System checks have been developed and are widely used during the prescribing and preparing stage, and less medication errors are noted during this early part of the medication process. Having a formalized system check during medication administration would aid in ensuring that current recommendations are being followed which would lead to a decrease in medication administration errors.

Parents and caregivers naturally expect that their children will be safe when in the healthcare system. Yet providing health care will always involve some degree of risk, due to both the complexity of the healthcare environment and the role that human judgment plays within it. Nurses play a role in improving the safety of children within their care. The role of the nurse is much wider than simply reporting patient safety incidents or near misses; it includes taking preventative actions, sharing experiences, learning from mistakes and helping to devise solutions. The next chapter will examine

how safe medication administration is assessed; ensuring knowledge and skill in safe medication administration is vital in reducing medication administration errors.

Table 2. Articles Included in Chapter Two Systematic Review

Author and year published	**Type of study**	**Sample**	**Location**	**Instruments used**	**Results**
Antonow, Smith & Silver (2000)	Comparison of survey findings with incident reports	Registered nurses, 63.7% of whom worked at least 36 hours per week	38-bed infant unit of a pediatric hospital that had a total of 232 beds	Survey, incident report	Total number of medication errors identified through incident reports was lower than what would be expected; the number of errors indicated by the survey did not match the number of written incident reports for the same time period.
Cadwell (2008)	Practice-based and literature review	N/A	N/A	N/A	The pediatric population including its particular vulnerabilities to medication errors is discussed, as well as implications for ED nurses.
De Wildt et al. (2007)	Case study	3 month old infant is case study subject, physician and information technology specialist provide background information	Case study subject was transferred from a regional hospital to a higher level hospital's PICU	N/A	Infant presents at a small hospital's emergency department with signs of meningococcal sepsis. The infant is transferred to a higher level hospital's PICU. During transfer, the patient was given infusions of dobutamine and noradrenaline. The concentrations were previously calculated by a resident from the referring hospital by entering the patient's weight into a preprogrammed PocketExcel spreadsheet for a PDA. Discovered that the patient had received a seven-fold higher dose of noradrenaline during the transfer (for approximately 2 hours). Discussion of how the use of the PocketExcel contributed to this error is included.

Table 2. Continued

Author and year published	Type of study	Sample	Location	Instruments used	Results
Dowdell (2004)	Case study	14 month old male admitted with the diagnosis of CHF and URI, assigned nurse, attending physician	PICU of a suburban hospital	N/A	The assigned nurse documented that a verbal order for administration of 0.7 mg of digoxin intravenously had been obtained from the attending physician. Based upon the patient's weight, 0.07 mg was the appropriate dose. Digoxin 0.7 mg IV was given by the assigned nurse, who was a "float" nurse that had never administered a pediatric dose of digoxin previously. The patient died later that day. The nurse's and attending physician's recall and documentation of the event differed.
Ferranti, et al. (2008)	Retrospective evaluation of all medication-related events	Medication-related events that occurred with pediatric patients over a year (December 1, 2004 until January 31, 2006)	Duke University Hospital inpatient pediatric units (3 ICUs, 2 general pediatric wards, and 2 transitional care units)	Computerized surveillance (ADE-S) and voluntary safety reporting (SRS)	849 voluntary reports (SRS) were submitted. 93 of these (11%) were deemed ADEs, resulting in an SRS incidence rate of 1.8 ADEs per 1000 patient-days. For the ADE-S system, a total of 1537 triggers fired. After review by pharmacy, 78 ADEs were found (5.1%) resulting in an overall rate of 1.6 ADEs per 1000 patient days. The difference in ADE discovery rates was not statistically significant between the two systems.

Table 2. Continued

Author and year published	Type of study	Sample	Location	Instruments used	Results
Ghaleb, et al. (2006)	Systematic review	Studies of the incidence and nature of medication errors in pediatrics.	N/A	N/A	Objective was to review articles that have reported the incidence of medication errors in pediatric patients and identify common errors. Three methods were used to detect medication errors in the studies reviewed: spontaneous reporting (n=10), medication order or chart review (n=14) and observation (n=8). There were variations in the definitions of medication errors used as well as the error rates reported. Most common type of error were errors due to incorrect dosing, often involving 10 times the actual dose. Antibiotics and sedatives were the most common classes of drugs associated with medication errors.
Holdsworth et al. (2003)	Prospective review of medical records and staff interviews	Pediatric patient admissions between from 9/15/00 to 5/10/01.	A general pediatric unit and a PICU in metropolitan medical center	N/A	The ADEs (6/100 admissions, 7.5/1000 patient-days) and potential ADEs (8/100 admissions, 9.3/1000 patient-days) were common in hospitalized children. After adjusting for length of stay, medication exposure played a significant influence on ADEs and potential ADEs.

Table 2. Continued

Author and year published	Type of study	Sample	Location	Instruments used	Results
Lefrak (2002)	Literature review	N/A	N/A	N/A	Error reduction techniques found in the literature included root cause analysis and failure mode analysis. Problem identification techniques include survey, case finding, error reporting mechanisms, and error, near miss and latent error review and analysis. A review of other practices and standards proven to improve patient safety related to medication administration are also discussed.
Otero et al. (2008)	Pre-intervention and post-intervention cross-sectional study	Sample of prescriptions that were ordered by physicians and medications that were administered by nurses in 2002 and 2004	NICU, PICU and general pediatric settings at the Hospital Italiano de Buenos Aires Departme nt of Pediatrics	Intervention included incorporating a positive safety culture, and specific prescribing and medication administration recommendatio ns were implemented	A total of 590 prescriptions and 1174 drug administrations for 95 patients occurred in the first phase of the study and were evaluated. The prevalence of medication error rate was 11.4% during the first phase. During the second phase, 1144 prescriptions and 1588 drug administrations for 92 patients were evaluated. The prevalence rate was 7.3% during the second phase.

Table 2. Continued

Author and year published	Type of study	Sample	Location	Instruments used	Results
Stratton et al. (2004)	Descriptive study	Convenience sample of 57 pediatric nurses and 227 adult hospital nurses	33 acute care units (27 adult and 6 pediatric) in 11 hospitals in 2 states. The size of the participating hospital ranged from 120 to more than 500 acute care beds.	Variance reports and questionnaire. The questionnaire asked the nurses' perceptions of the proportion of medication errors reported on their unit, why medication errors occur, and why medication errors are not always reported	Pediatric nurses indicated a higher proportion of errors were reported (67%) versus the adult nurses indicated (56%). The medication error rates per 1000 patient-days computed from the variance reports were also higher on pediatric units as compared to adult units (14.8 versus 5.66).

CHAPTER III

ASSESSMENTS OF SAFE MEDICATION ADMINISTRATION

Abstract

Quality and Safety Education for Nurses (QSEN) has a variety of suggested strategies for teaching safety, however they do not have a recommendation for how nursing faculty are to assess whether nursing students are competent in safety, specifically safe medication administration. The overall purpose of the work was addressed through two specific aims. The first aim was to identify and describe all instruments found to assess safe medication administration through a systematic review of the literature. The second aim was to identify methods used by nursing faculty members to assess nursing students' competency in safe medication administration including knowledge and skills prior to entering the clinical area by conducting a survey of deans and directors of AACN schools and programs of nursing. With regard to the general findings of this work, the systematic literature search identified the lack of instruments that comprehensively assess safe medication administration and have sufficient evidence of validity and reliability. In addition, the results of the survey indicated no standardized method for assessing safe medication administration in nursing education, and instead the results showed much variation in how and when safe medication administration is assessed in the education setting.

Background

The American Association of Colleges of Nursing (AACN) formed the Quality and Safety Education for Nurses (QSEN) to identify gaps in nursing education and implement a curriculum to include quality and safety (Cronenwett et al., 2007). The QSEN faculty adapted the Institute of Medicine (IOM) competencies for nursing and further defined six competencies for nursing graduates. In addition, QSEN outlined the knowledge, skills and attitudes (KSAs) for each competency appropriate for pre-licensure nursing education. While QSEN has a variety of suggested strategies for teaching safety (QSEN, 2010), they do not have a recommendation for how nursing faculty are to assess whether nursing students have attained the KSAs related to the competency of safety and specifically safe medication administration.

Purpose and Aims

The overall purpose of this chapter is to gain information on how safe medication administration is assessed. This purpose was addressed through two specific aims: 1) Conduct a systematic review of the literature to identify and describe all instruments found to assess safe medication administration and 2) Present the results of a survey developed to identify methods used by nursing faculty members to assess nursing students' knowledge and skills of safe medication administration prior to entering the clinical area. Specific research questions used to guide the systematic literature review were: 1) What assessments of safe medication administration are used in nursing practice and 2) What assessments of safe medication administration are used in nursing education.

Method for the Systematic Literature Review

In order to find instruments used within health care and currently in print, a systematic literature review was conducted. First, CINAHL Plus was searched using CINAHL headings. Specific search terms included the major heading "patient safety" which was expanded to include all sub-headings; also included were the major headings of: drug administration (including medication reconciliation), medication administration, research instruments (including instrument construction, instrument validation, and instrument scaling) dosage calculation (including medication reconciliation), and measurement issues and assessments (including clinical assessment tools and competency assessment). Then all major headings were expanded to include the previously identified sub-headings. These search terms were combined two and three at a time using the word "and" resulting in 487 articles from CINAHL being selected for review (see Table 3). All of the article abstracts were reviewed and articles were selected and viewed in their entirety when they included an instrument to assess safe medication administration. Articles not selected for review identified instruments to identify medication errors, instruments on attitude or perception of medication errors, instruments on performance of medication administration, and computerized physician order entry and medication bar coding systems. After those articles were deleted, the end result was ten articles being selected for inclusion and review.

Next, EBSCOhost was searched using the following databases: Academic Search Elite, ERIC, Health and Psychosocial Instruments, and Health Source: Nursing/Academic Edition. Search terms included: drug administration, medication administration, instruments, dosage calculation, and assessment. These search terms were combined two

and three at a time using the word “and” resulting in 746 articles being selected for review. The article abstracts were reviewed using the above specified criteria. Articles were viewed in their entirety if they included an instrument used to assess safe medication administration. Articles not selected included articles on instruments to identify medication errors, instruments on attitude or perception of medication errors, instruments on performance of medication administration, and computerized physician order entry and medication bar coding systems. Additionally, duplicate articles were extracted. The result yielded one article for inclusion.

Next, EBSCOhost was searched using the database International Pharmaceutical Abstracts. Search terms included medication administration, instrument, drug administration and assessment. These search terms were combined two at a time using “and” resulting in 255 articles being selected for review. The article abstracts were reviewed and viewed in their entirety if they included an instrument to assess safe medication administration. Articles not selected for review included articles on instruments to identify medication errors, instruments on attitude or perception of medication errors, instruments on performance of medication administration, and computerized physician order entry and medication bar coding systems. Additionally, duplicate articles were deleted. This search source did not yield any articles for inclusion.

Other searches were conducted using Google Scholar, Cochrane, Buros Institute, Agency for Healthcare Research and Quality, Kaiser Foundation, National Patient Safety Foundation and Quality and Safety Education for Nurses. These searches did not yield any articles meeting the criteria of the systematic review.

The entire process resulted in eleven articles meeting the selection criteria for inclusion. The references of the eleven articles selected were then reviewed and an additional three articles were obtained based upon the references cited by those authors. A summary of each article selected for inclusion is found in Table 4. A synthesis of the instruments found in the fourteen articles is presented in the following section.

Results of the Systematic Review

Fourteen articles were selected for review; the instruments identified in the articles had varying levels of evidence of validity and reliability. Some of the instruments' psychometric properties included just validity or reliability but not both, or the psychometric properties were weak, however, they were still included and reviewed because of the insufficient quantity and quality of instruments found to assess safe medication administration. The researcher made the choice to review any article found that identified an instrument that assessed safe medication administration. In addition, articles that identified an instrument that assessed *one aspect* of safe medication administration, such as one of the five rights of safe medication administration, were also included. The following review of the literature presents the findings of the systematic review.

Of the fourteen articles obtained, twelve were from nursing journals and two were dissertations. While a concerted effort was made to ensure that sources outside nursing literature were reviewed and considered for inclusion, none were applicable to the focus and were not selected. Ten articles were specific to the assessment of medication calculation abilities which assesses knowledge and skill of *right dose*, one of the five rights of safe medication administration (Ashby, 1997; Bayne & Bindler, 1988; Bayne &

Bindler, 1997; Bindler & Bayne, 1984; Bindler & Bayne, 1991; Bliss-Holtz, 1994; Flynn & Moore, 1990; Kohtz & Gowda, 2010; Rainboth & DeMasi, 2006; Serembus, 2000). One article was specific to assessing knowledge of pharmacology which assesses *right drug*, one of the five rights of safe medication administration (Ndosi & Newell, 2008). Three of the articles were more general to a comprehensive assessment of safe medication administration (Hsaio, et al., 2010; Ryan, 2007; Werab, Alexander, Brunt & Wester, 1994). What follows is a discussion of the validity and reliability of the instruments found in the articles referred to here and when appropriate, discussion will align the instrument to one or more of the five rights of safe medication administration.

Medication Calculation Instruments: Right Dose

Six different instruments were mentioned in ten articles that were specific to instruments to assess medication calculations with the instrument used most frequently was the Bayne-Bindler Medication Calculation Test (Ashby, 1997; Bayne & Bindler, 1988; Bayne & Bindler, 1997; Bindler & Bayne, 1984; Bindler & Bayne, 1991; Serembus, 2000). The Bayne-Bindler Medication Calculation Test is a 20-item fill-in-the-blank medication calculation examination to assess mathematical calculating ability (Bindler & Bayne, 1984) and is used with registered nurses, recent graduates that have not completed licensure, and nursing students (Ashby, 1997; Bayne & Bindler 1988; Bayne & Bindler 1997; Bindler & Bayne 1984; Bindler & Bayne, 1991; Serembus, 2000). The test includes questions about oral medications, intramuscular or subcutaneous medications, and intravenous medication calculations (Bindler & Bayne, 1988). As described by Ashby (1997), each test answer is worth five points for a total score of 100.

The Bayne-Bindler Medication Calculation Test was initially found to have evidence of content validity and an odd-even split half test of reliability of .82 (Bayne and Bindler, 1988). In their 1997 study, the authors found an internal consistency reliability using Cronbach's alpha was .72 for the pretest and .74 for the posttest (Bayne and Bindler, 1997).

Serembus (2000) provided additional evidence of validity and reliability on the Bayne-Bindler Medication Calculation test. She found additional evidence of content validity, and internal consistency reliability using the Kuder-Richardson formula was .70 for the pretest and .83 for the posttest (Serembus, 2000).

A second instrument that included two forms for assessing medication calculation abilities was described by Bliss-Holtz (1994). Each version contained 15 fill-in-the-blank questions involving calculations of intravenous medication administration rates, intramuscular and subcutaneous dosages, mixing of solutions, tablet dosages, and dosage-by-weight calculations. The two forms were reported to have content validity. Internal consistency reliability was calculated with alpha = 0.83 for Form I and alpha = .71 for Form II when piloting the instrument on 39 nurses, and the other results in a study of 51 nurses were alpha =.81 for Form I and alpha =.79 for Form II. Reliability was obtained by giving both tests in a random order to a convenience sample of 49 nurses, and a Pearson correlation of .94 was obtained (Bliss-Holtz, 1994).

Flynn and Moore (1990) developed a 20-item examination consisting of metric-English conversions and medication and intravenous calculations. Possible score range is 0 to 20. Content validity was established through two separate pilot studies. When 46

subjects participated, the alpha for internal consistency reliability was .83, and was .82 in a study with 64 nursing students.

Kohtz and Gowda (2010) described a 24-item tool that involved calculating the number of tablets to administer, calculating the number of milliliters to administer, calculating milliliters per hour, and calculating drops per minute. The authors state that content validity was established, but no additional information on the psychometric properties of the instrument was provided.

Rainboth and DeMasi (2006) described two different instruments in their article. The first instrument was a 14-item multiple-choice test, which they established content validity on and the internal consistency reliability was documented as alpha = 0.674. The second instrument was a 10-item fill-in-the-blank test, which they established content validity on and internal consistency reliability was documented as alpha = 0.135. The authors conclude the low reliability score for the second instrument could be explained by the large percentage of students who received 100% on the exam. No further information was included or could be located regarding validity or reliability of either of these instruments (Rainboth & DeMasi, 2006).

In summary, six instruments were discussed in the ten articles that were specific to assessing students' or nurses' ability to correctly calculate medication dosage, or assure right dose. The medication calculation test that has been used the most is the Bayne-Bindler Medication Calculation Test. In addition, this instrument had the most reported evidence of established validity and reliability for assessing individual's abilities for correctly calculating medication dosage, which is one aspect of safe medication

administration. This is the only instrument identified that was used to assess the preparation of students prior to the administration of medications.

Pharmacology Knowledge Instrument: Right Drug

Knowledge of pharmacology, or *right drug*, is an important component of safe medication administration. Ndosi and Newell (2008) developed an instrument to assess nurses' knowledge of pharmacology for medications commonly administered on surgical units. The instrument they developed was to assess knowledge of one out of four randomly chosen medications selected from the following list: codeine phosphate, diclofenac, dalteparin, and lansoprazole. The authors report the instrument had evidence of face validity and content validity. Reliability assessment for the pharmacology questionnaire was limited to inter-rater reliability and was determined by calculating the intra-class correlation coefficient (ICC). The average ICC for the study was .726 with p = .001, indicating the strength of agreement among raters was good (Ndosi & Newell, 2008). No further evidence of validity or reliability was reported.

Comprehensive Instruments: The Five Rights

Hsaio and colleagues (2010) developed and validated a questionnaire to measure nurses' knowledge of administering high-alert medications from eight categories: cardiovascular medications, chemotherapeutic agents, narcotics, opiates, anticoagulants, benzodiazepines, neuromuscular blocking agents and electrolytes. The 20-item questionnaire used a true/false format for ten questions focusing on drug delivery routes and dosage, and the other ten questions focus on how high-alert medications should be stored, regulated and written.

Face validity and content validity were established (Hsaio et al., 2010). Construct validity was established through the contrasted groups approach using registered nurses and nursing students. Results demonstrated a statistically significant difference in the knowledge scores of participants, and the authors concluded the questionnaire had construct validity. Internal consistency reliability was established for the pilot with an alpha=.66 (n=50) and for the study with 305 subjects, the alpha=.74.

In a separate article, Werab and colleagues discussed two instruments that assess medication administration (Werab et al., 1994). The first instrument was a 24-question pretest and the second instrument was a 45-question posttest. The posttest had a higher level of difficulty than the pretest. After 27 nurses had completed the instruments, an item analysis of the pretest and posttest was completed. Questions on the pretest frequently missed were reworded or discarded; questions never missed were revised with different distracters. In addition, the pretest was expanded to include questions to assess judgment, critical thinking skills and on the common types of errors at the hospital. After evaluation, the post-test was eliminated entirely and an alternate format was used to assess knowledge retention. No further information regarding the pretest or posttest was provided including overall validity and reliability of the final pretest after changes were made or the rationale for the elimination of the posttest (Werab et al., 1994).

The last instrument to be presented, the Safe Administration of Medication (SAM) Scale, was developed to objectively measure performance of the safe administration of medication (Ryan, 2008). The SAM Scale was constructed to be administered to associate degree and baccalaureate degree nursing students. This instrument was the most comprehensive instrument found. It assessed the broad concept

of safe medication administration, and included a detailed description of development and establishment of validity and reliability.

The SAM Scale has 70 items related to five clinical cases of hospitalized patients including adults and children (Ryan, 2007). For each item, participants are asked to evaluate the actions taken by the nurse and determine if the actions taken were correct or incorrect based on the five rights of safe medication administration. Content validity of the SAM Scale was established (Ryan, 2007).

Ryan reported evidence of fit validity, specifically both person fit and item fit, indicating the model fits the data. Specifically, Ryan reported a mean infit statistic of 0.99 and the mean outfit statistic of 0.86 for person fit, and a mean infit statistic of .99 and a mean outfit statistic of .87 for item fit.

Reliability of separation was 0.87 for medication items, indicating the items are significantly differentiated from one another and reliably define item difficulty (Ryan, 2007). This indicates that one can rely on the order of items when replicated and given to another sample of nursing students. Person separation reliability is similar to the KR20 measure of internal consistency (Wright & Stone, 1999). Ryan (2007) reported a reliability of separation of 0.39 for student nurses, indicating that the nursing students are not well differentiated. Ryan concluded that the SAM Scale demonstrated initial evidence of validity and reliability, but did recommend further evaluation of the instrument.

Review of Instruments Presented

To summarize, this literature review was conducted to locate instruments and other methods for assessing either an individuals' performance on *any* elements of safe

medication administration or on *all* elements of safe medication administration. Ten of the articles were specific for assessing the performance of medication calculation (Ashby, 1997; Bayne & Bindler, 1988; Bayne & Bindler, 1997; Bindler & Bayne, 1984; Bindler & Bayne, 1991; Bliss-Holtz, 1994; Flynn & Moore, 1990; Kohtz & Gowda, 2010; Rainboth & DeMasi, 2006; Serembus, 2000). Medication calculation is an important skill as it assures one of the five rights of safe medication administration: right dose. The most commonly used instrument to assess medication calculation was the Bayne-Bindler Medication Calculation Test, although a total of six instruments were found within the ten articles. Instruments that assess other aspects of safe medication administration were also found. One article was specific to assessing knowledge of pharmacology (Ndosi & Newell, 2008). Knowledge of pharmacology is also vital as it ensures one of the five rights of safe medication administration: right drug. Three articles were more comprehensive of safe medication administration (Hsaio, et al., 2010; Ryan, 2007; Werab et al., 1994). The instruments found in these articles were: Nurses' knowledge of high-alert medication questionnaire, medication module pretest and post-test, and the SAM Scale. These instruments incorporated all of the five rights of safe medication administration.

Thus, based on this systematic review there is a paucity of instruments in the printed literature to assess safe medication administration. Seven of the eleven instruments identified in the ten articles were lacking in that they only assessed one part of safe medication administration. The instruments identified that were comprehensive assessments of safe medication administration had insufficient evidence of established

validity and reliability because they did not use traditional methods of establishing validity and reliability or else had a small sample size.

Method for Survey Data Collection

As described in the previous section, a literature search demonstrated a scarcity of instruments with established psychometric properties that assess safe medication administration. Therefore, the second aim of this work was to identify strategies or tools used by baccalaureate nursing faculty members in accredited programs to elicit information on how safe medication administration was being assessed in pre-licensure nursing education prior to students being allowed to pass medications on the clinical area. The specific research questions addressed in the survey were: 1) How is safe medication administration assessed prior to students entering the clinical area, 2) How is safe medication administration assessed during clinical, 3) How is knowledge of "right drug" assessed in the classroom and 4) How is knowledge of "right dose" assessed in the classroom setting.

Sample

The dean or program director of every American Association of Colleges of Nursing (AACN) member schools that offers a BSN was invited to participate in the study. AACN membership includes programs from all 50 states, Washington D.C., Puerto Rico, online programs and international programs, totaling over 640 programs (AACN, 2010). The sample was accessed through an e-mail list and included over 600 email addresses.

Survey Instrument

A survey instrument was developed by the researcher for this proposed study based upon the results of the systematic literature review and the five rights of safe medication administration (Appendix A). The survey was developed to elicit information on how safe medication administration is being assessed in nursing education and address the four research questions: 1) How is safe medication administration assessed prior to students entering the clinical area, 2) How is safe medication administration assessed during clinical, 3) How is knowledge of "right drug" assessed in the classroom and 4) How is knowledge of "right dose" assessed in the classroom setting. The survey is comprised of 14 questions that address these four research questions; the majority of the questions were closed-ended questions requiring the participants to mark all that apply. A few questions allowed the respondents to simply answer the question. A summary of how the four research questions formed the basis of the survey questions is found in Table 5.

The content validity of the survey was evaluated initially by faculty at both public and independent nursing education programs. For this, the content reviewers were sent the survey and asked to review it for clarity of questions and answer options. In addition, they were asked to consider whether the survey captured how the competency of safe medication administration was assessed in nursing education. The experts were also asked to provide suggestions on whether additional questions were needed in the survey. Following review by the content experts, the survey was refined slightly by rewriting selected questions and by the addition of answer options for selected questions. Specifically, the reviewers suggested the survey make reference to "independent" rather

than “private” nursing education institutions, which impacted the answer options for question one, and adding “nursing faculty without a nursing degree” as an answer option for question six, which asked who teaches the pharmacology content. The final version of the survey was completed by both the Dean and Associate Dean at the nursing program where the researcher is a faculty member prior to distributing the questionnaire to the entire sample. Due to their involvement, this program was eliminated from participating in the study. No reliability evaluation of the survey was completed.

Procedure

The survey was placed online on a secured survey system, WebSurveyor. The deans or directors of the AACN BSN schools were emailed three separate times at designated intervals. The first email was sent immediately following IRB approval and the third email was sent prior to the end of the semester. Exact dates for the three emails were October 12, 2010; October 31, 2010; and November 30, 2010. Participation was voluntary; consent was indicated by completion of the survey. After each of the first two solicitations, selected e-mails were returned as undeliverable and the researcher attempted to get correct e-mails through the program’s website and resent the survey a third time.

Data Analysis

Data analysis was completed using an appropriate statistical software package, SPSS. The fourteen questions in the survey yielded nominal, frequency and ordinal data. Descriptive statistics are presented for each item of the survey.

Results

Over 100 emails were returned as undeliverable after the first email was sent; the researcher then went to the program's website to verify the correct email address for the dean or director. Following the second email, many emails were still returned as undeliverable indicating that the program's website did not list the correct email address for their dean/director.

Over 80 programs sent a reply email indicating their program was a BSN completion program (also known as RN to BSN program) and did not assess safe medication administration, thus the survey was not applicable to their education program; and they were removed from the email list. One program sent a reply email that their program was new and they did not have any nursing students beyond freshmen standing, thus the survey was not applicable to them as they had yet to assess safe medication administration in their nursing students. Five programs sent a reply email and requested to be removed from the email list and stated they would not be participating; some offered an explanation that they simply didn't have the time to respond to all the survey requests they receive each year. Ten programs responded to the emails asking if the researcher had obtained IRB approval at their institution and stated they would not be able to participate unless this was done. The researcher elected not to request IRB approval at each program's institution and offered to email the letter indicating IRB approval had been obtained at the researcher's institution.

The third email was sent to 457 email addresses; the final sample reflects data gathered from 239 programs that agreed to participate and submitted survey responses. It is estimated that there were ~450 applicable programs for this study; the participation rate

for this study was 53%. After reviewing the responses, none were deemed ineligible for any reason and all were included in the data analysis. However, some participants left questions blank on the survey rather than select the "unsure" option.

The first three questions of the survey collected demographic information. Of the 239 programs that participated, 47.3% (N=112) identified their program as being a part of an independent institution and 52.7% (N=125) identified their program as being a part of a public institution. Two participants chose not to provide this information. Ninety-six percent indicated they offered a BSN; a few offered a BA with a major in nursing. Over 63% of the programs (N=152) also offered a graduate nursing degree including a Master's in nursing, Doctorate in Nursing Practice or a Doctorate in Nursing. The programs varied in size with the smallest graduating 12 BSN students annually and the largest graduating 800 BSN students; the mean number of BSN students that graduated annually from the programs that participated was 111. Data from the 2010-2011 AACN report on baccalaureate enrollment indicates that there were 51,039 graduates from 608 generic (entry-level) baccalaureate nursing program between August 1, 2009 to July31, 2010; each program had an average of 84 graduates (Fang, Hu & Badnash, 2011). The Report did not provide a range for the number of graduates. While the reported average number of baccalaureate graduates is smaller than that reported by the sample, this may be due to recent enrollment increases. The participants were instructed to report the average number of baccalaureate students they graduate each year; this may have been based upon their current enrollment, rather than actual number they most recently graduated. This supports the generalizability of the data found in the present study as the average size of the sample is representative of the population of AACN BSN programs.

Research question one. The first research question asked how safe medication administration was assessed prior to students entering the clinical area and the participants could select as many answers as applied. Based on the individual item responses for this survey question, 60% (N=144) used the successful completion of a stand-alone pharmacology course, 36.8% (N=88) used successful completion of nursing course(s) that integrate pharmacology content, 29.3% (N=70) used computer-assisted safe medication administration module and exam, 85.4% (N=204) used examinations that included questions on safe medication administration, 96.2% percent of the programs (N=230) indicated they used medication calculation / mathematical exams, 95% (N=227) used performance assessment in skills laboratory on medication administration, 54.8% (N=131) used performance assessment prior to clinical, and 5.4% (N=13) indicated "other" (Figure 1). Specific comments in the "other" response option included: concurrent enrollment in pharmacology (N=4) and simulation (N=6). The most commonly used assessment strategy prior to students entering the clinical area was the use of a medication calculation / mathematical exam.

Research question two. The second research question asked how safe medication administration is assessed in the clinical setting; participants could select as many answers as applied. Ninety-three percent (N=223) used oral review with the clinical instructor, 90% (N=215) used performance assessment during clinical, 49.8% (N=119) used a written assignment, 1.3% (N=3) were unsure, and 4.2% (N=10) indicated "other" (Figure 2). Specific comments in the "other" response option included: simulation (N=2), PDA/iTouch (N=2), and preceptor (N=4). The most commonly used assessment strategy was oral review with the clinical instructor.

Research question three. The third research question was about assessment of "right drug" in the classroom, specifically asking who taught the pharmacology course and participants could select as many answers as applied. Of those that responded, eighty-nine percent (N=213) used nursing faculty with a nursing degree, 16.3% of the participants (N=39) indicated that a faculty member who was not a nurse taught the pharmacology content. As stated in the results of research question one, a variation was evident with regards to the placement of pharmacology content with respect to whether it is prior to students entering the clinical setting.

Research question four. The fourth research question was about assessment of "right dose" in the classroom. One item for this question asked about the use of a medication calculation or mathematical exam including how frequently it is administered to nursing students; participants could select only one answer. Of those that responded, fifty percent (N=116) indicated a medication calculation or mathematical exam was done each semester, 20.7% (N=48) indicated this was integrated into every nursing exam, 7.3% (N=17) indicated this is done annually, 6.5% (N=15) indicated this is only done once during the entire nursing program, 13.4% (N=31) responded with "other," 2.2% (N=5) were unsure, and 2.9% (N=7) did not provide a response (Figure 3). None of the participants chose to complete the "other" option for this question.

The second component of this question was open-ended and asked the participants to provide the "passing" percentage grade to be achieved on the examination. Of those participants that chose to respond the breakdown was as follows: passing percentage grade varied between 70-100%. The individual responses were; 4.5% (N=10) required between 70-79%, 21.9% (N=49) required between 80-89%, 43.8% (N=98)

required between 90-99%, and 29.5% (N=66) required 100% on the medication calculation exam in order to "pass." Sixteen participants did not answer this item. Two respondents provided narrative information indicating that the passing percentage grade varied based upon the nursing students academic level in the program.

The third item for this question was open-ended and asked what type of remediation was required for non-passing performance. Remediation for non-passing grades varied greatly with the most common type of remediation included meeting with faculty, lab coordinator, or math tutor (N=48). The second most common type of remediation included the use of computers, including Evolve and Elsevier textbook websites, ATI review, Kaplan review or other computer modules (N=34). Most programs indicated that students who did not pass the exam retook it at least once (N=105). Three programs specified that if the student did not pass it after three retakes then there was an automatic course failure or program dismissal. One program indicated the student could retake the exam as many times as needed in order to achieve a passing grade.

The last item for this question asked if the medication calculation exam was developed by faculty of the nursing education program. Of those who responded, 90.6% (N=213) indicated yes, 6.4% (N=15) indicated no, and 3% (N=7) were unsure.

Discussion

To summarize the results of the survey, it was found that there was no standardized method for assessing safe medication administration. The data for the first research question demonstrated the most frequently used assessment strategy by the nursing programs was the medication calculation / mathematical exam, which assesses

knowledge and performance of right dose. This echoes the findings of the literature search in that most of the instruments found in the literature related to safe medication administration were medication calculation or mathematical exams and focused on the calculation of right dosage. The other two most common forms of assessing safe medication administration prior to clinical were a "performance assessment" with one specifically stating it occurred in the skills laboratory. It is unclear if this is a comprehensive assessment of all aspects of safe medication administration, or if it is an assessment of just some of the parts of safe medication administration, such as correctly drawing up a medication from a vial into a syringe.

The data for the second research question demonstrated that the vast majority of nursing education programs required the instructor's presence when assessing safe medication administration in the clinical setting. This is concerning because of increased demands on the instructor during clinical, increasing size of clinical groups, and the increasing acuity of patients, all of which impact the quality of the educational experience for the nursing students. It is recommended students are allowed sufficient opportunities to practice and have their skill performance assessed prior to entering the clinical setting. This is beneficial to the nursing students, and it is also beneficial to the patient that the student has already *practiced and been assessed* prior to providing patient care.

The data for the third research question for the programs that responded indicated a variation in who teaches the pharmacology course and when it is placed in the program. If non-nurses are solely teaching the pharmacology course, there may be some question as to whether the course includes the nursing implications of pharmacology and safe medication administration. One respondent provided narrative information at the end of

the survey stating that placement of the pharmacology course is a current area of debate, and it is presently placed concurrently with the first clinical course, and that students are administering medications in clinical prior to successful completion of the pharmacology course. Another respondent provided narrative information indicating that the pharmacology course is placed concurrently with "Fundamentals" during the nursing student's sophomore year. It is clear that not all programs require successful completion of a pharmacology course prior to entering the clinical setting. Therefore, nursing students may be administrating medications without sufficient assessment of their knowledge of "right drug."

The data for the fourth research question demonstrated much variation in the frequency of the medication calculation / mathematical exam being administered in the nursing programs, what constituted a passing percentage grade for the examinations, and what type of remediation was required for non-passing grades. In addition, the vast majority indicated that the medication calculation exam was developed by the nursing program's faculty. This practice raises the question whether the medication calculation exam have been psychometrically evaluated, although the survey did not directly pose this question.

Limitations

One limitation of the present study is related to the newness of the survey. Meaningful responses came out of the "other" answer response in which participants were able to add additional comments, such as how many times students were allowed to retake a medication calculation exam or whether a program would ever dismiss students due to their inability to successfully pass the medication calculation exam. As this

information was not specifically asked in the survey, it is difficult to interpret the data in the context of descriptive study. Another limitation with the survey is that its reliability was not evaluated prior to the study. The survey should be further refined to add additional answer options that were provided in the "other" answer option in order to obtain additional descriptive data that could be analyzed for frequency trends. In addition, reliability assessment is recommended to see if multiple individuals from the same education institution would answer the survey similarly, and to ensure that there is consistency with result interpretation.

Another limitation was the uncertainty as to how many nursing education programs were eligible to participate and the lack of complete or accurate e-mails addresses to enable the researcher to directly contact every BSN program. It is impossible to determine survey response rate without knowing how many nursing education programs were eligible. Also, despite the multiple attempts to contact all BSN deans and directors, some programs may not have received their invitation to participate in the study. In addition, some nursing education programs websites were difficult to navigate and were time-intensive in order to discover who the dean or director was, and to find their email address. If the study were to be repeated, the researcher may want to incorporate phone calls with the solicitation of surveys via e-mail. This approach may enable the researcher to have a more accurate list of emails.

Future Direction

The call has been made by QSEN for all nursing education programs to integrate safety into the curriculum. While the knowledge, skill, and attitude (KSA's) for safety outlined by QSEN, assessments for this competency and more specifically, safe

medication administration are lacking. Further comprehensive assessments of safe medication administration are needed in order to evaluate whether nursing students have the KSA's and to evaluate various teaching strategies. Assessments should be all-inclusive to safe medication administration and not just focus on assessment of one of the five rights. Lastly, assessments of safe medication administration should have evidence of validity and reliability.

There is an overwhelming need for a comprehensive assessment of safe medication administration that can be used prior to the clinical setting, as it is vital to ensure nursing students are prepared to provide safe care. In addition, a comprehensive assessment of safe medication administration could be used to evaluate various teaching strategies, such as simulation. The SAM Scale is one assessment of safe medication administration identified in the literature review that is comprehensive and has some evidence of validity and reliability (Ryan, 2007). It is recommended that the SAM Scale be further evaluated using standardized methods for validity and reliability.

Table 3. Systematic Literature Search Results for Chapter Three

Search ID using EBSCOhost: CINAHL Plus	**Search Term**	**Results**	**Reviewed**	**Articles selected for inclusion**
S1	Major Heading "Patient Safety+"	38426	No	Not applicable
S2	Major Heading "Drug Administration"	3974	No	Not applicable
S3	Major Heading "Medication Reconciliation" or "Medication Administration (Iowa NIC)" or Medication Administration: Interpleural (Iowa NIC)" or "Medication Administration: Oral (Iowa NIC)" or "Medication Administration: Parenteral (Iowa NIC)" or Medication Administration: Topical (Iowa NIC)"	169	No	Not applicable
S4	Major Heading "Research Instruments" or "Instrument Construction" or "Instrument Validation" or "Instrument Scaling"	40374	No	Not applicable
S5	S2 and S4	31	Yes	Hsaio et al. Ryan Werab et al.
S6	S3 and S4	1	Yes	None selected
S7	S1 and S2 and S4	15	Yes	None selected
S8	S1 and S3 and S4	1	Yes	None selected
S9	S1 and S4	235	Yes	Ndosi & Newell Ashby Bindler &Bayne
S10	Major Heading "Medication Reconciliation" or "Dosage Calculation+"	1656	No	Not applicable
S11	S4 and S10	20	Yes	Serembus Flynn & Moore
S12	Major Heading "Measurement Issues and Assessments+" or "Clinical Assessment Tools+" or "Competency Assessment"	160677	No	Not applicable
S13	S10 and S12	76	Yes	Kohtz & Gowda Rainboth & DeMasi
S14	S3 and S12	8	Yes	None selected
S15	S2 and S12	100	Yes	None selected

Table 3. Continued

Search ID using EBSCOhost: Academic Search Elite; ERIC; Health and Psychosocial Instruments; Health Source: Nursing/Academic Edition	**Search Term**	**Results**	**Reviewed**	**Articles selected for inclusion**
S1	Patient safety	29745	No	Not applicable
S2	Drug administration	76791	No	Not applicable
S3	Medication administration	8966	No	Not applicable
S4	Instruments	161412	No	Not applicable
S5	S2 and S4	1519	No	Not applicable
S5	S3 and S4	76	Yes	None selected
S7	S1 and S2 and S4	54	Yes	None selected
S8	S1 and S3 and S4	6	Yes	None selected
S9	S1 and S4	713	No	Not applicable
S10	Dosage calculation	181	Yes	Bliss-Holtz
S11	S4 and S10	5	Yes	None selected
S12	Assessment	373698	No	Not applicable
S13	S10 and S12	13	Yes	None selected
S14	S3 and S12	411	Yes	None selected

Table 3. Continued

Search ID using EBSCOhost: International Pharmaceutical Abstracts	**Search Term**	**Results**	**Reviewed**	**Articles selected for inclusion**
S1	Medication administration	860	No	Not applicable
S2	Instrument	1919	No	Not applicable
S3	S1 and S2	5	Yes	None selected
S4	Drug administration	37605	No	Not applicable
S5	S2 and S4	88	Yes	None selected
S6	Assessment	18699	No	Not applicable
S7	S1 and S6	162	Yes	None selected

Table 4. Articles Included in Chapter Three Systematic Review

Author and year published	**Purpose of study**	**Sample and Setting**	**Instrument of interest used**	**Validity established by author(s)**	**Reliability established by author(s)**
Ashby (1997)	Assess medication calculation skills	Medical-surgical nurses at a 380-bed hospital in the Midwest	Bayne-Bindler Medication Calculation Test	Validity was not established for this study	Reliability was not established for this study
Bindler & Bayne (1991)	Determine nurse achievement on a medication calculation test, types of computations which are most difficult for nurses, the relationship between nurses' geographic characteristics and test scores, and the relationship between nurses' self-rating of skill and comfort in performing medication calculation to their test scores.	110 registered nurses from four western states.	Bayne-Bindler Medication Calculation Test.	Validity was not established for this study.	Reliability was not established for this study.

Table 4. Continued

Author and year published	Purpose of study	Sample and Setting	Instrument of interest used	Validity established by author(s)	Reliability established by author(s)
Bliss-Holtz (1994)	Design and test a method to discriminate between two different types of calculation errors: mathematical concept errors and arithmetic operation errors.	23 registered nurses and 28 graduate nurses attending orientation at a major medical center.	Medication dosage calculation test Form I and Form II.	Content validity established by a group of nurse experts in staff development, no mention of how many experts were used.	Internal consistency reliability for Form I: alpha = .83 in pilot, alpha = .81 in study; Form II: alpha = .71 in pilot, alpha = .79 in study. Parallel form reliability Pearson correlation of r = .94.
Flynn & Moore (1990)	Investigate the relationship between nursing students' math performance and variables previously found to affect general academic performance: math attitude, state anxiety, SAT math score, grade point average, number of high school math courses, age, and gender.	64 female junior nursing students at a baccalaureate program at a state university.	Medication and intravenous test.	Development was based on texts of medication and intravenous administration. Content validity established by seven nursing faculty members, items were approved as originally written.	Internal consistency reliability alpha = .93 for pilot and alpha = .82 in study. Reliability of lengthening test from 20 to 40 items using Spearman-Brown formula r_2 = .90.

Table 4. Continued

Author and year published	**Purpose of study**	**Sample and Setting**	**Instrument of interest used**	**Validity established by author(s)**	**Reliability established by author(s)**
Hsaio, Chen, Yu, Wei, Fang & Tang (2010)	Report the development and validation of an instrument to measure nurses' knowledge of high-alert medications and to analyze known administration errors.	30 nurses and 30 nursing students for pilot, 305 nurses for study in Taiwan.	Questionnaire developed to assess nurses' knowledge of high-alert medications. Questionnaire developed based on literature review and clinical consultation.	Content validity established by seven experts with CVI = .92. Construct validity established by contrasting groups during pilot. Face validity established during pilot.	Internal consistency reliability established using Kuder-Richardson formula 20 with alpha = .66 during pilot, and alpha = .74 in study.
Kohtz & Gowda (2010)	Compare the use of two approaches to drug calculation: dimensional analysis and conventional methods (ratio-proportion and calculation formulas)	79 nursing students. No information was provided as to their level in the nursing program or the type of degree they would receive in their nursing program	24-item tool comprised of the following: calculation of the number of tablets to administer, calculation of the number of milliliters to give, calculation of milliliters per hour, and calculation of drops per minute.	Content validity established through review of tool by educators who had taught the drug calculation content prior to tool administration.	Reliability was not established for this study.

Table 4. Continued

Author and year published	**Purpose of study**	**Sample and Setting**	**Instrument of interest used**	**Validity established by author(s)**	**Reliability established by author(s)**
Ndosi & Newell (2008)	Determine if nurses had adequate pharmacology knowledge of the drugs they commonly administered.	42 nurses working in surgical wards in a hospital in North England.	Questionnaire to assess nurses' knowledge of pharmacology. Questionnaire developed based on pharmacology textbooks, previous similar studies, and consultation with a pharmacist.	Face validity established by the authors. Content validity established by review of pharmacology textbooks, previous studies and one expert pharmacist. Internal validity established by pilot study with five nurses.	Inter-rater reliability using intra-class correlation coefficient (ICC) = .726 with p = .001, indicating strength of agreement among rates was good.
Rainboth & DeMasi (2006)	Evaluate the efficacy of a strategy for teaching medication calculation abilities in nursing students	99 sophomore level diploma nursing students at a Midwestern diploma college	14-item multiple choice test used for pretest/posttest 10-item fill-in-the-blank exam used as a final performance measure	Content validity was established through review by a group of expert nurse educators in mathematics Content validity established through review by a group of expert nurse educators in mathematics	Internal consistency reliability Cronbach's alpha = 0.674 Internal consistency reliability Cronbach's alpha = 0.135.

Table 4. Continued

Author and year published	**Purpose of study**	**Sample and Setting**	**Instrument of interest used**	**Validity established by author(s)**	**Reliability established by author(s)**
Ryan (2007)	Continue development of the Safe Administration of Medication (SAM) Scale and to objectively measure performance of nursing students.	137 associate degree nursing students and 130 baccalaureate nursing degree nursing students in Georgia.	Safe Administration of Medication (SAM) Scale	Mean infit statistic of 0.99 and the mean outfit statistic of 0.86 for person fit, and a mean infit statistic of .99 and a mean outfit statistic of .87 for item fit. This indicates that the model fits the data.	Reliability of separation = 0.87 for medication items. Reliability of separation = 0.39 for student nurses.
Serembus (2000)	Compare computational ability of nursing students when using the dimensional analysis method for medication dosage calculation with those using the formula/ration-and-proportion method.	90 nursing students from two university baccalaureate programs in Pennsylvania and Delaware.	Bayne-Bindler Medication Calculation Test.	Content validity established by three doctoral-prepared nursing faculty and a review of the literature.	Internal consistency reliability using Kuder-Richardson formula r = .70 for the pretest and r = .83 for the posttest.

Table 4. Continued

Author and year published	**Purpose of study**	**Sample and Setting**	**Instrument of interest used**	**Validity established by author(s)**	**Reliability established by author(s)**
Werab, Alexander, Brunt & Wester (1994)	Provide one-on-one individualized learning modules on medication administration for registered nurses and licensed practical nurses referred to Staff Developmental by their clinical supervisors due to medication errors.	12 nurses in initial part, total of 27 nurses enrolled from a hospital in Ohio.	Medication module pretest and posttest. Pretest was developed to screen for weaknesses in medication administration or knowledge base. Posttest development was based on assigned readings and used to evaluate retention of information from medication modules.	Posttest questions had a higher level of difficulty. Item analysis based on data from 27 nurses; questions frequently missed were reworded or discarded, questions never missed were revised with alternate distracters; pretest expanded to include common types of errors and to assess judgment and critical thinking. Posttest eliminated and in lieu an outcome study was used to evaluate effectiveness.	Reliability was not established for this study
* Bayne & Bindler (1988) *obtained from references of Ashby (1997), Bayne & Bindler (1991) and Serembus 2000)*	Determine if nurses have the skills necessary for accurate medication calculation	62 nurses from two large hospitals in Eastern Washington, including 29 registered nurses and 33 graduate nurses awaiting state board results	Bayne-Bindler Medication Calculation Test	No additional validity presented	No additional reliability presented

Table 4. Continued

Author and year published	**Purpose of study**	**Sample and Setting**	**Instrument of interest used**	**Validity established by author(s)**	**Reliability established by author(s)**
* Bayne & Bindler (1997) *obtained from references of Serembus 2000)*	Test the effectiveness of three enhancement methods to improve medication calculation skills of practicing RNs	67 nurses from three healthcare facilities in Washington state including a major university teaching hospital, a urban tertiary-care hospital and a home healthcare agency	Bayne-Bindler Medication Calculation Test	No additional validity presented	Internal consistency reliability when used as a pretest was .72 and when used as a posttest was .74.
* Bindler & Bayne (1984) *obtained from references of Ashby (1997) and Serembus 2000)*		40 baccalaureate senior nursing students from the Intercollegiate Center for Nursing Education	Bayne-Bindler Medication Calculation Test	Content validity established by three nursing experts and a thorough review of pharmacology and nursing literature	Odd-even split half test of reliability = .82

Table 5. Development of Survey Questionnaire Based on Research Questions

Research Question	**Survey Question**
1. How is safe medication administration assessed prior to students entering the clinical area	4. Please identify which of the following methods are used in your nursing program to assess the baccalaureate students' ability to administer medications safely prior to administering medications in the clinical setting. Mark all that apply.
	12. Is a specific "performance checklist" for safe medication administration used in the skills laboratory, clinical or both in your nursing program?
	13. Is there anything else you would like to include to better describe how your nursing program assesses its baccalaureate students for safe medication administration?
	14. Would you be comfortable sharing any of your assessments with the researcher (such as the performance checklist, exams, etc)? If so, please copy the document into the space below, email or send via postal service to the researcher.
2. How is safe medication administration assessed during clinical	5. Please identify which of the following methods are used in your nursing program to assess the baccalaureate students' ability to administer medications safely while in the clinical setting. Mark all that apply.
	12. Is a specific "performance checklist" for safe medication administration used in the skills laboratory, clinical or both in your nursing program?
	13. Is there anything else you would like to include to better describe how your nursing program assesses its baccalaureate students for safe medication administration?
	14. Would you be comfortable sharing any of your assessments with the researcher (such as the performance checklist, exams, etc)? If so, please copy the document into the space below, email or send via postal service to the researcher.
3. How is knowledge of "right drug" assessed in the classroom	4. Please identify which of the following methods are used in your nursing program to assess the baccalaureate students' ability to administer medications safely prior to administering medications in the clinical setting. Mark all that apply.
	6. Who teaches the pharmacology course content in your nursing program to baccalaureate nursing students? Mark all that apply.
	13. Is there anything else you would like to include to better describe how your nursing program assesses its baccalaureate students for safe medication administration?

Table 5. Continued

Research Question	**Survey Question**
4. How is knowledge of "right dose" assessed in the classroom setting	4. Please identify which of the following methods are used in your nursing program to assess the baccalaureate students' ability to administer medications safely prior to administering medications in the clinical setting. Mark all that apply.
	7. How frequently do the BSN nursing students take a medication calculation exam in your nursing program?
	8. Did you or members of your faculty develop the medication calculation exam used in your nursing program?
	9. What is a passing percentage grade on the medication calculation exam in your nursing program?
	10. If the student is not successful on the medication calculation exam, what type of remediation, if any, is the student expected to complete in your nursing program?
	11. Is there any additional information you can provide to clarify how your nursing program ensures competency in medication calculations?
	13. Is there anything else you would like to include to better describe how your nursing program assesses its baccalaureate students for safe medication administration?

Figure 1. Data for Chapter Three Research Question One

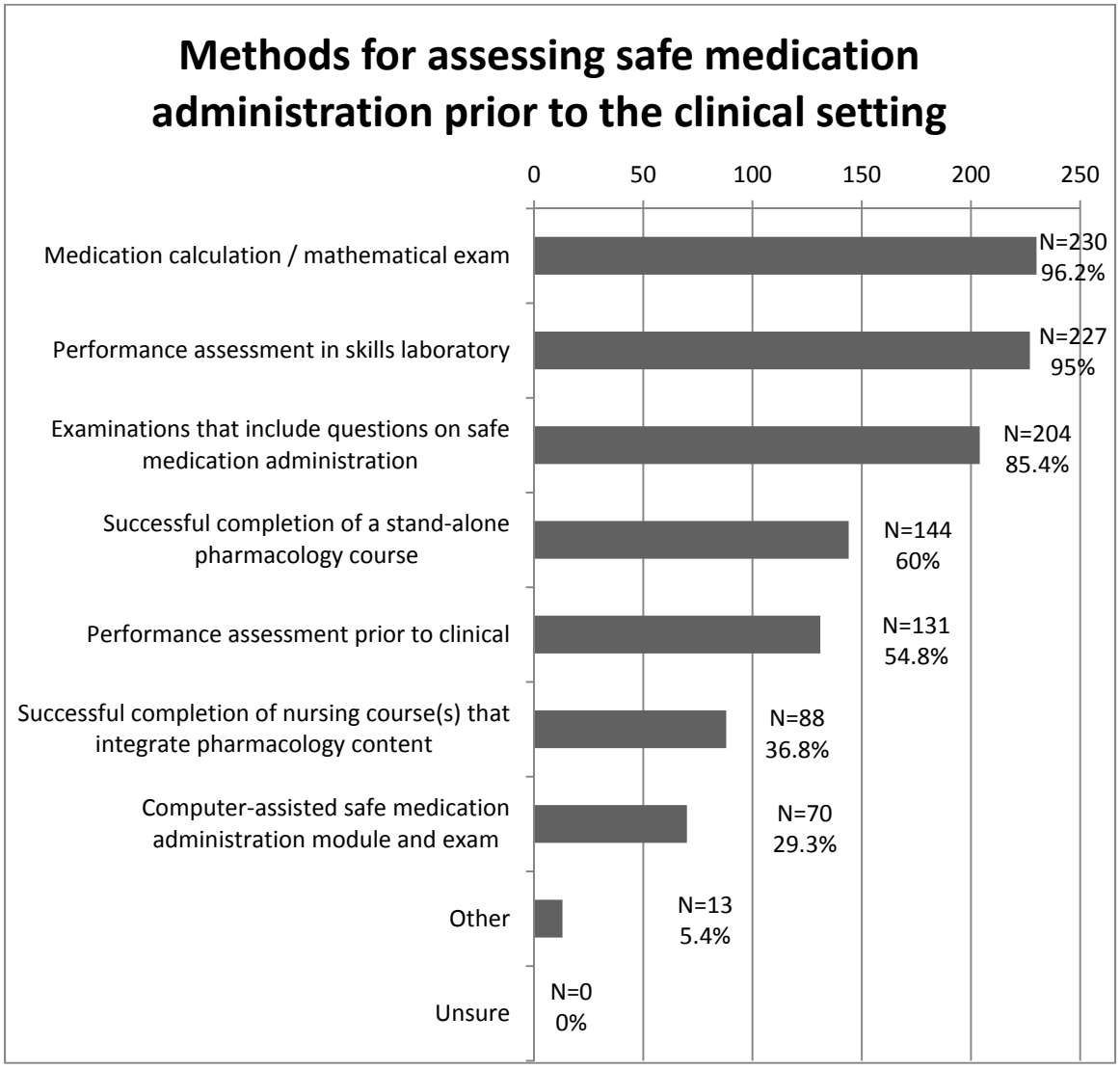


Figure 2. Data for Chapter Three Research Question Two

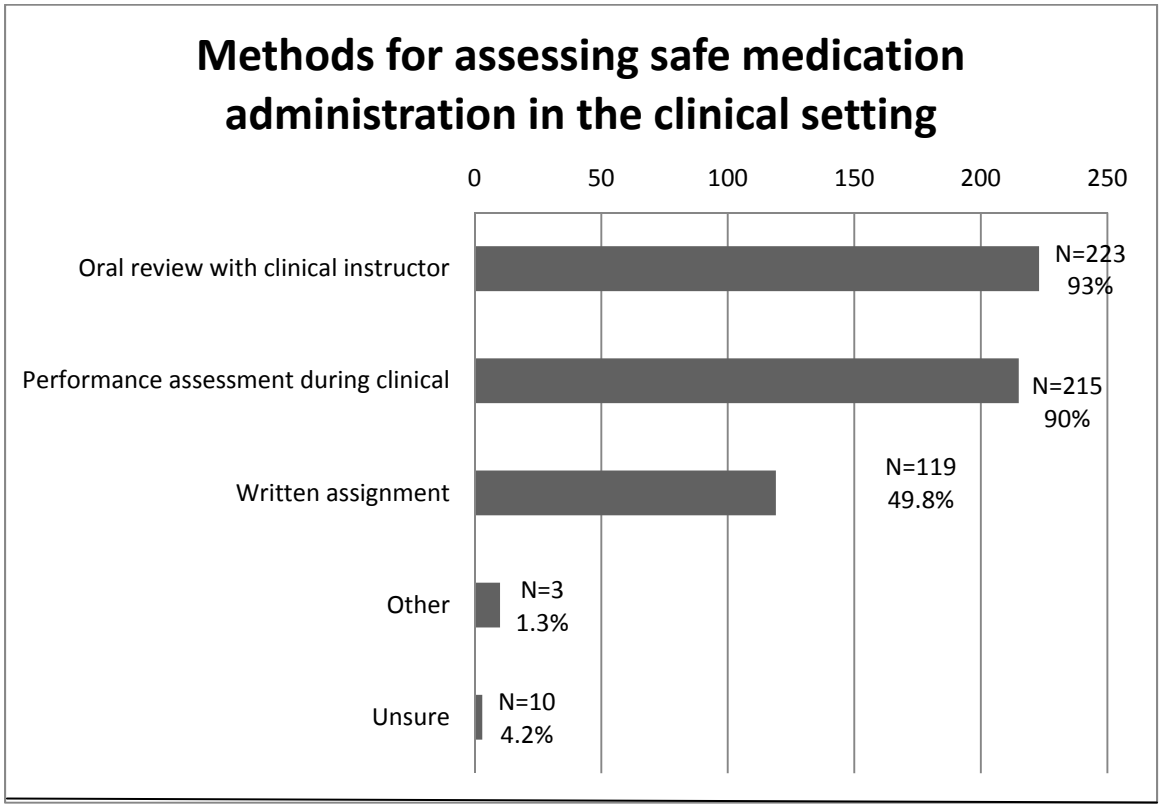
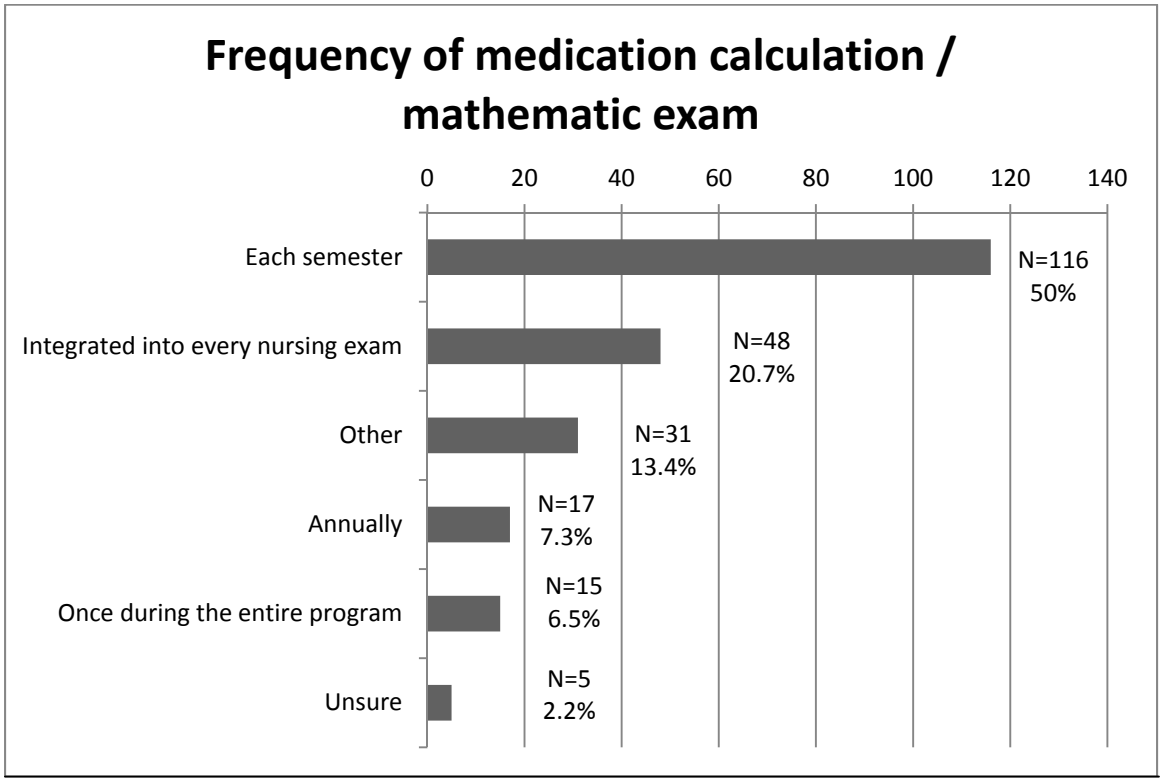


Figure 3. Data for Chapter Three Research Question Four



CHAPTER IV

VALIDITY AND RELIABILITY OF THE SAFE ADMINISTRATION OF MEDICATION (SAM) SCALE

Abstract

The specific aims of this study were: 1) to provide data of content validity on the SAM scale, 2) to provide data of construct validity through the use of contrasting groups, 3) to provide data of construct validity using different instruments and 4) to provide data of internal consistency reliability on the SAM scale. General findings for aim one: consensus was not reached by the outside reviewers on whether the five rights of safe medication administration were assessed in each vignette. General findings for aim two: the seniors (high group) mean score on the SAM Scale was significantly higher than the sophomores (low group) mean scores, thus the data supports construct validity through contrasting groups. General findings for aim three: a high score on the risk-taking DOSPERT Scale correlated with a low score on the SAM Scale, which supports construct validity using the different instrument approach. General findings for aim four: evidence of internal consistency reliability was supported, indicating that every item on the SAM Scale measures the same variable, safe medication administration. Thus, the results of this study provided additional evidence of validity and reliability of the SAM Scale.

Background

A valid and reliable instrument for comprehensively assessing nursing students' medication administration is needed to ensure that students are competent in the safe administration of medications prior to entering the clinical area. One instrument found in the literature directly relates to the safe administration of medication, and that is the Safe Administration of Medication (SAM) Scale (Appendix B) (Ryan, 2007). Initial psychometric evaluation conducted by the developer using Rasch measurement supports its reliability and validity; however additional evidence of its validity and reliability was documented as needed (Ryan, 2007).

Significance and Specific Aims

Traditional methods used for assessment of safe medication administration include medication calculation exams and observation of medication administration in skills laboratory, simulation scenarios or administration experience in the clinical setting (Ryan, 2007). However, these learning settings present a limited opportunity to fully assess the nursing students' ability in the performance of safe medication administration. For example, the performances on medication calculation exams are indicative of the students' ability to determine safe dosage, which is only one part of safe medication administration. Additionally, assessments during educational observation are dependent upon the opportunity to administer medications and may come too late, such as when the students are already in the clinical setting.

This study contributes to the nursing literature by providing additional data of the validity and reliability of the SAM Scale, which if established, could be used to assess safe medication administration by nursing students prior to their administration

experience in the clinical area. While previous evidence of validity and reliability was established by the author of the SAM Scale, the specific procedures utilized were based on Rasch measurement. At this time, Rasch measurement is gaining recognition, but it is not as widely recognized or accepted within the research community as compared to more traditional methods of establishing validity and reliability (Bond & Fox, 2007). Subsequently, this researcher chose to use the standard procedures for establishing validity and reliability as supported by the nursing research literature (Norbeck, 1985). The specific aims of this study were: 1) to provide data of content validity on the SAM scale, 2) to provide data of construct validity through the use of contrasting groups, 3) to provide data of construct validity using different instruments and 4) to provide data of internal consistency reliability on the SAM scale.

Review of the Literature

Psychometrically-sound instruments are the foundation of all rigorous research designs (DeVon et al., 2007). Assuring the validity and reliability of an instrument is a prerequisite for interpreting research study findings. Without valid and reliable instruments for assessing knowledge and performance of safe medication administration, any attempt to generate and analyze research regarding teaching strategies lacks credibility. Additionally, nursing faculty members are left to wonder whether the nursing students are ready for the medication administration experience in the clinical setting. What follows is a brief discussion of major components of validity and reliability, as well as a review of medication errors in nursing education.

Validity and Reliability

Validity refers to an instrument's ability to gather the data it is intended to gather (Nieswiadomy, 2008). Two sources of validity evidence assessed in this study are content validity and construct validity. Content validity focuses on whether the items in the instrument are able to measure the concept or construct of interest (Nieswiadomy, 2008). It is largely based on how an instrument is developed, and ensures that the content of the measure represents the content of the domain (Waltz, Strickland & Lenz, 2005). Construct validity determines the extent to which relationships among items included in the measure are consistent with the theory and concepts as operationally defined. It is especially important to ensure construct validity in nursing research in particular, as the study variables are often abstract, are very similar to other variables, and difficult to measure (DeVon et al., 2007).

Reliability refers to the ability of an instrument to measure an attribute consistently (DeVon et al., 2007). Reliability is a precondition for validity (Nieswiadomy, 2008; Waltz et al., 2005). Internal consistency reliability will be assessed in the present study and evaluates whether all items on an instrument measure the same variable (Nieswiadomy, 2008). Internal consistency reliability is used to indicate how well the items in an instrument fit together conceptually (DeVon et al., 2007).

Medication Errors in Nursing Education

Unfortunately, medication administration errors do occur in nursing education. Studies related to this topic were found in the literature and relevant findings follow, including the types of medication errors committed by nursing students, causes of

medication errors and contributing factors, and strategies for decreasing nursing students' medication errors.

Types of errors committed by nursing students. The most frequent error made by nursing students were omission errors (Harding & Petrick, 2008; Wolf, Hicks & Serembus, 2006). Other errors included improper dose, wrong time, and extra dose (Wolf et al., 2006), wrong route, wrong patient, system factors, and knowledge and understanding (Harding & Petrick, 2008).

Causes of errors and contributing factors. Wolf and colleagues found that performance deficit, procedure/protocol not being followed, knowledge deficit and communication were the *causes* of students' medication errors, and the two most frequent *contributing factors* to student medication errors were inexperienced staff and distractions (2006). Harding and Petrick also identified busyness and distraction, and inexperience in reading or interpreting the Medication Administration Record (MAR) as factors that contributed to omission errors (2008). Another contributing factor identified in another research study was the level of supervision of nursing students (Reid-Searl, Moxham, Walker & Happell, 2008). In their study, medication errors occurred when students reported levels of supervision as "being absent" and "being near" (Reid-Searl et al., 2008). While this study showed insufficient supervision as a factor in medication errors, there are other strategies to assist with medication experience to help students prior to students entering the clinical area and that discussion of these strategies follows.

Strategies for decreasing nursing students' errors. Within the nursing literature, there is recent interest in strategies specific to *teaching* safe medication administration and decreasing medication administration errors committed by nursing

students. Strategies for teaching safe medication administration were found in the literature such as problem-based learning (Papastrat & Wallace, 2003), computer simulation (Jeffries, 2001), clinical simulation (Pauly-O'Neill, 2009) and other curriculum revisions including laboratory practice to include physician orders, medication records, simulation medications, patient identification bands, narcotic boxes and narcotic administration records and documentation (Wolf et al., 2006) However, one major concern identified in the articles that examined simulation strategies was the lack of a valid and reliable assessment instrument for measuring safe medication administration (Wolf et al., 2006; Papastrat & Wallace, 2003; Jeffries, 2001; Pauly-O'Neill, 2009), thus reinforcing the importance of this work to further assess the validity and reliability of the SAM Scale. The call has been made for the need of assessment strategies for safe medication administration.

Medication errors do exist within nursing education and unfortunately, there may be a greater incidence with the faculty shortage and the increased reliance on preceptors. In addition, nurses within hospitals are overloaded and may not have the time to devote to nursing students when they are administrating medications. These studies support the significance of this paper and the need to have a valid and reliable instrument for assessing safe medication administration. In addition, these types of errors and their respective causes can be prevented if the five rights of safe medication administration are adhered to (NCC MERP, 1999).

SAM Scale

The SAM Scale was developed to objectively measure performance of the safe administration of medication of student nurses and is based on the five rights of safe

medication administration, as well as a review of the literature on common medication errors made by nurses (Ryan, 2007). As conveyed by the author, the five rights were used as the gold standard of safe medication administration and the literature demonstrated that nursing students' medication errors are often related to lack of adherence to the five rights of medication administration.

Initial evidence of validity and reliability was gathered by Ryan (2007). The SAM Scale was found to have evidence of content validity. Other assessments for validity and reliability of the SAM Scale were based on the principles of Rasch measurement. Ryan reported a greater number of easy items than difficult ones on the SAM Scale, and also showed a high level of ability among the BSN student nurses. This was supported by a variable map and logic scale using Rasch measurement (Ryan, 2007).

For reliability, Ryan (2007) reported the items on the SAM Scale were significantly differentiated from one another and reliably defined item difficulty. The students, however, were not well differentiated, indicating that the SAM was not difficult enough for the nursing students who were completing it.

Ryan reported evidence of fit validity (Ryan, 2007), or that each item and person fits with the underlying construct, which Fox and Bond (2007) state is analogous to construct validity, although Ryan does not explicitly make this comparison in her data analysis. The initial results of the psychometric properties of the SAM Scale support its validity and reliability using Rasch measurement. However, Ryan concluded that additional research to determine additional psychometric properties of the SAM Scale would be warranted.

Methodology

The purpose of this study was to collect evidence using traditional research methods to assess content validity, construct validity, and internal consistency reliability of the SAM Scale. The specific aims were: 1) what is the evidence of content validity on the SAM Scale, 2) what is the evidence of construct validity on the SAM Scale using contrasting groups, 3) what is the evidence of construct validity on the SAM Scale using different instruments and 4) what is the evidence of internal consistency reliability on the SAM Scale. IRB approval was obtained from the university where data collection was conducted.

Subjects and Setting

A convenience sample of sophomore and senior baccalaureate nursing students from a private Midwest university were invited to participate in the study. The nursing program offers an integrated nursing curriculum, and students begin clinical rotations during the first semester of their junior year. The majority of the nursing students were female. At the time of data collection, sophomore students were taking their required prerequisite courses and had not had any core nursing courses or any clinical experience; senior students were completing their final core nursing courses and clinical experiences prior to the nursing preceptorship.

There were 80 senior nursing students and 90 sophomore nursing students in the nursing program, and all were invited to participate. The students were given the chance to complete the SAM Scale using two different formats (online and on paper).

Instrument

The SAM Scale (Appendix B) was initially developed to objectively measure performance in the safe administration of medication of nursing students (Ryan, 2007). Based on the five rights of safe medication administration, it includes a total of five cases, each case including two or three vignettes, and each vignette having five items for a total of 70 items. The validity and reliability of the SAM scale have been previously described.

Procedure

The procedure for collecting data for the first aim, content validity, included providing paper copies of the SAM Scale to five nurse experts. Inclusion criteria for the experts were being a registered nurse, having had experience within the previous twelve months administering medications or overseeing a student administer medications, and working full-time in the nursing profession (Appendix C). Four of the experts were nursing faculty from the university where data collection occurred; of which three were clinical faculty and the other taught patient safety content in both the undergraduate and graduate program. The non-faculty content expert was a bedside nurse who routinely administered medications. The five content experts collectively had clinical expertise in adult medical-surgical, pediatrics, labor and delivery, oncology, emergency department, intensive care unit and geriatric nursing. After reviewing the SAM Scale, the content experts were asked to complete a questionnaire (Appendix D) evaluating the content validity of the SAM Scale that was developed by the researcher for this study.

For the second, third and fourth aims of construct validity and internal consistency reliability, participants completed the SAM Scale online or on paper. Online

surveys were completed using a secure survey system used by the university, BlueQ. The informed consent letter was provided as part of the paper copy of the SAM Scale (Appendix E). Participation was voluntary and had no bearing on the nursing students' grade in any courses. Upon reviewing the consent form, students demonstrated evidence of consent by completing the SAM Scale. Demographic information collected included academic level of education, and whether they had taken an elective interdisciplinary course entitled "Patient Safety" (Appendix F). This information was collected immediately after students reviewed the consent document and before beginning the SAM Scale.

The procedure for completing the SAM Scale was the same for all participants whether they chose to complete the SAM Scale online or on paper. Following review of the informed consent document and completion of demographic questionnaire, students accessed the SAM Scale and reviewed instructions for completing it. Instructions allowed them to use calculators and drug books. The students were able to stop participation at any time. All participants received a small gift in exchange for participating in the study: either an aluminum water bottle or a gift card valued at five dollars.

For the second and third aims for assessing construct validity, two methodological approaches were used. The first method (aim two) used contrasting groups, one group consisted of sophomore nursing students and the other group was senior nursing students. Sophomore nursing students had not had any core nursing courses or related clinical experiences; so they were expected to have low scores on the SAM Scale. It was expected that senior nursing students would score higher on the SAM Scale as they were

nearing the end of their nursing education program and were more knowledgeable of safe medication administration.

The second method (aim three) of assessing construct validity used different instruments. The senior nursing students were asked to complete a second instrument (either online or in person: the revised Domain-Specific Risk-Taking and Risk Perception (DOSPERT) Scale (Appendix G). The revised DOSPERT Scale was completed immediately following completion of the SAM Scale.

The revised DOSPERT Scale is one of a few instruments that measures risk propensity in healthcare decisions with relevance to the clinical environment (Blais & Weber, 2006), which is why it was selected. Improving safety and reducing errors requires the nurse to detect and respond to risk signals (Despins et al., 2010). Based upon this, it was assumed that nursing students who were risk-inclined would not respond to medication errors and be less safe in medication administration.

The revised DOSPERT Scale has 30 items and evaluates risk-taking and risk-perception in five content domains: ethical, financial (including gambling and investment), health/safety, social and recreational decisions using a 7-point rating scale (Blais & Weber, 2006). Internal consistency reliability for the revised DOSPERT scale using Cronbach's alpha ranged from .75-.86 across the five domains of the risk taking part of the scale, and Cronbach's alpha ranged from .74-.83 across the five domains for the risk perception part of the scale (Blais & Weber, 2006). A high score on the revised risk-taking DOSPERT Scale indicates a higher level of risk-taking; therefore an inverse relationship would be expected between a score on the SAM Scale and the revised risk-taking DOSPERT Scale. A high score on the revised risk perception DOSPERT Scale

indicates a high level of risk perception; a direct relationship would be expected between a score on the SAM Scale and the revised risk perception DOSPERT Scale.

Data Analysis

Data analysis was completed using the statistical software package, SPSS. For the first aim: content validity, specific procedures for data analysis included analyzing percentage of agreement across reviewers. For the second aim: construct validity using contrasting groups, the t test was used to determine if there was any significant difference between the two groups scores on the SAM Scale. For the third aim: construct validity using different instruments, Pearson correlation was used to determine if there were any significant correlations between seniors' scores on the SAM Scale and their scores on the DOSPERT Scale. For the fourth aim: internal consistency reliability, Cronbach's alpha coefficient was used to examine the senior nursing students' scores on the SAM Scale.

Results

Using the online approach, there were 61 participants who accessed the SAM Scale and began data collection, however only 26 actually completed data collection as defined by viewing all the screens and actually "submitting" the data. Of the 26 who submitted their data, only 24 had actually answered the majority of the questions. One sophomore and one senior were omitted from data analysis as they had left over 90% of the answers blank. Only one individual, a sophomore, completed the SAM Scale using the paper option. This resulted in a final sample size of 25 participants out of 170 eligible participants, yielding a 15% participation rate. Of these, 11 were sophomores and 14 were seniors. Of the 14 senior nursing students who have participated, only four indicated that they had taken an elective interdisciplinary patient safety course.

General analysis of the SAM Scale. It is interesting to note the general pattern of student responses on the SAM Scale. Items that 100% of the sophomores (N=11) and seniors (N=14) got the following items correct: number 6, 15, 16, 17, 19, 25, 26, 27, 29, 30, 31, 32, 35, 36, 37, 55, 56, and 64 (Figure 4); totaling 18 items or 25.7% of the SAM Scale. In contrast, items 11, 33, 38, 43, 51 and 53 were answered correctly by 54.5% or less of the seniors and by 27.3% or less of the sophomores. Based on the categorization of the five rights, there was no pattern in the students' responses with regard to the five rights represented in the scale.

Interesting to note that item seven was answered correctly by 45.5% of the sophomores and only 18.2% of the seniors, while item 49 was answered correctly by 72.7% of the sophomores and only 45.5% of the seniors. The results of these two items tend to be the opposite of what one would expect with the two groups of nursing students completing the SAM Scale.

Aim one: Content validity. The questionnaire completed by the five nurse experts (Appendix D) was used to address whether the construct of safe medication administration, specifically the five rights of safe medication, were present in each vignette, whether each item had *relevance* to the concept of safe medication administration, whether the items *sufficiently represent* the concept of safe medication administration, and whether any items were *unclear*. Consensuses at the percent agreement of 80% on whether or not the five rights were assessed on most items except the following: 4, 11, 18, 21, 23, 33, 34, 35, 47, 52, 53, 54, 60, 63 and 69 (Table 6). The lowest percentage of agreement found was 40% for item 34, item 47, and item 69. For the more general components, consensus at the percent agreement of 80% on whether or

not the SAM Scale was relevant, sufficient and realistic to safe medication administration was achieved for the entire SAM Scale. Specific comments and suggestions for improvement were also provided by some of the reviewers (Table 6).

Aim two: Construct validity using contrasting groups. The highest possible score on the SAM Scale was 70. The mean score for the seniors (N=14) was 61.93 with a standard deviation of 5.92. The mean score for the sophomores (N=11) was 53.55 with a standard deviation of 5.48. The two groups overall scores were significantly different with a p value = 0.001 and had a mean difference of 8.38 between the two groups. This provides evidence of construct validity of the SAM Scale using contrasting groups (Table 7).

Aim three: Construct validity using different instruments. The mean score for the seniors on the SAM Scale was 61.93, the mean score for the health/safety subscale of the *risk-taking* DOSPERT Scale was 15.21. Pearson correlation between the SAM Scale and the health/safety subscale for the sample of seniors was -0.56 with a p value = 0.04. This demonstrates a significant negative correlation between the SAM Scale and the health/safety subscale on the risk-taking DOSPERT Scale (Table 8). No statistically significant correlation was found between the overall *risk-taking* DOSPERT Scale and the seniors score on the SAM Scale.

No statistically significant correlation was found between the health/safety subscale of the *risk-perception* DOSPERT Scale and the seniors score on the SAM Scale, or between the overall *risk-perception* DOSPERT Scale and the seniors score on the SAM Scale (Table 8). This shows that while a relationship was found between

health/safety risk-taking and performance on the SAM Scale, no relationship was found for overall risk-taking or risk-perception and performance on the SAM Scale.

Aim four: Internal consistency reliability. A coefficient alpha of .70 was set to be acceptable for this analysis since the SAM Scale is relatively new (DeVon, 2007). The analysis of the Cronbach's alpha for all 70 items was 0.77 which demonstrates that the SAM Scale has moderate evidence of internal consistency reliability (Table 9). Cronbach's alpha was also examined by omitting each item one at a time, and it was found that the reliability of the SAM Scale ranged from .74 to .79, demonstrating minimal variation (Table 9).

Discussion

The specific aims of this study were: 1) to provide data of content validity on the SAM scale, 2) to provide data of construct validity through the use of contrasting groups, 3) to provide data of construct validity through using different the same group with different instruments and 4) to provide data of internal consistency reliability on the SAM scale. For aim one, consensus was not reached by the outside reviewers on whether the five rights of safe medication administration were assessed in each vignette. After reviewing the questionnaires and SAM Scales completed by the content validity experts, it became evident that the reviewers were simply answering the items on the questionnaire as if they were completing the SAM Scale and were not following the instructions provided by the researcher to evaluate the content validity of the tool. Although the researcher piloted the wording of the questionnaire, it became clear that the intent of the researcher was not clear to the reviewers. Thus, it is suggested that the content validity questionnaire be reworded for future use. Consensus was achieved

elsewhere on the questionnaire indicating that the SAM Scale was relevant, sufficient and realistic to safe medication administration.

For aims two and three, evidence of construct validity was supported through the use of contrasting groups and applying different instruments to the same student groups. For aim two, the seniors (high group) mean score on the SAM Scale was significantly higher than the sophomores (low group) mean scores, which is expected when the data supports construct validity through contrasting groups. For aim three, a high score on the health/safety domain of the risk-taking DOSPERT Scale correlated with a low score on the SAM Scale. The results of aim two and three indicate that the SAM Scale measures the concept of safe medication administration.

For aim four, evidence of internal consistency reliability was supported, indicating that every item on the SAM Scale measures the same variable, safe medication administration. The results of this study provide additional evidence of validity and reliability, and support the initial findings by Ryan (2007).

Some of the students had previously taken an elective patient safety course. Since these students were in the sample, the question arose as to whether those students who had completed this course would score higher on the SAM Scale. An independent t test was used to determine if there was a difference between the seniors who had taken an elective patient safety course and those who had not. Only four seniors had taken the elective patient safety course, the remaining ten had not. The mean score for students who had taken the elective patient safety course was 64.25 and the mean for students who had not taken the course was 61 (Table 10). Data analysis showed when the two student groups were compared, the p value =.37 thus the results were not statistically significant.

Limitations

There was one major limitation to the study: the small sample size. The participation rate was low and further investigation revealed over twice as many students started the SAM Scale but stopped before completing the instrument. It was felt that the low participation rate and high abandonment rate was attributed to the length of the SAM Scale, competing demands on the students' time, and lack of interest in the subject matter. Nursing students often verbalized that they had insufficient time for completing their studies, let alone for additional activities for which they did not directly benefit. Since many of the students started the SAM Scale and then stopped before completing it, this led the researcher to believe that the length was a concern, they could not understand the merit of the scale, or the students lost interest.

Another limitation to the study was the questionnaire used for content validity. Content validity experts did not understand how to correctly respond to one section of the questionnaire and instead simply answered the SAM Scale, which impacted the specific question whether the five rights of safe medication administration were present in each of the vignettes. It is recommended that the content validity questionnaire be reworded prior to future use in order to ensure that the questionnaire is adequately assessing the content validity of the SAM Scale. In addition, it is recommended that the content validity reviewers actually complete the SAM Scale first, and then answer the content validity questionnaire. This would allow the reviewers to see the difference between answering the items on the SAM Scale and completing the first section of the questionnaire, which was a source of concern in the present study.

Future Direction

It is suggested that the SAM Scale be further refined for increased utility in nursing education. The author of the instrument suggested nursing students be allowed one hour to complete the SAM Scale; nursing faculty often do not have the luxury of an extra hour in the curriculum for this assessment, therefore the instrument should be shortened. In addition, there is currently only one version of the SAM Scale, which limits its ability to be used as a pretest and posttest for assessing teaching strategies.

One specific suggestion that combines these two concerns would be to create additional items, vignettes and cases with the intention of dividing the subsequent product into two parallel forms. In its current format, splitting the tool in half is not feasible because the cases and vignettes have varying levels of difficulty, and there is inequality in the frequency of which the five rights are violated within each vignette.

The present study and Ryan (2007) found that there are too many easy questions and that student ability is higher than the level of difficulty. A ceiling effect was observed in the present study with 18 items (25.7%) of the SAM Scale being answered correctly by both the low and high groups. A ceiling effect is said to occur when a high proportion of subjects in a study have maximum scores on the observed variable, and inhibits the ability to truly rank the top performers (Powers & Knapp, 2010). The current cases and vignettes could be refined to increase the scale difficulty with additional cases and vignettes. In addition, the researcher recommends ensuring that the five rights are violated equally in the two parallel forms of the revised SAM Scale (for example two violations of right patient would be found in each Version A and Version B). It is recommended that the new items be developed based upon a review of the literature for

the common medication administration errors made by nursing students and practicing nurses. As previously stated in the review of the literature, the most frequent error made my nursing students are omission errors (Harding and Petrick, 2008; Wolf et al., 2006). This type of error is not currently found in the SAM Scale. Another frequent source of medication error is improper dose (Wolf et al., 2006); the parallel forms of the revised SAM Scale would include more violations of right dose. In addition, general comments made by the content review experts were related to updating the case studies and vignettes to reflect currently standards of practice. This would include using military time and approved abbreviations in each case and vignette.

While it has been suggested that being aware of and responding to risk signals is associated with safety, evidence is lacking (Despins et al., 2010). Feng and colleagues completed a dimensional concept analysis of patient safety culture in nursing, and their analysis identified *personal attributes* as impacting patient safety culture (Feng et al., 2008). This is supported by the patient risk detection theory which identifies internal factors as influencing risk detection (Despins et al., 2010). This is landmark as thus far, the literature has predominantly focused on the climate and its impact on patient safety, and not on the individual nurse. The present study did find a relationship between personal risk-taking in the area of health/safety and safe medication administration; although no relationship was found between personal risk-perception and safe medication administration. Other researchers may want to examine the relationship between personal risk and safe medication administration.

The results of this study provide additional evidence of validity and reliability for the SAM Scale. It is recommended that the SAM Scale be further refined in order to

increase its applicability to nursing research and nursing education. In addition, further research into personal risk and its impact on patient safety may be warranted with using the revised DOSPERT Scale in nursing research.

Figure 4. Descriptive Statistics of Correct Responses by Each Item of the SAM Scale

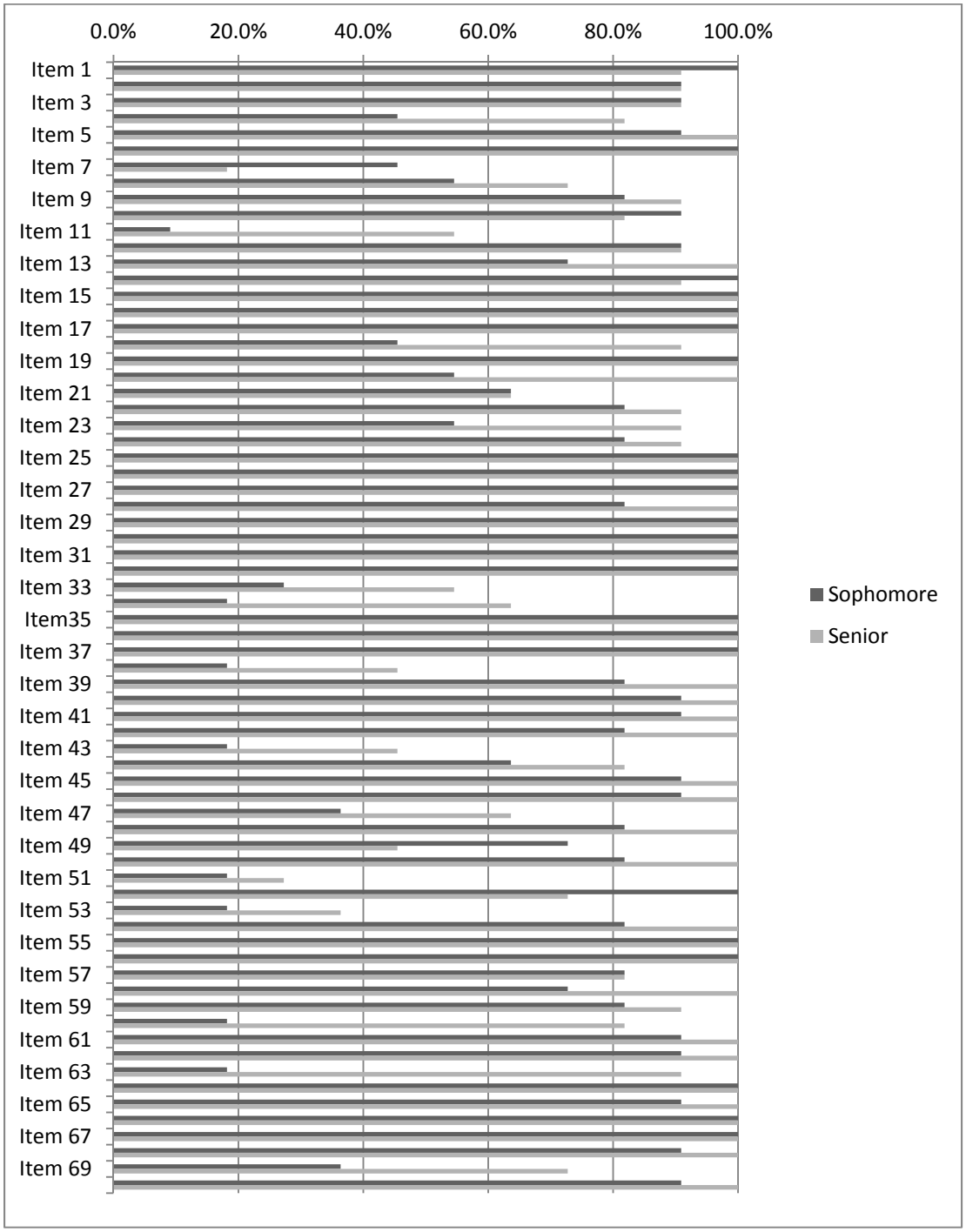


Table 6. Results for Aim 1: Content Validity

	Classification System of Errors				
	Right Patient	**Right Drug**	**Right Dose**	**Right Time**	**Right Route**
Percentage of agreement indicating that in vignette 1 items 1-5, each of the five rights are being assessed	100%	80%	80%	60%	80%
Percentage of agreement indicating that in vignette 2 items 6-10, each of the five rights are being assessed.	100%	80%	100%	80%	100%
Percentage of agreement indicating that in vignette 3 items 11-15, each of the five rights are being assessed.	60%	100%	100%	80%	100%
Percentage of agreement indicating that in vignette 4 items 16-20, each of the five rights are being assessed.	100%	100%	60%	100%	100%
Percentage of agreement indicating that in vignette 5 items 21-25, each of the five rights are being assessed.	60%	100%	60%	100%	100%
Percentage of agreement indicating that in vignette 6 items 26-30, each of the five rights are being assessed	100%	100%	80%	100%	100%

Table 6. Continued

	Classification System of Errors				
	Right Patient	**Right Drug**	**Right Dose**	**Right Time**	**Right Route**
Percentage of agreement indicating that in vignette 7 items 31-35, each of the five rights are being assessed.	100%	80%	60%	40%	60%
Percentage of agreement indicating that in vignette 8 items 36-40, each of the five rights are being assessed	100%	100%	80%	100%	100%
Percentage of agreement indicating that in vignette 9 items 41-45, each of the five rights are being assessed	100%	100%	80%	100%	100%
Percentage of agreement indicating that in vignette 10 items 46-50, each of the five rights are being assessed	100%	40%	80%	80%	80%
Percentage of agreement indicating that in vignette 11 items 51-55, each of the five rights are being assessed	80%	60%	60%	60%	100%

Table 6. Continued

	Classification System of Errors				
	Right Patient	**Right Drug**	**Right Dose**	**Right Time**	**Right Route**
Percentage of agreement indicating that in vignette 12 items 56-60, each of the five rights are being assessed	100%	100%	80%	100%	60%
Percentage of agreement indicating that in vignette 13 items 61-65, each of the five rights are being assessed	100%	100%	60%	100%	100%
Percentage of agreement indicating that in vignette 14 items 66-70, each of the five rights are being assessed	80%	80%	80%	40%	80%

Table 6. Continued

	Responses by Content Validity Experts		
	Yes	**No**	**Comments**
Percentage of agreement as to whether each item is *relevant* to the concept safe medication administration	100%	0%	
Percentage of agreement as to whether the items on the SAM Scale *sufficiently* represent the concept of safe medication administration	100%	0%	
Percentage of agreement as to whether there any items on the SAM Scale were *unclear*	40%	60%	Content reviewer A: *Minor changes could be made to bring the SAM Scale up to date i.e. mL instead of cc, use military time, leave out names of nurses, gender neutrality, etc.* Content reviewer B: *Regarding Vignette 1, what pain medication was given four hours ago as stated in the vignette?*
Percentage of agreement as to whether each vignette is *realistic*	100%	0%	

Table 7. Results for Aim 2: Construct Validity Using Contrasting Groups

Group Statistics

	Year	N	Mean	Std. Deviation	Std. Error Mean
Score	Senior	14	61.93	5.92	1.58
	Soph	11	53.55	5.48	1.65

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Score	Equal variances assumed	.03	.86	3.63	23	.001	8.38	2.31	3.61	13.16

Table 8. Results for Aim 3: Construct Validity Using Different Instruments

Descriptive Statistics for Risk-taking DOSPERT Scale			
	Mean	Std. Deviation	N
SAM Score	61.93	5.92	14
Health/Safety Score	15.21	4.56	14
Overall Score	91.57	12.24	14

Correlations for Risk-taking DOSPERT Scale				
		SAM Score	Health/Safety Score	Overall Score
SAM Score	Pearson Correlation	1	-.55*	-.28
	Sig. (2-tailed)		.04	.33
	N	14	14	14
Health/Safety Score	Pearson Correlation	-.55*	1	.43
	Sig. (2-tailed)	.04		.13
	N	14	14	14
Overall Score	Pearson Correlation	-.28	.43	1
	Sig. (2-tailed)	.33	.13	
	N	14	14	14

*. Correlation is significant at the 0.05 level (2-tailed).

Descriptive Statistics for Risk-perception DOSPERT Scale			
	Mean	Std. Deviation	N
SAM Score	61.93	5.92	14
Health/Safety Score	33.00	4.24	14
Overall Score	132.93	21.60	14

Correlations for Risk-perception DOSPERT Scale				
		SAM Score	Risk-perception Health/Safety Score	Overall Risk-perception DOSPERT Score
SAM Score	Pearson Correlation	1	.16	-.03
	Sig. (2-tailed)		.59	.92
	N	14	14	14
Health/Safety Score	Pearson Correlation	.16	1	.40
	Sig. (2-tailed)	.59		.15
	N	14	14	14
Overall Score	Pearson Correlation	-.03	.40	1
	Sig. (2-tailed)	.92	.15	
	N	14	14	14

Table 9. Results for Aim 4: Internal Consistency Reliability

Reliability Statistics for All Items	
Cronbach's Alpha	N of Items
.77	70

Item Statistics			
	Mean	Std. Deviation	N
Item 1	.93	.27	14
Item 2	.93	.27	14
Item 3	.93	.27	14
Item 4	.86	.36	14
Item 5	1.00	.00	14
Item 6	1.00	.00	14
Item 7	.21	.43	14
Item 8	.79	.43	14
Item 9	.93	.27	14
Item 10	.86	.36	14
Item 11	.57	.51	14
Item 12	.93	.27	14
Item 13	1.00	.00	14
Item 14	.93	.27	14
Item 15	1.00	.00	14
Item 16	1.00	.00	14
Item 17	1.00	.00	14
Item 18	.93	.27	14
Item 19	1.00	.00	14
Item 20	1.00	.00	14
Item 21	.64	.50	14
Item 22	.93	.27	14
Item 23	.93	.27	14
Item 24	.93	.27	14
Item 25	1.00	.00	14
Item 26	1.00	.00	14
Item 27	1.00	.00	14
Item 28	1.00	.00	14
Item 29	1.00	.00	14
Item 30	1.00	.00	14
Item 31	1.00	.00	14
Item 32	1.00	.00	14
Item 33	.50	.52	14
Item 34	.71	.47	14
Item35	1.00	.00	14
Item 36	1.00	.00	14
Item 37	1.00	.00	14
Item 38	.57	.51	14

Table 9. Continued

Item 39	1.00	.00	14
Item 40	1.00	.00	14
Item 41	1.00	.00	14
Item 42	1.00	.00	14
Item 43	.50	.52	14
Item 44	.86	.36	14
Item 45	1.00	.00	14
Item 46	1.00	.00	14
Item 47	.71	.47	14
Item 48	1.00	.00	14
Item 49	.50	.52	14
Item 50	1.00	.00	14
Item 51	.21	.43	14
Item 52	.79	.43	14
Item 53	.50	.52	14
Item 54	1.00	.00	14
Item 55	1.00	.00	14
Item 56	1.00	.00	14
Item 57	.86	.36	14
Item 58	1.00	.00	14
Item 59	.93	.27	14
Item 60	.86	.36	14
Item 61	1.00	.00	14
Item 62	1.00	.00	14
Item 63	.93	.27	14
Item 64	1.00	.00	14
Item 65	1.00	.00	14
Item 66	1.00	.00	14
Item 67	1.00	.00	14
Item 68	1.00	.00	14
Item 69	.79	.43	14
Item 70	1.00	.00	14

Table 9. Continued

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Item 1	61.50	19.65	-.10	.78
Item 2	61.50	18.42	.44	.76
Item 3	61.50	18.42	.44	.76
Item 4	61.57	18.26	.35	.76
Item 5	61.43	19.50	.00	.77
Item 6	61.43	19.50	.00	.77
Item 7	62.21	17.26	.58	.75
Item 8	61.64	18.40	.25	.77
Item 9	61.50	18.42	.44	.76
Item 10	61.57	19.65	-.09	.78
Item 11	61.86	20.44	-.20	.79
Item 12	61.50	19.50	-.03	.77
Item 13	61.43	19.50	.00	.77
Item 14	61.50	19.19	.10	.77
Item 15	61.43	19.50	.00	.77
Item 16	61.43	19.50	.00	.77
Item 17	61.43	19.50	.00	.77
Item 18	61.50	18.27	.51	.76
Item 19	61.43	19.50	.00	.77
Item 20	61.43	19.50	.00	.77
Item 21	61.79	17.10	.52	.75
Item 22	61.50	19.19	.10	.77
Item 23	61.50	18.27	.51	.76
Item 24	61.50	19.19	.10	.77
Item 25	61.43	19.50	.00	.77
Item 26	61.43	19.50	.00	.77
Item 27	61.43	19.50	.00	.77
Item 28	61.43	19.50	.00	.77
Item 29	61.43	19.50	.00	.77
Item 30	61.43	19.50	.00	.77
Item 31	61.43	19.50	.00	.77
Item 32	61.43	19.50	.00	.77
Item 33	61.93	19.15	.02	.78
Item 34	61.71	18.53	.19	.77
Item35	61.43	19.50	.00	.77
Item 36	61.43	19.50	.00	.77
Item 37	61.43	19.50	.00	.77
Item 38	61.86	16.44	.67	.74
Item 39	61.43	19.50	.00	.77
Item 40	61.43	19.50	.00	.77
Item 41	61.43	19.50	.00	.77
Item 42	61.43	19.50	.00	.77
Item 43	61.93	17.46	.41	.76
Item 44	61.57	17.96	.46	.76
Item 45	61.43	19.50	.00	.77

Table 9. Continued

Item 46	61.43	19.50	.00	.77
Item 47	61.71	16.84	.63	.74
Item 48	61.43	19.50	.00	.77
Item 49	61.93	18.84	.09	.78
Item 50	61.43	19.50	.00	.77
Item 51	62.21	18.34	.27	.76
Item 52	61.64	18.86	.12	.77
Item 53	61.93	16.84	.56	.77
Item 54	61.43	19.50	.00	.77
Item 55	61.43	19.50	.00	.77
Item 56	61.43	19.50	.00	.77
Item 57	61.57	18.11	.41	.76
Item 58	61.43	19.50	.00	.77
Item 59	61.50	18.42	.44	.76
Item 60	61.57	17.80	.51	.75
Item 61	61.43	19.50	.00	.77
Item 62	61.43	19.50	.00	.77
Item 63	61.50	18.27	.51	.76
Item 64	61.43	19.50	.00	.77
Item 65	61.43	19.50	.00	.77
Item 66	61.43	19.50	.00	.77
Item 67	61.43	19.50	.00	.77
Item 68	61.43	19.50	.00	.77
Item 69	61.64	18.56	.21	.77
Item 70	61.43	19.50	.00	.77

Table 10. Results for Patient Safety Elective

Group Statistics					
	Safety Class	N	Mean	Std. Deviation	Std. Error Mean
SAM Score dimensional	Yes	4	64.25	3.30	1.65
	No	10	61.00	6.60	2.09

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SAM Score	Equal variances assumed	.17	.30	.92	12	.37	3.25	3.52	-4.42	10.92

CHAPTER V

CONCLUSION

The central assumption guiding this body of work was that nurses need to be prepared to promote safe, quality patient care (AACN, 2008). Thus, critical to this expectation is that nursing programs teach this competency to nursing students, then enabling practicing nurses in the profession to be proficient in this area of safety. As it is documented, the most common breach in safety occurring in hospital settings are medication errors (The Joint Commission, 2008), subsequently decreasing medication errors and improving safe medication administration needs to be a priority for health care organizations and nursing education programs alike (Kohn et al., 2000; AACN, 2008).

The patient risk detection theory was used as the guiding framework; it identifies both organization and individual attributes that affects the nurses' ability to detect patient risk signals (Despins et al., 2010). Patient risk detection theory states that nurses' signal sensitivity is a learned process that is influenced by internal factors as well as by the physical and organizational environment in which they work. The patient risk detection theory is based on the idea that identification of potential medical errors occurs primarily at the level of the individual nurse. The focus of this research was solely on the individual nurse and not on the organization or system.

This body of work evolved out of an interest in the patient safety literature focused on the pediatric population. When medication errors occur in the pediatric population, the impact can be devastating. A systematic literature search was initiated in order to obtain a grasp of the scope of this problem with respect to this population (Paper I). Following this, the researcher had planned to implement an intervention study to

evaluate effective strategies for teaching safe medication administration. However, the researcher was unable to locate a valid and reliable assessment of safe medication administration that could be used to assess the efficacy of a teaching strategy. Thus, the lack of a reliable and valid instrument led the researcher to the current scope of this body of work with the focus to identify assessments to aid in evaluating safe medication administration.

The general purpose of this work was to gain knowledge about medication errors and safe medication administration practices in relation to practicing nurses and nursing students via different approaches. The specific purpose for each paper and the corresponding research questions were addressed individually in each chapter. The intent of this section is to review briefly the work accomplished during this dissertation. One of the approaches was a systematic literature search of medication errors and assessments of safe medication administration. A second approach was the conducting of a survey focusing on the assessment strategies for safe medication administration in nursing education. The final approach was the psychometric evaluation of the only instrument located through the systematic search with initial evidence of validity and reliability used to comprehensively assess safe medication administration: the Safe Medication Administration (SAM) Scale. The remaining sections of this chapter will discuss the findings of the three approaches, as well as implications for practice, education, and research.

Summary and Relationship of Papers I, II and III

Paper I (Chapter II) entitled *Medication Administration Errors and the Pediatric Population: A Systematic Search of the Literature,* described the five themes elicited

regarding medication administration errors and the pediatric population. The five themes were: incidence rate of medication administration errors, specific medications involved in medication administration errors and classification of the errors, why medication administration errors occur, medication error reporting, and interventions to reduce medication errors. Other critical points came to light relating to medication administration in this population. For example, a variety of factors make the pediatric population more susceptible to medication errors and potential complications resulting from medication administration. Errors in dosage were found to be a common cause for medication errors in the pediatric population. Interventions that lead to a successful reduction in medication administration errors were congruent with the current recommendations for safe medication administration. It is astounding that no additional equipment or knowledge was required to reduce medication administration errors. This calls into question whether the current recommendations are being uniformly followed by practicing nurses. This review of the literature highlighted the need for periodic competency assessment and an instrument to assess safe medication administration, which relates to the other two papers which seek to identify a valid and reliable assessment of safe medication administration.

Paper II (Chapter III), entitled *Assessments of Safe Medication Administration* presented findings from a systematic literature review and a national survey. The literature and survey findings both identified that medication calculation knowledge and abilities, or right dose, were routinely assessed with practicing nurses and nursing students. One instrument, the Bayne-Bindler Medication Calculation Test was identified repeatedly through the literature search and was shown to have evidence of validity and

reliability (Bindler & Bayne, 1984). While this assessment has been used within nursing research with both practicing nurses and nursing students, it was not identified specifically in this researcher's survey results as being used in nursing education. Ninety-six percent of participants indicated their nursing education program used a medication calculation or mathematical exam as an assessment of safe medication administration, with 90.6% indicating their medication calculation exam was developed by a member of the faculty. In addition, the survey demonstrated that among the participants, there is much variance within nursing programs on the frequency of this assessment, what constitutes a passing grade, and how non-passing grades are remediated.

In contrast to the number of findings in the literature identifying instruments that assess medication calculation, only three instruments were identified in the literature which *comprehensively* assesses safe medication administration. Again as was communicated about the calculation examination in the survey, none of these instruments identified through the search were specifically referred to by participants in the survey results as being used in nursing education. The survey results identified that a comprehensive assessment of every aspect (i.e. each of the five rights) of safe medication administration is largely occurring in the clinical area, thus at the point of actual patient care. A comprehensive assessment of this competency *prior* to entering the clinical setting is inconsistent as to *how* and even *if* it is occurring. This information is vital to disseminate as it has implications for nursing practice, education and research. This paper included assessments that have been used with both practicing nurses and nursing students, and set the stage for the third paper in which the SAM Scale was selected for

further psychometric evaluation. The SAM Scale was selected because it was deemed superior over the other two comprehensive instruments in its construction, as it had established evidence of validity and reliability.

Paper III (Chapter IV), entitled *Validity and Reliability of the Safe Administration of Medication (SAM) Scale,* obtained additional evidence on the psychometric properties of the SAM Scale. Traditional methods of validity and reliability evaluation were employed including content validity, construct validity using two separate approaches, and internal consistency reliability. Findings from this work found evidence of validity and reliability and supported the previous psychometric evaluation using the Rasch method, conducted by the author of the SAM Scale. In addition, this study also found a relationship between personal risk-taking in the area of health/safety and safe medication administration, which supports Feng, Bobay and Weiss's (2008) analysis identifying personal attributes as impacting patient safety culture, as well as Despins, Scott-Cawiezell and Rouder's (2010) patient risk detection theory identifying internal factors as influencing risk detection. These findings are significant as previous studies have concentrated on the climate and environment as affecting patient safety, and not on the characteristics of the individual.

Implications

It was previously stated that promoting safe, quality care is of the utmost importance in nursing; deciding what to teach, how to teach, and how to assess learning remains an issue in nursing education (Cronenwett et al., 2007). While QSEN has recommendations for how to teach safe medication administration, the assessment instruments critical to these recommendations are lacking. This body of work attempted

to address this gap by identifying available assessments of safe medication administration which support the recommendations of safe medication administration by NCC MERP.

It was demonstrated that there are very few instruments with evidence of sound psychometrics, and there is evidence to support the lack of standardized strategies to document performance of nursing students in the area of medication administration. The outcome of this work demonstrates the need for a standardized and psychometrically-sound assessment of safe medication administration in order to verify that nurses and nursing students are prepared to give safe, quality care. This body of work has implications to nursing in three distinct domains: practice, education, and research.

Nursing Practice

Unfortunately, few formalized system checks are in place for safe administration of medications (Stratton et al., 2004). Nurses need to be taught the importance of safe medication administration and this competency needs to be routinely reassessed. In the practice setting, safe medication administration may be assessed incrementally (such as through a medication calculation test or observation during orientation) or it may simply be subsumed under other forms of assessment including successful completion of a nursing education program and NCLEX examination. Alarmingly, this body of work showed a lack of standardization in how safe medication administration is assessed in nursing education programs, which means that depending on this form of assessment may not be a true indicator of practicing nurses' true knowledge and skills in safe medication administration. In addition, "Pharmacological and Parenteral Therapies" comprises only 12-19% of NCLEX questions, thus heavy reliance on successful completion of the NCLEX equating with competency in the area of safe medication administration is also

misleading. Based on the literature review of Paper I, nursing practice can no longer rely on previous assessments of safe medication administration to be timeless for the duration of a nursing career.

A key concept identified in the patient risk detection theory that has implications for nursing practice was detection bias (Despins et al., 2010). If signals are hard to discern, there is a high likelihood of false alarms, or a belief that errors will not occur, then detection bias will play a significant role in the decision-making process regarding patient risk detection and errors may be more likely to occur. However, if safety is a primary concern of the nurse and the organization, then the individual will remain vigilant and detection bias will play a minimal role in patient risk detection. Periodic communication and monitoring of safe practices by an organization is vital in ensuring that the individual understand the expectation of continuously scanning for possible errors. This may include monitoring the nurse while she administers medications to an actual patient, or during a simulated patient experience or through some form of competency evaluation.

A number of years ago, calls were made for periodic examination of nurses to assess both competence and knowledge of safety practices (Kohn et al., 2000). Ten years after the IOM report *To err is human* (Kohn et al., 2000), Consumers Union Safe Patient Project campaign reported that progress on medication errors has fallen short, specifically citing that high levels of medication name confusion remains, electronic prescribing has not been widely adopted, and no national reporting system for medication mistakes exists (Consumers Union, 2009).

It is time to put the call into action. Safe medication administration needs to be assessed periodically to ensure that practicing nurses have the knowledge and skills for following the current recommendations of safe medication administration. Consumers Union reported that efforts to improve competency have solely come from the private sector and results are fragmented and without a systematic process to promotion and measure national improvement (Consumers Union, 2009). Requirements for license renewal have focused on continuing education, despite evidence that this has little impact on competency. Nursing may look to other professions with regards to their standards for competency assessment. Consumers Union compares nursing to police officers who demonstrate firearms proficiency in requalification tests at least twice a year, and to airline pilots who must pass ongoing proficiency testing with flight simulators (Consumers Union, 2009). There is a need for period assessment of the competency of safe medication administration within nursing practice.

As was previously discussed in the first paper, interventions found to reduce medication administration errors were congruent with current recommendations for safe medication administration. Thus, the question needs to be posed that if the current recommendations are being followed uniformly, then why are so many medication errors occurring. Thus, it is critical to also implement random evaluation of safe medication administration practices, which could lead to better adherence to the current recommendations and reduce medication administration errors. In addition, focused remediation should occur in response to the periodic competency evaluation of knowledge and skills, random evaluation of safe medication administration practices, near misses and actual medication administration errors. Focused remediation follows

the current recommendations that individuals should not be blamed, but rather allowed the opportunity to learn from the mistake so that future medication errors can be prevented (Kohn et al., 2000).

Lastly, system checks for medication administration need to be put into place. It was previously stated that medication errors are more commonly detected and intercepted in the early stages of medication processing, such as during prescribing and preparing the medication, due to the system checks. There are few system checks in place during safe medication administration requiring the nurse to follow the recommendations of safe medication administration. While medication bar coding is one type of system check that has been found to reduce medication administration errors, it is not used in all practice settings. With the initiation of system checks, medication administration errors will decrease and safe medication administration recommendations will be abided.

Nursing Education

A key concept identified in the patient risk detection theory that has implications for nursing education was sensitivity (Despins et al., 2010). Factors that impact sensitivity include education and adequate opportunities. With education and adequate opportunities to detect and correctly interpret signals, individuals become more adept and the cognitive processes become more automatic (Despins et al., 2010). This applies to sensitivity towards medication errors and safe medication administration practices.

Assessing knowledge and competence of safe medication administration practices begins with nursing students. A valid and reliable assessment of safe medication administration is needed in nursing education to ensure that nursing students are competent in this area. Competence should be verified *before* students enter the clinical

setting. In addition, competence should be verified *periodically throughout the remainder* of the nursing students' educational program. This recommendation follows the recommendation for practicing nursing: periodic competency evaluation and is key to safe practice.

Without a standardized method for assessing safe medication administration, it is impossible to evaluate various teaching strategies. Nursing education is challenged with the task of ensuring that graduate nurses are prepared to provide safe, quality care. However, nursing education is filled with many constraints that impede this effort including a curriculum that is dynamic where additional content is often added, yet nothing is ever omitted. There is a constant imbalance of not enough time, faculty, and resources. Therefore, it is necessary to be prudent with all available resources, including the time and energy spent in developing new teaching strategies. Currently, there is much attention and interest in simulation as a teaching strategy and this strategy absolutely should be considered for teaching safe medication administration. However, without a valid and reliable assessment of safe medication administration, the effectiveness of this teaching strategy is unknown. In order for nursing education to move forward with the QSEN curriculum recommendations, a standardized assessment of safe medication administration is needed.

Nursing Research

Research on patient safety and medication errors has largely focused on computerized physician order entry and medication bar-coding. Nursing research on safe medication administration has largely focused on teaching strategies. This body of work exposed a gap in assessments of safe medication administration. The findings of this

body of work have implications for facilitating empirical study of teaching strategies as well as suggesting further study in the area of teaching strategy validation.

The SAM Scale is a comprehensive assessment of safe medication administration that was found to have additional evidence of validity and reliability, however refinement is strongly recommended. First, the SAM Scale was found to be a lengthy instrument given the constraints of nursing education. It is recommended that the SAM Scale be shortened so that it can be reasonably completed in thirty minutes or less. Another recommendation is the advent of two parallel forms to allow for pretest and posttest intervention studies. This is pivotal in order to assess the effectiveness of various teaching strategies. Another recommendation is to increase the level of difficulty. This recommendation was supported by the author of the SAM Scale and the findings presented in the third paper. The last recommendation is to ensure that the inherent violations of the recommendations for safe medication administration are purposeful and reflect medication administration errors that occur in practice. For example, errors of omission are common but are not reflected in the SAM Scale. In addition, there needs to be an even number of violations of each category of safe medication administration. In its current format, the SAM Scale only had one violation of right route. This may be an area of insufficient knowledge for individuals but one item is not sufficient to identify a gap in their knowledge.

Research on factors that influence patient safety culture have largely focused on the culture of safety within a specific clinical practice setting. This study elicited data that is among the first to demonstrate a relationship between a practitioner attribute and patient safety. Specifically, the work showed a relationship between personal risk-taking

in the area of health/safety and safe medication administration. This suggests that there might be individual factors that are affecting risk-taking when providing patient care that have yet to be identified. Further study is needed to explore personal attributes that impact patient safety. Implications of these findings suggest that in addition to changing the clinical setting to create a culture of patient safety, an awareness of individual practitioner attributes have a role in promoting patient safety.

The purpose of this body of work was to address medication errors and safe medication administration in relation to practicing nurses and nursing students. The second and third paper sought to obtain an assessment of safe medication administration that has evidence of validity and reliability. While the SAM Scale was found to have evidence of validity and reliability, it does not meet all the needs of nursing practice, education and research. It does, however, provide a starting point for the refinement and further development of a psychometrically-sound assessment of safe medication administration that can be used in a variety of settings within nursing.

APPENDIX A

SURVEY FOR AACN BACCALAUREATE NURSING PROGRAMS ON METHODS FOR ASSESSING SAFE MEDICATION ADMINISTRATION

1. Type of school the nursing program is a part of:
   _____ Independent (private) institution
   _____ Public institution

2. What nursing degrees does your college or school offer? Mark all that apply.
   _____ Bachelor of Science in Nursing (BSN)
   _____ Bachelor of Arts with a major in Nursing
   _____ Master's of Science / Arts in Nursing
   _____ Doctorate in Nursing Practice (DNP)
   _____ PhD in Nursing
   _____Other (please describe)
   _____
   _____
   _____

3. What are the number of BSN students that your program typically graduates each year
   _____

4. Please identify which of the following methods are used in your nursing program to assess the baccalaureate students' ability to administer medications safely prior to administering medications in the clinical setting. Mark all that apply.

   _____ Successful completion of a stand-alone pharmacology course
   _____ Successful completion of nursing course(s) that integrate Pharmacology content
   _____ Computer-assisted safe medication administration module and exam
   _____ Examinations that include questions on safe medication administration
   _____ Medication calculation / mathematical exam
   _____ Performance assessment in skills laboratory on medication administration
   _____ Performance assessment prior to clinical
   _____ Unsure
   _____Other (Please describe)
   _____
   _____

5. Please identify which of the following methods are used in your nursing program to assess the baccalaureate students' ability to administer medications safely <u>while in the clinical setting</u>. Mark all that apply.

   _____ Oral review with clinical instructor
   _____Written assignment
   _____ Performance assessment during clinical
   _____ Unsure
   _____Other (Please describe)

   _____
   _____

6. Who teaches the pharmacology course content in your nursing program to baccalaureate nursing students? Mark all that apply.

   _____Nursing faculty with nursing degree
   _____Nursing faculty without nursing degree
   _____ Non-nursing faculty
   _____ Unsure

7. How frequently do the BSN nursing students take a medication calculation exam in your nursing program?

   _____Once during the entire program
   _____ Annually
   _____Each semester
   _____ Integrated into every nursing exam
   _____ Unsure
   _____ Other (Please describe)
   _____
   _____

   .

8. Did you or members of your faculty develop the medication calculation exam used in your nursing program?

   _____ Yes
   _____ No
   _____ Unsure

9. What is a passing percentage grade on the medication calculation exam in your nursing program?

   _____

10. If the student is not successful on the medication calculation exam, what type of remediation, if any, is the student expected to complete in your nursing program?

    _____
    _____

11. Is there any additional information you can provide to clarify how your nursing program ensures competency in medication calculations?

    _____
    _____

12. Is a specific "performance checklist" for safe medication administration used in the skills laboratory, clinical or both in your nursing program?

    _____ Yes
    _____ No

13. Is there anything else you would like to include to better describe how your nursing program assesses its baccalaureate students for safe medication administration?

    _____
    _____

14. Would you be comfortable sharing any of your assessments with the researcher (such as the performance checklist, exams, etc)? If so, please copy the document into the space below, email or send via postal service to the researcher.

kelly-benda@uiowa.edu
Kelly Gonzales
7832 Bondesson St
Omaha, NE 68122

Please contact the researcher if you would like to receive the results of this survey.

APPENDIX B

SAFE ADMINISTRATION OF MEDICATION SCALE

Instructions for completion of the Safe Administration of Medication Scale

This scale is designed to assess your ability to apply the five rights of administering medication safely.

1. Attached you will find five Clinical Cases that incorporate a total of fourteen vignettes of nurses administering medications.

2. Each Case incorporates two or three vignettes that describe the administration of medication by a nurse to a hospitalized patient.

3. Read each vignette and determine if the actions taken by the nurse, in the process of administering the medication is the correct action or an incorrect action.

4. Use the Case response table associated with each vignette to indicate a correct action by placing "yes" in the corresponding box and "no" if the action the nurse took was incorrect.

Item #					
Case 1	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 1					

In the space provided describe a short narrative description of what the nurse should have done, if you determine the action the nurse took was incorrect. If all actions were correct write No Errors.

Provide correct nursing action for each identified error.

_____

_____

_____

_____

_____

Do Not Put Your Name on the Forms.

Case 1

Patient: Gary Molesom
Sex: Male
Age: 75 years old
Allergies: NKA.
Date: 6/02/2005
Hospital ID # 29475963

Chief Complaint
Mr. Molesom presented in the emergency room with a complaint of pain in the right upper quadrant. He states that the pain came on suddenly and it has not gotten any better over the last three hours. Dr. J. Thomas

History & Physical Exam
Mr. Molesom appeared to be acutely ill and in a great deal of discomfort. He has a low-grade fever of 101.2^0 F. He describes a recent history of being bothered by fatty foods, and also feels discomfort and mild nausea after a meal. Admission weight/ ht: 76 kg, 6'1"
Dr. J. Thomas

Diagnosis: Acute Gallbladder Attack

Physician orders
1. Admit to inpatient unit, room # D6548 @ 3:30pm
2. Clear liquids, NPO after midnight
3. Laparoscopic cholecystectomy
4. Ultrasound scan
5. Labs: WBC, AST, LDH, serum bilirubin level.
6. D5 NS with 20 Meq KCL/liter at 60cc/hr

Dr. J. Thomas MD

Medication Orders:
Demerol 75mg IM q6hrs PRN
Hydroxyzine 25mg IM on call to OR
Dr. J. Thomas MD

Gary Molesom
ID # 29475963

Case 1, Vignette 1

Katherine Jones was the nurse caring for Mr. Molesom. When she arrived on the floor at the start of her shift, Mr. Molesom activated his call light and requested pain medication. Ms. Jones looked at the medication book and noted that it had been four hours since his last pain medication. She did the following:

Ms. Jones accessed the Demerol from the narcotics cabinet. She selected Demerol for injection, 100mg/ml. She drew up 75mg (0.75ml) in a syringe and checked the dose with another nurse. She also had the other nurse witness her disposal of the remaining Demerol. She proceeded to the patient room, introduced herself to Mr. Molesom and verified his name by looking at his armband and ID#. She then gave the injection in his right ventrogluteal muscle.

Item #	1	2	3	4	5
Case 1	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 1					

Provide correct nursing action for each identified error

Go To Next Page

Gary Molesom
ID # 29475963

Case 1, Vignette 2

The OR called for Mr. Molesom and Ms. Jones prepared his pre-op medication. She had a vial of Hydralazine 20mg/ml. She drew up 1.25ml, checked his armband and ID# and gave the injection in his left ventrogluteal muscle.

Item #	6	7	8	9	10
Case 1	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 2					

Provide correct nursing action for each identified error

_____
_____
_____
_____
_____

End of Case 1

Case 2
Patient: Peter Johnson
Sex: Male
Age: 5 years old
Allergies: pollen, dust mites & molds
Date: 5/02/2005
Hospital ID # 39294023

Chief Complaint
Peter Johnson was brought to the emergency room by his mother at 2:00pm. His mother states that he was playing outside with some children in the neighborhood. He came inside because he was having difficulty breathing. She called the pediatrician. The pediatrician told her to bring Peter to the emergency department.

History & Physical Exam
Peter is a five-year-old male, sitting in mother's lap, presenting with respiratory rate of 36/minute, heart rate of 132, substernal retractions, bilateral inspiratory and expiratory wheezing on auscultation. Peter has history of allergies to pollen, dust mites and molds. He was admitted to the hospital six months ago with similar symptoms and was diagnosed with asthma. This is the first significant recurrent episode. He has had milder bouts of asthma that were managed at home with an albuterol inhaler. J. Thomas MD

Diagnosis: Acute Asthmatic Attack **Admission weight**: 16 kg

Physician Orders
Admit to Pediatric Ward: Room D123 @ 3:30pm
Bedrest or in mother's lap
O2 2L/min via nasal cannula Keep O2 sat >95%
Pulse oximetry
Arterial blood gasses (done in ER)
Chest x-ray (done in ER)
D5 ¼ NS with 20Meq KCL/ liter at 70cc/hr
Call physician for increased respiratory distress or no improvement after third dose of Albuterol
Monitor intake and output q4 hrs and daily weights. J. Thomas MD

Medications:
Nebulized albuterol with O2 @ 6 liters flow 0.15mg/kg/dose (max 5mg/dose) every 20 minutes up to 1 hour. (Done by Respiratory Therapist)
Prednisone 30mg po bid (8:00am + 4:00pm)
250mg aminophylline/250ml D_5 ¼ NS IVPB to run at 1.5mg/kg/hr
J. Thomas MD

Go To Next Page

Peter Johnson
ID # 39294023

Case 2, Vignette 3

Laura Stone is the nurse assigned to care for Peter Johnson. She reviews the orders that came with Peter when he was transferred from the Emergency room at 3:30pm. Peter arrived on the unit with an IV in place and the following information on the label.

Peter Johnson Rm: Pediatric D123
Hospital ID # 39294023

Aminophylline: 250mg/250cc D_5 ¼ NS

IV Rate: 24ml/hour
Date:5/02/05
Expires: 5/3/05

The nurse checks the IV label and determines it is what has been ordered. The IV site soft, dressing dry and intact and medication is compatible with IV fluid and KCL. She checks the IV pump and determines that it is set at 24cc/hr.

Item #	11	12	13	14	15
Case 2	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 3					

Provide correct nursing action for each identified error.

Go To Next Page

Peter Johnson
ID # 39294023

Case 2, Vignette 4

At 4:00pm, the nurse prepares to give Peter his prednisone. The prednisone comes in liquid version and the label reads Prednisone 5mg/ml. The nurse uses a 10cc oral syringe and draws up 8ml. She checks his armband and ID# and proceeds to give the prednisone to Peter while his mother holds him across her lap. She administers the medication orally. Peter spits out the medication.

Item #	16	17	18	19	20
Case 2	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 4					

Provide correct nursing action for each identified error.

Go To Next Page

Peter Johnson
ID # 39294023

Case 2, Vignette 5

The nurse notifies the doctor and he changes the order to: Prednisolone 30mg IV now and q 12h. J. Thomas MD
Pharmacy sends up a vial in a plastic bag labeled Peter James ID# 28769233. The vial provides 50mg/ml. The nurse determines Prednisolone is compatible with Aminophylline, draws up 0.5mls, checks his armband and injects it slowly into the IV line port.

Item #	21	22	23	24	25
Case 2	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 5					

Provide correct nursing action for each identified error.

_____
_____
_____
_____
_____

End of Case 2

Case 3
Patient: Jason Hardy
Sex: Male
Age: 1 week old
Allergies: None Known
Date: 4/24/2005
Hospital ID # 5838298

Chief Complaint: Mother states that Jason has "not been eating well, he falls asleep after only a few minutes of breastfeeding and he has fewer wet diapers." "He just doesn't seem right, I wonder if I should give him formula instead of breast feeding." J. Horton MD

History & Physical Exam
Jason was born on April 17th, 2005 at 5:37 am, at Thomasville Community Hospital. He weighed 7lbs. 9oz. He was diagnosed with a ventricular septal defect (VSD) and referred to a cardiologist for further diagnostic studies. He was discharged to home on April 18, 2005 and had an appointment with a cardiologist scheduled on May 2nd, 2005. Over a period of several days, his mother noted his breathing was more rapid and he was falling asleep after only a few minutes of breast-feeding. He also has had fewer wet diapers. She called the cardiologist and he admitted Jason to Children's Medical Center for evaluation. He was diagnosed with mild congestive heart failure, tachypnea (50-70 breaths/minutes) and decreased urine output. He was scheduled for a cardiac catheterization. J. Horton MD

Current Weight 7 lbs 8oz. (3.4 kg)

4/24/05 Progress Note
Jason had a cardiac catheterization on 4/24/05, and has just returned to the unit. He is sleeping but will be able to resume breastfeeding when he wakes up. His mother has been instructed to keep his right leg straight, and notify the nurses if he has any bleeding from his pressure bandage.
J. Horton MD

Post-catheterization orders:
1. Admit to cardiac step-down unit
2. Diagnosis: VSD
3. Status: Post catheterization (right femerol)
4. Condition stable
5. Diet: breast-feeding
6. Daily weights
7. Intake & output
8. 02 @ 2 L/min per nasal cannula
9. Observe pressure dressing for bleeding, keep right leg straight
10. Check pedal pulses in both lower extremities with vital signs
11. Monitor vital signs q/15minutes for 1st hour, then q 1hr. J. Horton MD

Medication Orders:
Furosemide 1 mg/kg PO stat & then q 12hrs (available stock: 10 mg/mL)
Digoxin 8 mcg/kg PO stat and then qd (Available stock: elixir 50 mcg/mL)
J. Horton MD

Jason Hardy
ID # 5838298

Case 3, Vignette 6

Carol Jones RN is the nurse assigned to care for Jason. Jason has just been admitted to the cardiac ICU step-down unit after his cardiac catheterization. It is 9:45am.

The nurse does an initial assessment with the following findings. Mother holding & breastfeeding infant, bilateral pedal pulses present with apical heart rate 124, good capillary refill, right foot slightly cooler than left foot, no edema, dressing dry and intact over right groin area. Informed mother of need to keep affected leg straight and notify nurse of any bleeding or color changes in right leg or foot.

The nurse prepares to give Stat Medications. The following information is on the label.

Jason Hardy Bed 2 Hospital ID # 5838298 Digoxin Elixir 50mcg/ml Expiration 10/24/07

Medications are available on the unit at 10:00 am. The nurse checks the Digoxin medication label against the original order. She calculates the Digoxin dose for Jason and determines she needs to administer 0.54ml. She informs the mother of the medication she is giving, checks Jason's apical pulse for 60 seconds (apical heart rate is 120) and checks his armband and ID#. She then administers the medication PO using an oral syringe.

Item #	26	27	28	29	30
Case 3	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 6					

Provide correct nursing action for each identified error.

Go to Next Page

ID # 5838298

Case 3, Vignette 7

At noon Carol Jones RN returns to Jason's room with 3.4ml of Furosemide, rechecks Jason's armband & ID# and administers the medication orally.

Item #	31	32	33	34	35
Case 3	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 7					

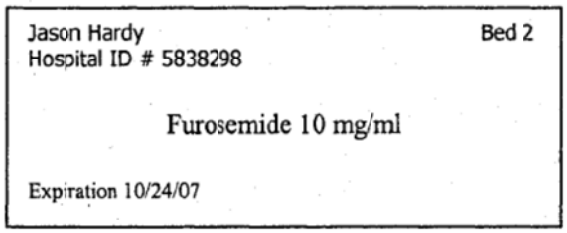
Provide correct nursing action for each identified error.

Go to Next Page

Jason Hardy
ID # 5838298

Case 3, Vignette 8

Nurse Philips arrives on the unit to do her 7:00pm – 7:00 am shift. She gets report from Carol Jones who is ending her shift. "Jason is a 1-week old infant who had a cardiac catheterization this am. Mom is at the bedside and she is breastfeeding him. His heart rate has been 120-126 beats/minutes. He has had 6 wet diapers." At 10:00pm Nurse Philips prepares his Furosemide.



Nurse Phillips checks the medication sheet with the order sheet. She notes that Furosemide was ordered stat at 10:00am but given at 12:00 noon. Since the order stated q 12 hours she waits until 12:00 midnight to give the second dose. At midnight calculates the dosage and draws up 0.016ml in an oral syringe. She checks Jason's armband and ID# and administers the medication orally.

Item #	36	37	38	39	40
Case 3	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 8					

Provide correct nursing action for each identified error.

_____
_____
_____
_____
_____

End of Case 3

Case 4
Patient: Mr. James Jones
Sex: Male
Age: 53
Allergies: None Known
Date: 10/02/2005
Hospital ID # 39294023

Chief Complaint
Mr. James Jones arrived in the emergency room at 8:00 am, with a painful and slightly swollen right calf. He stated: "My leg began to feel sore yesterday while I was at work. It seems to be swollen and feels warm." Dr. G. Jackson

History & Physical Exam
Mr. Jones denied any history of injury to his leg. In comparison to his left calf, his right calf is slightly swollen, warm and red. This is the first time he has experienced these symptoms.
He is being treated for arthritis, but states "this pain is different". Mr. Jones was hospitalized two weeks ago for gallbladder surgery and had an uneventful stay. He has no known history of thrombosis. **Admission weight**: 72 kg. Dr. G. Jackson

Diagnosis: Deep Vein Thrombophlebitis (DVT) of right calf

Physician orders
Admit to hospital: Room E237 @ 9:45am
Complete bedrest with bathroom privileges, Elevate legs on two pillows
Avoid rubbing or massaging the affected calf
Thigh high elastic compression stockings
Peripheral IV Normal Saline with 20Meq KCL/liter at KVO
Regular diet, Monitor intake and output q8 hrs
Lab Work: APTT q4 hrs
Monitor for indications of bleeding
Dr. G. Jackson

Medications Ordered:
IV heparin:Initial IV bolus 100units/kg (7200u) given in ER @ 0930 M. Paul RN
Upon arrinval on the unit, begin continuous heparin at 10 units/kg/hr (720 units/hr)
Celebrex 100mg, PO BID (takes at 8:00am and 8:00pm at home)
Dr. G. Jackson

Lab Values

Laboratory Test	Date/Time	Patient Value	Normal Range	Therapeutic Range
APPT	10/02/05 @ 1300	60 seconds	25.0 – 38.0 seconds	2.0 – 2.5 times normal range
INR	10/02/05 @ 1300	1.9	0.9 – 1.2	1.5 – 4.5

Mr. James Jones
ID# 39294023

Case 4, Vignette 9

Susan Ross RN is the nurse assigned to care for Mr. James Jones.
Mr. Jones has just arrived on the unit at 10:00am and is in room E237.
The nurse does an admission assessment and informs Mr. Jones that she will be getting his medications as ordered by the physician. He received his bolus dose of heparin 7200 units in the emergency room and should be started on his continuous heparin dose upon arrival on the floor.
Nurse Ross receives an IV bag from the pharmacy that has the following information on the label.

Mr. James Jones Room E237
Hosp. ID: # 39294023

Heparin 10,000 units/100ml of Normal Saline.
Dose Ordered: 720 units/hour

IV Rate: 72ml/hour

Date: 10/02/2005 prepared by: *J. Parker* Pharm.D.
Expires: 10/03/05 @ 10:00am

The nurse checks the physician's medication orders against the original order form.
Nurse Ross checks the APPT result for Mr. Jones. It is 50 seconds. Nurse Ross goes to room E237 at 10:15am and says, "Good morning Mr. Jones, how are you feeling today as she checks his ID# & armband, IV site and medication label. I have the medication Dr. Jackson ordered for you." She proceeds to hang the Heparin and sets the IV pump to deliver 72ml/hr.

Item #	41	42	43	44	45
Case 4	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 9					

Provide correct nursing action for each identified error.

Go To Next Page

Mr. James Jones
ID# 39294023

Case 4, Vignette 10

Susan Ross RN also has Mr. James Jones' arthritis medication "this is your morning dose". She checks his armband & ID# and administers 100mg of Celexa (Two 40mg tablets and One 20mg tablet) PO with water.

Item #	46	47	48	49	50
Case 4	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 10					

Provide correct nursing action for each identified error.

GO TO NEXT PAGE

Mr. James Jones
ID# 39294023

Case 4, Vignette 11

Kathy Smith RN is the nurse assigned to care for Mr. James Jones the next day. Mr. Jones had an uneventful first 24 hours.

The nurse informs Mr. Jones that she will be changing his IV medications shortly. Nurse Smith receives an IV bag from the pharmacy that has the following information on the label.

Mr. George Jones Room F327
Hosp. ID: # 32049293

Heparin 10,000 units/100cc of Normal Saline.
Dose Ordered: 600 units/hour

IV Rate: 60 cc/hour

Date: 10/03/2005 prepared by: *J. Parker* Pharm.D.
Expires: 10/04/05 @ 10:00am

Nurse Smith goes to room E237 at 10:00am and says, "Good morning Mr. Jones, how are you feeling today? I have the medication Dr. Jackson ordered for you." The nurse states that the dose is lower than yesterday. She checks his IV site, armband and ID#. She then proceeds to hang the medication and sets the IV pump to deliver 60cc/hr. "I will be back to check on you. Use your call light if you need anything." She then leaves the room.

Item #	51	52	53	54	55
Case 4	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 11					

Provide correct nursing action for each identified error

_____
_____
_____
_____
_____

End of Case 4

Case 5
Patient: Patricia Henry
Sex: Female
Age: 61
Allergies: None Known
Date: 4/23/05
Hospital ID # 4528495

Chief Complaint:
Ms. Henry was having "trouble breathing" during the night and had to "sit on the side of the bed". She was still "short of breath" and called her son, who took her to the hospital.

History & Physical
Ms. Henry, a 61-year-old female was admitted to the coronary care unit at 6:00am.
Patient appears tired and anxious, Skin cool and moist, capillary refill slow
Peripheral pulses weak bilaterally, mild pitting edema in lower extremities
Breath sounds: inspiratory crackles. *J. Jones, MD*

Vital Signs
Heart rate = 120 beats/min, irregular
Respiratory rate = 24 breaths/min shallow
Blood pressure = 140/70 mm Hg
Temperature = 38.10^0 C
Wt: 154lbs (70kg) HT: 5'6"

Diagnosis: Congestive Heart Failure/ Pulmonary Edema

Physician Orders:
1. Admit to E461
2. Bedrest with HOB elevated 45^0
3. O_2 via NC @ 2 liters/min
4. IV D_5W @KVO
5. Chest x-ray & EKG
6. Cardiac monitor
7. Foley catheter
8. Daily weights , Low sodium diet
9. Labs: ABG, CBC, Electrolytes, UA
10. Digoxin Level @ 8:00pm (done) Ms, Henry's (0.06 ng/ml) Therapeutic (0.5 -2 ng/ml) *J.Jones, MD*

Medications:
Lasix 40mg IV @ 8:00 am
Digoxin 0.7mg IV Stat @ 2:00am given in ER @ 2:30am. K. Smith RN
Digoxin 0.35 mg IV @ 8:00am and 2:00pm
Potassium Chloride 30mEq PO qd @ 2:00pm *J. Jones, MD*

Patricia Henry
ID # 4528495

Case 5, Vignette 12

Nurse Miller completes an assessment of Ms. Henry and prepares to give her 8:00am medications. Nurse Miller verifies medication orders with medication sheet. She prepares three medications: Digoxin, Lasix, and Potassium Chloride.

The first order is for 0.35mg Digoxin, IV. The ampule contains 0.25mg/ml. Nurse Miller calculates that she will need to withdraw 1.4mls of Digoxin for Ms. Henry. The nurse uses a 3cc syringe and withdraws the medication until it reaches 1.4ml. She then labels the syringe with patient name and drug name/dose.
The nurse then proceeds to Ms Henry's bed and tells her she has her Digoxin and checks her armband & ID#. The nurse takes an apical pulse for 60 seconds, and proceeds to administer the Digoxin SQ in her right arm.

Item #	56	57	58	59	60
Case 5 Vignette 12	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 12					

Provide correct nursing action for each identified error.

Go To Next Page

Patricia Henry
ID # 4528495

Case 5, Vignette 13

The nurse also has her second 8:00am medication, Lasix 40mg, IV to be given over 5 minutes. The dose on hand is 5mg/ml. The nurse drew up 6ml of Lasix in a 10ml syringe and labeled the syringe. The nurse checks the patient's armband & ID#, and notes the IV site is dry and intact without swelling or redness. She gives the Lasix by injecting it slowly into the IV tubing port over 5 minutes.

Item #	61	62	63	64	65
Case 5	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 13					

Provide correct nursing action for each identified error.

Go To Next Page

Patricia Henry
ID # 4528495

Case 5, Vignette 14

She also has her third medication, Potassium Chloride 30mEq PO, qd. Potassium chloride comes in individual 30 mEq/15ml containers. The nurse brings one individually packaged oral Potassium Chloride. The nurse then checks the patient's armband and ID# gives Ms. Henry her Potassium Chloride by mouth.

Item #	66	67	68	69	70
Case 5	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 14					

Provide correct nursing action for each identified error.

End of Case 5

Scoring Guide

Item #	1	2	3	4	5
Case 1	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette I	No Error	No Error	No Error	Error	No Error
Item #	6	7	8	9	10
Case 1	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette 2	No Error	Error	No Error	No Error	No Error
Item #	11	12	13	14	15
Case 2	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette 3	Error	No Error	No Error	No Error	No Error
Item #	16	17	18	19	20
Case 2	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette 4	No Error	No Error	Error	No Error	No Error
Item #	21	22	23	24	25
Case 2	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette 5	Error	No Error	Error	No Error	No Error
Item #	26	27	28	29	30
Case 3	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette 6	No Error	No Error	No Error	No Error	No Error
Item #	31	32	33	34	35
Case 3	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette 7	No Error	No Error	Error	Error	No Error

Scoring Guide

Item #	36	37	38	39	40
Case 3	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette 8	No Error	No Error	Error	No Error	No Error
Item #	41	42	43	44	45
Case 4	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette 9	No Error	No Error	Error	No Error	No Error
Item #	46	47	48	49	50
Case 4	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette 10	No Error	Error	No Error	No Error	No Error
Item #	51	52	53	54	55
Case 4	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette 11	Error	No Error	Error	No Error	No Error
Item #	56	57	58	59	60
Case 5	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette 12	No Error	No Error	No Error	No Error	Error
Item #	61	62	63	64	65
Case 5	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette 13	No Error	No Error	Error	No Error	No Error
Item #	66	67	68	69	70
Case 5	Right	Right	Right	Right	Right
	Patient	Drug	Dose	Time	Route
Vignette 14	No Error	No Error	No Error	Error	No Error

Source: Ryan, D. (2007). *Measurement of student nurse performance in safe administration of medication.* Unpublished doctoral dissertation. Emory University.

APPENDIX C

INCLUSION CRITERIA FOR CONTENT VALIDITY EXPERTS

A total of 5 experts which:

- 4 experts are faculty from the nursing program where data collection will occur
- At least three of the four faculty experts have to be clinical faculty who routinely administer medications with their students
- 1 expert to be a bedside nurses who routinely administers medications

Inclusion criteria for experts

1. Is a registered nurse
2. Has experience administering medications or overseeing a student administer medication in the past 12 months
3. Has a minimum of a BSN
4. Works full-time (36 hours per week) in the nursing profession

APPENDIX D

EVALUATION OF CONTENT VALIDITY OF THE SAM SCALE

Directions: The SAM Scale assesses safe medication administration and was developed based upon the five rights of safe medication administration including: right patient, right drug, right dose, right time and right route. Please review the SAM Scale and answer the questions below.

1. In vignette 1 items 1-5, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 1					

2. In vignette 2 items 6-10, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 2					

3. In vignette 3 items 11-15, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 3					

4. In vignette 4 items 16-20, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 4					

5. In vignette 5 items 21-25, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 5					

6. In vignette 6 items 26-30, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 6					

7. In vignette 7 items 31-35, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 7					

8. In vignette 8 items 36-40, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 8					

9. In vignette 9 items 41-45, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 9					

10. In vignette 10 items 46-50, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 10					

11. In vignette 11 items 51-55, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 11					

12. In vignette 12 items 56-60, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 12					

13. In vignette 13 items 61-65, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 13					

14. In vignette 14 items 66-70, which of the five rights are being assessed? This is not asking you to identify whether the resulting nursing action is correct or incorrect, but simply asking whether the five rights are being assessed in each vignette. Check all that apply.

	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Found in vignette 14					

15. The SAM Scale has 70 items. Is each item *relevant* to the concept safe medication administration?

    ____ Yes

    ____ No

    If no, please indicate what concept is being measured using the table below.

Item					
Concept being measured					

Item					
Concept being measured					

16. Do you believe the items on the SAM Scale *sufficiently* represent the concept of safe medication administration? This means that all of the elements of safe medication administration are present.

    ____ Yes
    ____ No

    If you answered no, please indicate what elements of safe medication administration are missing in the space below.

17. Are there any items on the SAM Scale that are unclear?

    ____ Yes
    ____ No

If you answered yes, please indicate which items are unclear in the space below.

18. Is each vignette realistic
    ____ Yes
    ____ No

If no, which vignette and provide an explanation in the space below.

If you would like copies of the compiled results, please contact the researcher.

APPENDIX E

CREIGHTON UNIVERSITY INTERNAL REVIEW BOARD CONSENT FORM

Study Purpose and Procedures

The purpose of this study is to examine the validity and reliability of an instrument used for assessing knowledge of safe medication administration, the Safe Administration of Medication (SAM) Scale. Specific aims are: 1) to provide data of content validity, 2) to provide data of construct validity through the use of contrasting groups and different instruments, and 3) to provide data of internal consistency reliability.

The SAM Scale measures safe medication administration and asks questions based upon five case studies. You must complete the SAM Scale in one sitting; you will not be allowed to re-access it. You will have one hour to complete the SAM Scale, at which time it will "time out." If you are a senior nursing student, you will be asked to complete a second instrument, the revised DOSPERT Scale which will be used to assess construct validity of the SAM Scale. You must complete the revised DOSPERT Scale in one sitting; you will not be allowed to re-access it. You will have an unlimited amount of time to complete the revised DOSPERT Scale.

Once all data collection has been completed, you will be emailed a link to the BlueQ website that will contain the answers to the SAM Scale. Please refrain from discussing the SAM Scale with your peers until the answers have been posted.

Risks of Participating in the Study

There are no foreseeable risks of participating in the study.

Benefits of Participating in the Study

There are no direct benefits for your participation in this study, but there may be indirect benefits to you and others. This study may help to identify an instrument that can be used to assess knowledge of safe medication administration with nursing students. This study may potentially benefit future nursing students as well as their potential patients by ensuring that nursing students are prepared to safely administer medications. In addition, if the SAM Scale proves to be valid and reliable instrument, then various teaching strategies can then be assessed that teach safe medication administration.

Disclosure of Appropriate Alternatives

You may choose not to participate in the study.

Confidentiality

No personal identification information will be collected in such a manner that it can link you to the data collected. Any information collected during this study is kept confidential. The data will be stored in a locked cabinet in the researcher's home and will only be seen by the researcher during the study and will be retained for three years after the study is complete. The information in this study may be published in journals or presented at professional meetings, but your confidentiality will always be maintained.

Compensation for Participation

There is a gift for you for participating in this study; you may choose to receive a Creighton University School of Nursing aluminum water bottle which is being sold by nursing senate for $10, or you may receive $5 in JayBucks. It is the expectation once you have completed the SAM Scale (and DOSPERT Scale if you are a senior), you will be able to print out a receipt which will demonstrate evidence of participation in the study. Then take the receipt to Jan Schnack in the School of Nursing Office of Research (office 218) and provide her with your name and CU identification number. At this point, there will be no way to link your name and CU identification number with your results. This information is only recorded for bookkeeping to ensure the participants are thanked for their time. Once your receipt of participation, name and CU identification number have been received, you will receive the aluminum water bottle or your JayBucks card will be credited with $5.

Your participation is completely voluntary. Your participation in this study will have no bearing on your grade in any of your courses.

Research Related Injury

There are no foreseeable injuries related to participation in this research study. The investigator will make every effort to prevent study-related injuries and illnesses. If you are injured or become ill while you are in the study and the illness or injury is due to your participation in this study, you will receive necessary medical care at the usual charge. The costs of this care will be charged to you or to your health insurer. No funds are available from Creighton University or Creighton University Medical Center to repay you or compensate you for a study related injury or illness. There is also no compensation available for payment of your lost wages or other losses.

By participating in this study, you will not be waiving any of your legal rights which you otherwise would have as a subject in a research study.

Disclosure Statement

The researcher has no financial relationship with the SAM Scale or its author, or with the revised DOSPERT Scale or its author.

Contact Information

You may ask any questions concerning this research and have those answered before agreeing to participate in the study as well as anytime during the study. You may call the investigator at (402) 968-1258 or (402) 280-2078. If you have questions concerning your rights as a research subject that have not been answered by the investigator or to report any concerns about the study, you may contact the Creighton University Institutional Review Board Research Compliance Hotline at (402) 280-3200.

Unforeseeable Risks

There are no unforeseeable risks to the participant with participating in this study.

Termination of Subjects Participation by Investigator

There are no anticipated circumstances under which the subject's participation may be terminated by the investigator without regard to the subject's consent.

Additional Costs to the Subject

There are no additional costs that are expected as a result of participation in this study.

Consequences of Subjects Decision to Withdraw

You are free to decide not to participate in this study or to withdraw at any time without adversely affecting your relationship with the investigator or Creighton University. Your decision will not impact your grade in the course.

Significant New Findings

It is not anticipated that significant new findings will develop during the course of the research. Results obtained from the study will not be analyzed until all data collection is complete.

You are free to refuse to participate in this research project or to withdraw your consent and discontinue participation in the project at any time without penalty or loss of benefits to which you are otherwise entitled or effect on your medical care.

Name and phone number of investigator

Kelly Gonzales, MSN
(C) 402-968-1258
(W) 402-280-2078

My participation and completion of the SAM Scale indicates that all my questions have been answered. I agree to participate in the project as described above.

If you are not satisfied with the manner in which this study is being conducted, you may report (anonymously if you so choose) any complaints to the Institutional Review Board by calling (402) 280-2126, or addressing a letter to the Institutional Review Board, Office of Human Research Protection, Creighton University, 2500 California Plaza, Omaha, NE 68178

APPENDIX F

DEMOGRAPHIC QUESTIONNAIRE

1. Are you a sophomore or a senior nursing student?

2. Have you taken the elective course IPE 410 (Patient Safety)?

APPENDIX G

REVISED DOSPERT SCALE

Domain-Specific Risk-Taking (Adult) Scale – Risk Taking

For each of the following statements, please indicate the **likelihood** that you would engage in the described activity or behavior if you were to find yourself in that situation. Provide a rating from *Extremely Unlikely* to *Extremely Likely*, using the following scale:

1	2	3	4	5	6	7
Extremely Unlikely	Moderately Unlikely	Somewhat Unlikely	Not Sure	Somewhat Likely	Moderately Likely	Extremely Likely

1. Admitting that your tastes are different from those of a friend.
2. Going camping in the wilderness.
3. Betting a day's income at the horse races.
4. Investing 10% of your annual income in a moderate growth mutual fund.
5. Drinking heavily at a social function.
6. Taking some questionable deductions on your income tax return.
7. Disagreeing with an authority figure on a major issue.
8. Betting a day's income at a high-stake poker game.
9. Having an affair with a married man/woman.
10. Passing off somebody else's work as your own.
11. Going down a ski run that is beyond your ability.
12. Investing 5% of your annual income in a very speculative stock.
13. Going whitewater rafting at high water in the spring.
14. Betting a day's income on the outcome of a sporting event
15. Engaging in unprotected sex.
16. Revealing a friend's secret to someone else.
17. Driving a car without wearing a seat belt.
18. Investing 10% of your annual income in a new business venture.
19. Taking a skydiving class.
20. Riding a motorcycle without a helmet.

21. Choosing a career that you truly enjoy over a more prestigious one.
22. Speaking your mind about an unpopular issue in a meeting at work.
23. Sunbathing without sunscreen.
24. Bungee jumping off a tall bridge.
25. Piloting a small plane.
26. Walking home alone at night in an unsafe area of town.
27. Moving to a city far away from your extended family.
28. Starting a new career in your mid-thirties.
29. Leaving your young children alone at home while running an errand.
30. Not returning a wallet you found that contains $200.

Domain-Specific Risk-Taking (Adult) Scale – Risk Perceptions

People often see some risk in situations that contain uncertainty about what the outcome or consequences will be and for which there is the possibility of negative consequences. However, riskiness is a very personal and intuitive notion, and we are interested in **your gut level assessment of how risky** each situation or behavior is.

For each of the following statements, please indicate **how risky you perceive** each situation. Provide a rating from *Not at all Risky* to *Extremely Risky*, using the following scale:

1	2	3	4	5	6	7
Not at all Risky	Slightly Risky	Somewhat Risky	Moderately Risky	Risky Risky	Very Risky	Extremely Risky

31. Admitting that your tastes are different from those of a friend.
32. Going camping in the wilderness.
33. Betting a day's income at the horse races.

34. Investing 10% of your annual income in a moderate growth mutual fund.
35. Drinking heavily at a social function.
36. Taking some questionable deductions on your income tax return.
37. Disagreeing with an authority figure on a major issue.
38. Betting a day's income at a high-stake poker game.
39. Having an affair with a married man/woman.
40. Passing off somebody else's work as your own.
41. Going down a ski run that is beyond your ability.
42. Investing 5% of your annual income in a very speculative stock.
43. Going whitewater rafting at high water in the spring.
44. Betting a day's income on the outcome of a sporting event
45. Engaging in unprotected sex.
46. Revealing a friend's secret to someone else.
47. Driving a car without wearing a seat belt.
48. Investing 10% of your annual income in a new business venture.
49. Taking a skydiving class.
50. Riding a motorcycle without a helmet.
51. Choosing a career that you truly enjoy over a more prestigious one.
52. Speaking your mind about an unpopular issue in a meeting at work.
53. Sunbathing without sunscreen.
54. Bungee jumping off a tall bridge.
55. Piloting a small plane.
56. Walking home alone at night in an unsafe area of town.
57. Moving to a city far away from your extended family.
58. Starting a new career in your mid-thirties.
59. Leaving your young children alone at home while running an errand.
60. Not returning a wallet you found that contains $200.

Source: Blais, A.R. & Weber, E. (2006). A Domain-specific Risk-taking (DOSPERT) scale for adult populations. *Judgment and Decision Making*, *1*(1), 33-47.

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