Nurses' Perceptions of the Impact of Work Systems and Technology on Patient Safety During the Medication Administration Process

A Thesis

Submitted to the Faculty

of

Drexel University

by

Mary Gallagher Gordon

in partial fulfillment of the

requirements of the degree

of

Doctor of Philosophy

August, 2012

DEDICATIONS

My inspiration for this study stems from a finite event that occurred while I was accompanying my father through his journey with cancer. Toward the end of his life, my father was the victim of a medication error that caused him to suffer in what should have been a time of peace. Despite the fact that his medication allergies were clearly and specifically listed on his chart, he was given a derivative or "cousin" of a drug to which he was allergic. At the time of the error and in the aftermath of his death shortly thereafter, I was distraught -- as a nurse I could not understand how such an error could have happened when his chart so clearly indicated that this was a prohibited drug. Ever the optimist, the words of Jimmy Valvano ran through my mind: "Don't give up, don't ever give up." Accordingly, I declined to dwell on the matter, and instead chose to pursue a path that might help fix these errors in the future. By examining the process of medication administration, and changes that could be made in order to achieve a better system, I knew my research could help people like my father. If by sharing my knowledge, I can help keep our loved ones safe when they are most vulnerable, I have done what I set out to do.

ACKNOWLEDGEMENTS

I would like to offer my deepest thanks to Susan Gasson, my chair, without whom my goals would lay fallow. Her years of guidance and selfless support helping me realize my ability to achieve my goals of attaining my PhD. I would like to send my sincere gratitude to my committee members, Prudence Dalrymple, Michelle Rogers, Susan Wiedenbeck, and Zane Wolf, for all of the help and encouragement they have given me on this journey. The consistent and tailored assistance of these faculty has been instrumental in helping me earn my PhD. Finally, I would like to thank my family for all of their behind the scenes support, both academically and emotionally. Truly, this was a team effort over the span of years, and I have such extraordinary gratitude for all who have helped me to this end. Thank you all for your time and patience. Benjamin Franklin encapsulates my journey succinctly: "little strokes fell great oaks."

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ABSTRACT

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This dissertation examines nurses' perceptions of the impacts of systems and technology utilized during the medication administration process on patient safety and the culture of medication error reporting. This exploratory research study was grounded in a model of patient safety based on Patricia Benner's Novice to Expert Skill Acquisition model, James Reason's Error Theory and the Toyota Production Systems quality management approach. Data were collected from professional nurses in the mid-Atlantic United States, through exploratory interviews, an online survey and post-survey follow-up interviews. The findings indicate that advances in the medication administration process and the use of technology have provided the potential to improve the quality of patient care while reducing errors associated with the medication administration process. Several process and work environment issues remain however. These include frequent distractions and interruptions during the process; the inability to take breaks during work-shifts, and the potentially negative impact of technology systems on the duration and flow of work. In addition, the findings indicate that nurses may still not be reporting medication errors. The main contributions of this study are to highlight the mechanisms that lead to medication errors and to demonstrate the key rationale for integrating standardized procedures with effective support for nurses at the point of care. This study provides an important point of reference, indicating how medication administration has changed since the findings of earlier studies. Changes to management policy in the area of medication administration are indicated, to make the process safer and more reliable.

CHAPTER ONE: MOTIVATION FOR RESEARCH

1.1 INTRODUCTION

There are over three million registered nurses in the United State and almost half work in the acute care setting (Shalala, 2011). In the IOM report *Keeping Patients Safe, Transforming the Work Environment of Nurses*, Page (2004) discussed how workspace design should be efficient to prevent and mitigate errors. Other studies have looked at the nurse's perception of medication errors in relation to why errors occur in various aspect of nursing care (Armutlu, Foley, Surette, Belzile, McCusker, 2008; Mayo, 2004; Osborne, Blais, & Hayes, 1999; Ulanimo, O'Leary-Kelley, & Connolly, 2007). Researchers have looked at nurses' opinions as to what will make the medication administration process safer (McBride, 2007; Cohen, Robinson, Mandrack, 2003; Cohen & Shastay, 2008). The results show that fatigue, math calculation skills, reworks and works arounds have the potential to result in errors in the medication administration process. Cohen et al. (2003) and Cohen and Shastay (2008) showed that nurses' knowledge and attitudes of medication errors has improved from the initial study in 2002 until 2008, but that there is still much room for improvement in all areas of the medication administration process. In 2008, the Robert Wood Johnson Foundation approached the Institute of Medicine (IOM) to look at the effects of the changing healthcare care climate on the nursing profession (Shalala, 2011). From this partnership the Future of Nursing: Leading Change, Advancing Health was developed. Of the eight recommendations within the report, the second recommendation to "expand the opportunities for nurses to lead and diffuse collaborative improvement efforts" (Shalala, 2011) invites the opportunity to look at the nursing and the medication administration

process, the systems involved, and how and where to improve patient care outcomes. Recommendation seven of the report, to "prepare and enable nurses to lead change to advance health" (Shalala, 2011), is critical when looking at changes in a system or process. These two recommendations consider having members of the nursing profession working collaboratively in key decision processes that impact patient cares, as well as having professionals act as change agents in the healthcare environment. One of the key messages of the Future of Nursing report (Shalala, 2011) is the notion that nurses should practice to the full extent of their education and training. The proper education of a nurse should include the ability to understand the medication administration process, the standardization of the system, and the proper reporting response when problems occur within the context of this process (Polifroni, McNulty, & Allchin, 2003). Nurses are with the patient 24/7 thus; empowering and educating the profession will improve patient safety. These nurses need to have the tools at the bedside that will allow them to give safe patient centered care. Integration of technology into the medication administration process should be seamless, allowing for safe and effective care to the patient (Cheek, 1997; Sittig et al., 2007; Koppel, Wetterneck, Telles, & Karsh, 2008).

Has the evidence of the results researchers such as Armutlu et al., Mayo, Osborne et al., and Ulanimo et al. made the transition into nursing education and practice across America? Are practicing nurses aware that taking an extra shift due to short staffing under the common mentality of "Who will help out if I don't stay" may actually be compromising patient safety? Do hospitals reassess nurses' math calculation skills yearly, as they do with OSHA fire safety, and CPR skills? A key goal of this research is to understand how and why errors occur during the high-risk process of medication

administration by professional nurses, in order to improve nursing practice, thereby enhancing patient safety.

When integrating new technology on patient floors, it is critical to involve nursing in the process, pilot the technology, observe the changes in work patterns and errors produced, evaluate the impact of the changes on workflow, and finally note any impact on patient outcomes (Berntsen, 2004; Ash, 2007; Smetzer, 2007). Many times, the floor nurse does not have much input into the tools that are utilized at the bedside. Even with the best-laid plans, the technology may not meet the needs of the facility and the nursing staff in providing excellent patient care. A second goal of this research is to find out what barriers are perceived by nurses when using systems and other technology tools for medication administration. Do errors and near misses get reported when they occur? If not, why not? What is the culture of the hospital on reporting of errors involving nursing and the medication administration process? The intent is to understand what, when and why medicine administration goes wrong, in an attempt to minimize the impact on future patients.

1.2 THE PROBLEM

The purpose of this research is to identify nurses' perceptions of the elements that contribute to medication administration errors to a hospitalized patient. Specifically, this study seeks to investigate the impact on patient safety work systems and technology utilized during the medication administration process performed by professional nurses. The result of this analysis will serve to identify necessary changes in nurses' role in the medication administration process to promote patient safety and allow nurses to practice to their full capability.

1.3 Background Information

1.3.1 Medication Errors

Medication errors can be defined in a myriad of ways, but the primary definition that will be used for this research was developed in 1982 by the American Society of Hospital Pharmacists:

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

Published research on medication errors began in the late 1960s with a primary focus on unit dose dispensing systems and medication errors (Barker & McConnell, 1962; Francis, 1980). Barker and McConnell (1962) conducted the first research looking at medication errors observing nine nurses over a two-day period. As early as 1962, the pharmacy community realized and began to acknowledge the magnitude of medication errors (Flynn, Barker, Pepper, Bates, & Mikeal, 2002). By the 1980s research of the problem of medication errors in the nursing profession was being published with increasing frequency (O'Shea, 1999; Wakefield, McLaws, Whitby, & Patton, 2010). At this time Francis (1980), a nursing professor at the Virginia Commonwealth University, began looking at medication error reporting specific to nurses who administer medications. O'Shea (1999) defined nine categories of medication errors were identified. These categories included: errors of omission, unauthorized drug errors, wrong dosage, time, route, and preparation for the medication, wrong dose form, and incorrect administration technique.

In 1995, the National Coordinating Council for Medication Error Reporting and Prevention was founded and spearheaded by the United States Pharmacopeia (USP). This organization was developed to promote education on reporting of medication errors and to understand and prevent future errors. Reporting of medication errors became front-page news with the 1995 death of a health reporter from a massive chemotherapy overdose (Altman, 1995). In 1998, MedMARX, a national hospital database system for medication errors, was launched. The system received approximately 20,000 reports a month during its first year of operation. Currently, there are approximately 775 hospitals that use the MedMARX system for error reporting. The obvious question looms: why is there is no national central repository in the United States to gather the full facts and evaluate the true scope of the errors within the healthcare system? This is a critical question that must be addressed to identify globally the issues that must be addressed at the educational level, as well as common variables across the nation.

Dr. Leape (1994), a pioneer in the patient safety initiative, posited that professional acknowledgment of areas of potential errors, in addition to the crafting of a comprehensive plan to promote safer practice at every level of medical practice, would result in an overall improvement in patient care. The landmark IOM report, *To Err is Human; Building a Safer Health System* (Kohn et al., 2000) was released and stated that there are between 44, 000 and 98,000 medical errors in the United States each year. This calculation could convert to a jumbo jet falling out of the sky each day (Wachter, 2004). The IOM looked at numerous studies involving hospital settings, long term care settings, and outpatient facility settings, and found there may be more than 1.5 million preventable errors each year (Kohn et al., 2000; National Research Council, 2001; Page et al., 2004;

Aspden et al., 2007). Until there is an infrastructure in place that acts as a central repository for all actual and potential medication errors, the real numbers and effects of patient errors will not be known (Hughes, 2008). In addition, we still do not understand the reasons for these errors or how to prevent them *systematically*. One must also look at the systems, how they work, and what factors may precipitate errors (Iedema, 2009).

As a consequence of the 1999 IOM report formal organizations were created to analyze the occurrence of errors in healthcare. Opportunities and programs exist through which healthcare organizations can voluntarily report safety outcomes to the Agency for Healthcare Research and Quality (AHRQ, Publication 11-008.20) and Leapfrog Group, which are accessible to consumers. In 1999, the American Hospital Association partnered with the Institute of Safe Medication Practices (ISMP) to provide support and promote safe medication goals for all U.S. hospitals (Smetzer, 2002).

As a result of the increased publicity of medical errors in the healthcare, the American public is more aware of the problem of errors in medicine. Despite this increased awareness, it is questionable whether the public understands that the loss of life in the medical field can be similar to an accidental plane crash, in that one system failure can cause great harm to many innocent clients (Morrissey, 2011; Wachter, 2004). Despite this similarity, an airline tragedy is something that consistently makes the headline news, whereas medical errors rarely do. According to Leape et al. (1995) a review of records indicated that over 51 days, 11,602 orders for medications were written at a large teaching hospital. This volume of medication orders leaves plenty of room for errors, which occur, yet go largely unnoticed by the public at large. What makes the significant issue of medication errors and death any less important than a tragic plane crash? To date,

death from medical errors is one of the leading causes of death in the United States. More people are dying from medical errors than breast cancer, AIDS and motor vehicle accidents combined (AHRQ Publication No. 11-008). People who are admitted to the hospital are vulnerable. Nurses are the healthcare practitioner who spends the most time interacting with, and delivering care to, the patient (Page, 2003). Looking at nurses' perceptions of the medication errors and the nursing procedures and systems for administering medications may provide an answer to improving patient safety outcomes and ensuring a better and safer service for the consumer.

1.4 Rationale for Research

1.4.1 The Process of Medication Administration

Research has shown that the process from when a medication is ordered to the time it is administered to the patient can have between 50 to 100 steps to complete (Hughes & Belgen, 2008). At any point in the process, medication errors may occur. These errors usually result from a combination of human and system issues (Keohane et al., 2008). In the IOM report *Preventing Medication Errors: Quality Chasm Series* (Aspden, 2007), m*e*dication errors are the errors most often identified in hospitals. These errors can occur as a result of the technology, design process, or the task utilized for the medication administration (Keohane & Bates, 2008, Koppel et al., 2008).

Nurses have standardized the process of the administration of the medication utilizing the "rights of medication administration process". These rights consist of basic principles that include the nurse's individual performance of the *right* patient, *right* medication, *right* route, *right* dose, *right* time, *right* implementation and *right* documentation (Cook, 1999; Cohen, 1999; Davidhizar & Lonser, 2003; Eisenhauer, Hurley, & Dolan, 2007;

Nguyen, Connolly, & Wong, 2009; Ulanimo et al., 2007,). These rights are indoctrinated into the student nursing mindset from the beginning of the nursing education (Cook, 1999). The complexity and high risk of the medication process is such that there is a need to standardize the medication administration process to preclude the most frequent sources of errors. This has resulted in the use of as mental checklist, known as the rights of medication administration (Hughes & Belgen, 2008). By utilizing these rights during the medication administration process should minimize the error by the nurse.

Errors and workarounds secondary to systems involved in the nursing process have additional unknowns that can contribute to medication administration errors, including the environmental factors, the patient to staff ratio, and interruptions that commonly occur during the medication administration process. Nurses working in the acute care setting deal with many changing variables due to the human nature of the clients. An important inquiry is whether nurses understand and implement the concept of the 'sterile cockpit' during the medication administration process (Pape, 2003)? This concept (Nance, 2008) was developed as an FAA safety rule for pilots, barring anyone from interrupting the cockpit with non-essential activities during certain periods of flight. Nurses have always been visible on the floor to other professionals, patients, families and staff, and therefore are often subject to interruptions while performing professional duties. The sterile cockpit concept can be applied to nurses when they are performing critical skills where interruptions may increase the risk of a breach in patient safety (Pape, 2003). Due to improvements in technology and the higher acuity of patients, nurses administer an increasing amount of medications to clients over time. Yet *Miller's Law* posits that the human brain can only actively focus on seven divergent pieces of

information at any given time (Miller, 1956). This is relevant to the nursing profession, as nurses may have seven patients at one time, each may have seven critical issues.

Despite the fact that nurses may think they have perfected the art of multitasking, studies have shown that multitasking has increased the rate of errors (Eisenhauer et al., 2007). A nurse's full plate of responsibilities coupled with consistent interruptions increases the chance of errors and therefore puts patient safety at risk (Nguyen et al., 2010; Pape, 2003; Pape et al., 2005; Trbovich, 2010; Zhan, Hicks, Blanchette, Keyes, & Cousins, 2006).

1.4.2 The Role of Technology in Nursing Practice

Technology utilized with the medication administration process varies with individual hospital facilities. Thus, the tools and environment tied to the process of administering medications will change within the context of each hospital. Traditionally, orders for medications were handwritten in a patient's chart, transcribed by the nurse or the unit secretary and sent to the pharmacy to be filled. The medications were then brought by the pharmacy to the floor and placed in individual patient medication drawers. The nurse would then pull a patient's medications from medication drawers, place these in a small medication cup, and then place them on a tray. Each patient would have a medication card and the medication cup would be placed on top of the medication card. Once the medications for all of the patients for that hour were poured the nurse would go from patient to patient to administer medications.

Over time the medication administration process has evolved and improved. Handwritten medication orders on the patient's paper chart were difficult to translate so frequently the order could not be understood. Hospital facilities have begun the transition

to an electronic format of ordering medications, entering patient data and retrieving diagnostic results. This allows for a seamless flow of patient information and promotes better patient outcomes. Studies have shown that utilizing an electronic system called a computerized physician order entry (CPOE) decrease errors by 55% (Bates, Leape, & Cullen, 1998; Wolfstadt et al., 2008). CPOE systems ensure that the orders for medications, lab tests, and consultations are legible. CPOE maybe linked with decision support software and if utilized correctly by the ordering provider should improve patient outcomes (Ash, Sittig, Poon, Guappone, Campbell, & Dykstra, 2007; Sittig et al., 2007). Having the ability to validate information such as drug interactions and dosage and laboratory value considerations are critical to the medication administration process (Sittig et al., 2007). A laboratory value consideration (described above) is important with medications that have a small therapeutic range (a blood value level to show if there is too much medication in the body to become toxic or not enough to be therapeutic) such as Digoxin or Coumadin. In addition to the "rights" of medication administration, change in the process must include mandating client weight, allergies, and date of birth is included in the documentation. These critical criteria should not have the ability to be overridden by the CPOE system (Smetzer, 2007).

In addition to CPOE, which can help in minimizing order entry errors, utilizing a bar-coding medication systems (BCMA), may reduce medication administration errors (Sittig et al., 2007; Tang, Sheu, Yu, Wei, & Chen, 2007). BCMA is commonly used alongside an electronic medication administration system. This type of process allows nurses to document the medication via the scanning equipment and electronic documentation at the point of care (Poon et al., 2010). The system allows a nurse to scan the medication's bar

code, the patient's identification band, in order to verify that the medication is given to the correct patient at the correct time. Therefore, the nurse can follow the rights of the medication process.

Many of these tools for the medication administration process require orientation and training in the use of the devices and the processes for reporting results (Bobo, 2002). By the very nature of change, new technology and improvements in current technology lends itself to the potential for errors by a healthcare professional (Koppel et al., 2008; Patterson, Cook, & Render, 2002). Often, many of the errors in the process are the result of a system failure (Leape et al., 1995). With respect to system failures, the following question flows naturally: what are the roles of the safety systems that have been put into place during the medication administration process? Each introduction of new technology creates the potential for rework (Patterson, Rogers, & Render, 2004). Rework of the process of administering medications may cause the nurse to deviate from the standards of care in order to get the job done with the tools at hand known as workarounds. It is imperative that nurses are instructed as to what constitutes a medication error with every new advance in technology and administration. Workarounds and their impact on patient safety must be discussed as new technologies and systems are implemented (Carayon et al., 2007). As more and more technology is added to the daily interactions of the nurse, the role of that technology in medication errors must be considered.

1.4.3 The Impact of a Safety Culture

Reason (1997) defined a culture of safety as one where the organization is informed, just, flexible, willing to learn, willing to change, and willing to improve. The nursing profession may utilize a human systems approach to analyze the present system and

anticipate the potential errors that may occur with the medication administration process (Vincent, Taylor-Adams, & Stanhope, 1998). Additionally, the culture of the healthcare environment must be evaluated, with an eye toward the safety implications of each activity completed within the entire medical system. The environment must also be evaluated for its openness and willingness to accept the changes that need to occur and should strive to incorporate safety in all practices and procedures (Hudson, 2003). However, this change will not be quick or easy. By way of example, the airline industry took over a decade to implement this kind of large-scale change in culture (Nance, 2008). In a culture of patient safety, people must be held accountable for their actions. In order for this accountability to prove fruitful, the culture must be changed from one of *shame and blame* upon making a mistake, to one of *identifying the root cause of a problem* in order to prevent repeat errors (Reason, 1997). A root cause analysis allows people to learn from their mistakes and make improvements in the process. A particularly thorny issue in the medical profession is a prevalent mindset of infallibility plaguing this particular community (Reason, 1997). Because of this perception of infallibility, clinicians often find difficulty identifying the real cause of an error. Root cause analysis attempts to answer three questions; what happened, how did it happen and how can it be prevented in the future. This has become a standard of practice in healthcare to eliminate latent errors (Pham, 2010).

The *Toyota Production System* (TPS) utilizes the process of asking “Why” five times to assist in a root cause analysis of problems with business processes. By the fifth time, the team can usually drill down to a focused problem (Onio, 1988). Additionally, the negativity that is attached to healthcare errors may prevent the error from being reported.

"The task of outlining what acting safely, being safe and feeling safe consists of weighs heavily on patient safety research" (Iedema, Flabouris, Grant, & Jorm, 2006). Historically, healthcare has been reactive in reporting errors and following up a problem (Hudson, 2003). If the hospital has developed a culture of safety, all participants within the system are attuned to potential threats or issues that may impact patient safety (Flanders & Clark, 2010). However, attentiveness to patient safety depends on the culture of the individual hospital; and in many hospitals, errors are not reported due to the perceived punitive effect on the nurse involved with the error. Nurses fear it will negatively affect evaluations of job performance, and therefore do not always report the errors (Lehmann, 2007). A weighty example is the recent suicide of a RN in Seattle: a 10-fold medication error lead to the death of an eight-month-old baby, the dismissal of the nurse from the hospital, and her subsequent suicide (Aleccia, 2011).

In order to increase patient safety, all hospitals need to shift toward a culture of non-punitive behavior. This will foster an atmosphere encouraging root cause analysis, allowing practitioners to evaluate the error without fear of retribution. A root cause analysis allows a practitioner to determine what happened; why the error happened; and what steps can be taken to prevent the error from happening again (Bagian, 2002). For example, the Virginia Mason Medical Center (VMMC) hospital integrated the Toyota Safety Production system to improve patient safety. The Toyota Safety Production system included the implementation of Patient Safety Alerts (PSA) into the culture of the hospital. In 2004 at VMMC, a patient died after a preventable, devastating error during a procedure. Although the PSA system did not save the patient, the hospital was transparent about what happened, and what changes were going to be made to ensure that

the error did not happen again in the future. No one was fired, and the hospital used the event as a catalyst to continue to promote the patient safety agenda. Ironically, this same situation had occurred in the months before this situation, but it was not shared with the public and used as a teachable moment so it would not happen to other patients in the future (Kenney, 2011).

The healthcare system is complex, with human performance factors and system interactions at all levels. Errors are most commonly detected and corrected in the prescribing and preparing stages of the medication, thanks to system checks already in place (Dowdell, 2004). Errors that occur later in the medication administration process often go undetected; this is the portion of the process where nurses are the last stop before the administration of the medication. Near misses often go unreported, and accordingly, nurses are unable to perform a system check, thereby precluding a possible teaching moment or improvement in process (Gonzales, 2010). There is a lack of information regarding nurses' perception on the impact of technology and the use of technology during the medication administration process. The following questions have remained unanswered: what is the impact of patient safety without consistent reports of errors and near misses? How are nurses educated on the importance of reporting near misses and medication errors? Would improvements in the systems and technologies occur if near misses were reported? These are omissions that must be remedied in order to improve patient safety.

1.5 Significance of the Study

Nursing is a profession that looks at the response of the individual and family on the actual or potential patient health problems. Nurses are educated to look at the whole

person, building upon their education to care for the individual to help them return and reach their full potential (ANA, 2003). This research will fill a gap in the information available regarding the medication administration process by collecting information from nurses currently working at the point of care. To date, there have been studies considering the technology used in medication administration process, but minimal data have been collected on the nurse's perception of the systems and technologies that may lead to errors. Looking at the additional layer of technologies utilized in the medication administration process will further contribute to the research body of knowledge with the intent of improving patient outcomes.

1.6 Research Questions and Methods

The literature discussed in chapter two of this proposal illustrates how the process to manage and administer medications in hospital settings has evolved since the iconic and influential 1999 IOM report. As improvements are made in the nursing portion of the medicine administration process, new questions and errors arise. This dissertation study will examine three research questions:

Research Question 1: How do nurses perceive the factors that contribute to medication errors originating during the medication administration process?

This question examines the processes and standards of practice. It aims to evaluate the perceptions nurses have regarding the variables that occur with the medication administration process and how do these variables contribute to errors. Sociotechnical theory recognizes that humans and the environment are interwoven in a complex environment (Reason, 1997).

Research Question 2: How can interactions between nurses and technology be improved to support the medication administration process?

This question addresses nurses' perceptions of safety with the systems and technologies utilized during medication administration. Due to the complexity of the healthcare system, the complex tools of the trade, and the significant involvement of humans with technology, there will always be errors in the system. These errors can hinge on many factors, including the complexity of human beings in the system, the illness of the person, and the immense array of technology available to assist in the diagnosis, assessment and evaluation of the medical process. However, we need to understand how to minimize these errors by observing the workflow and technology utilization as well as verification of consistent error reporting.

Research Question 3: How does the hospital culture affect the reporting of medication administration errors and what types of errors are not reported?

Understanding the reason why medication errors continue to occur during the nurses' administration and the gaps in the existing research about standardization of the process defines the focus for this dissertation topic. The intent of this research is to increase nurses' knowledge of what constitutes a medication error and when a medication error should be reported.

1.7 METHOD OVERVIEW

The research is designed in three parts:

1. An interview-based exploratory study based on issues of concern from the literature, designed to investigate the issues and concerns of nurses with respect to the use of various systems for medication administration.

2. A qualitative survey, based on issues raised by the literature and findings from the exploratory study.
3. Post survey interviews to explore issues raised by the survey in greater depth.

Findings from both interviews and the survey will contribute to our knowledge of why current systems and standards still have a role to play in the causes of medication errors.

1.8 Limitations

Due to the non-random sampling of the population for this study, the results may not be generalizable to the nursing profession as a whole. Some of the data were collected via interviews, and the information shared by interview subjects was limited by their willingness to talk openly about a very sensitive topic.

1.9 Summary

The motivation for this research is a desire to evaluate the administration of medication by nurses in order to improve patient outcomes. In addition to the medication administration process, the second objective is to determine the impact of the systems utilized on patient safety.

This study is intended to provide insight into one portion of the medication process: how nurses perceive medication errors, how technology affects the potential for errors during medication administration and the effect of the reporting culture. The expected findings will help in the development of future policies related to the medication administration process and to patient safety.

1.10 Overview of the Proposal Structure

The balance of this dissertation is divided up into five chapters. Chapter two presents a comprehensive literature review of medication administration process, the technology

utilized, and causes of errors related to this study. Chapter three outlines the methodology, participants, and design selection. Chapter four presents the research findings. Chapter five summarizes and discusses key findings from the study, its limitations and contribution to nursing practice, policy, and future research.

CHAPTER TWO: REVIEW OF LITERATURE

2.1 INTRODUCTION

Human fallibility is an unchanging constant. Medication errors can occur in many different situations and environments. For example, in the home, an individual with the common cold may take a combination cold medication, which may have acetaminophen as an ingredient. The person may also have a headache and take some other drug containing acetaminophen for a headache. Over the course of the cold, the person will have ingested high levels of acetaminophen and could be admitted to the hospital for "belly" pain resulting from an enlarged liver due to the toxic effects of a mild overdose of acetaminophen. This common medication error results in self-harming consequences that are unintended, yet prevalent (Nourjah, Rizwanuddin, Karwoski, & Willy, 2005).

In the hospital, human fallibility is also an issue as medication errors can occur for a variety of reasons. Possible errors include administration of the wrong medication, administration of medication to the wrong patient, administration of medication at the wrong time, administration through the wrong route, administration of medication for the wrong reason, or administration of the wrong dose. The complexity of working in an ever-changing healthcare environment where human interaction and communication are common components of care lends itself to the potential for error (Leonard, Graham, & Bonacum, 2004). The acuity of the patient population, the patient staff ratio and continual shift in patient medical needs lends the environment to be one prone to medical errors. The process of administering medications has been identified as a major source of errors and a high-risk activity (Dain, 2002; Flynn et al., 2002; Jones, 2010). Systems have been developed and implemented to promote safety throughout the administration of

medications yet there are areas where errors can occur. Research regarding the nurses' perceptions of the systems utilized with the medication administration process and the effect on patient safety needs additional research as errors continue to occur.

The 1999 IOM report, *To Err is Human*, states that "one out of every 854 inpatient deaths were medication related" (Kohn et al., 2000). According to Mahoney et al. (2007), over 7,000 deaths a year are related to medication errors, with an estimated $3.5 billion in hospital costs to remedy those errors alone. Medication errors are second in frequency of all medical errors, and these medication errors can have a tremendously negative effect on patient safety (Leape et al., 1995). Bates (1995) deduced that for each reported medication error that caused harm to a patient, an estimated one hundred undetected errors occurred that did not cause harm. Nurses must avoid actions that negatively affect patient safety outcomes, such as overriding alerts and workarounds of systems and policies (Cohen, H. 2007). Maintaining patient safety during patient care is of paramount importance. Reports from the Institute of Medicine (Aspden et al., 2004; Aspden, 2006; Kohn et al., 2000;) indicate that hospital medication administration errors sometimes occur for preventable reasons, but these reasons are not fully understood (Hughes & Belgen, 2008). Technology, standardization, the development of a culture of safety, and increased education of both the healthcare profession and consumer will greatly impact improving outcomes. The works of Patricia Benner (1984) and the stages of skill acquisition from novice to expert, James Reason's error theory (1990) and the Toyota Production System (Liker, 2004) will be used as the foundation for the model of patient safety.

2.2 Factors Affecting Nurses' Ability To Administer Medications Safely

Patient safety is a critical component of the medication administration process. Administering medications to patients is an ongoing process in a dynamic environment where change in patient status is a constant. With these changes comes the continual shift of cognitive load for the nurse. Within the process, the four variables have been identified are the nursing factors, environmental or extraneous issues, the systems and technologies utilized with the process and a culture of safety with accurate reporting of all potential and actual medication errors. In the model below, the process is embedded in the research of Patricia Benner (Benner, 1982; Benner, 1984; Benner, Tanner, & Chesla, 1992; Benner, Tanner, & Chesla, 2009) and her stages of skill acquisition from novice to expert; James Reason's Swiss Cheese Model of Defense (1995) looking at the mental checklists of the rights of medication administration and how to prevent latent errors from adversely affecting patient safety and utilization of the Toyota Production System (TPS) (Liker, 2004) to standardize the process preventing errors.

Nursing factors include all areas of the medication administration process that involve the nurses. This would include the nurse advancing from a novice to expert utilizing Benner's (1984) stages of clinical competence. It would include education about improvement in the process related to error reporting and standard work. The environmental/extraneous issues are related to the nurse administering medications. This would include both the physical design of the unit, location of the supplies and medications, and the patient care threading TPS throughout the process. In the medication administration process and systems, Benner (1984), Reason (1995) and the TPS (Liker, 2004) theories should be integrated to allow for a reliable, seamless process to provide

the safest care to the patient. If the nurse is educated about the culture of safety, error reporting will increase to promote patient safety, critical thinking skills will be honed as the nurse moves through the stages of clinical competency and standardization of the process will be maintained to continue to prevent defects in the process.

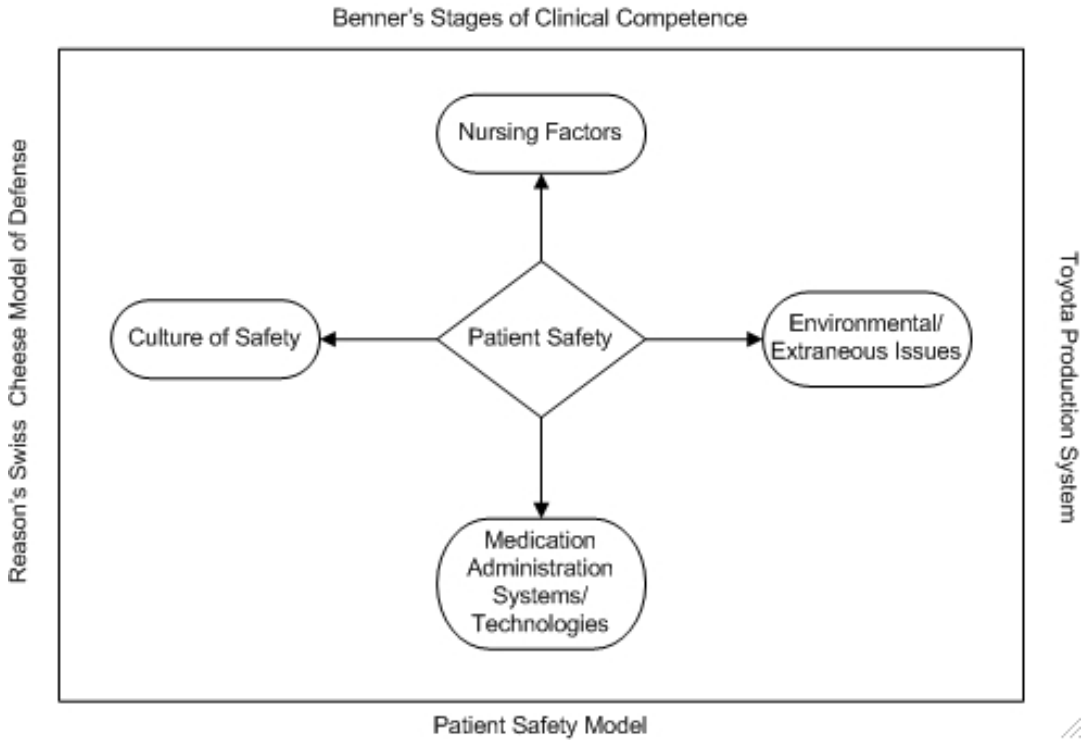

Figure 2.1: Model of Patient Safety – Causes of Error and Mechanisms To Prevent Errors In Medication Administration

2.2.1 Benner's Stages of Clinical Competence

Patricia Benner, a prominent nurse educator has spent many years researching nurses' skill and knowledge acquisition as the nurse transitions from a novice to expert clinician. Her premise is that with a sound education and rich clinical experiences, a nurse develops expert patient care skills over time. The nurses needs to learn more than "knowing how" to do the skill with "knowing that" knowledge gained working on clinical care (Benner, 1984). This model can be applied to the nurse administering medications and the skills

and attributes developed over time. Benner describes how a nurse moves thorough the five levels of stage development to become an expert in the nursing profession. In the first stage, novice, the nurse has no experience and is taught using rules to assist with task performance. The nurse is mentored and is essentially undergoing an orientation during this novice time frame. To the nurse, the rules are context free, independent of specific cases, and applied universally to the situation. Such rule-governed behavior of the novice is limited in scope and is inflexible. Novice nurses are nurses who do not have practical experience to fall back on, and therefore need to be told what to in order perform the skills of the profession (Benner, 1984; Benner et al., 1992).

In the second stage, the advanced beginner, the nurse begins to demonstrate acceptable performance. This improved performance is the result of experience garnered from actual patient experience. At this point, the nurse can begin to recognize recurring and meaningful components. This development requires meaningful exposure and mentoring before recognition of these components occurs. The principles of nursing, which are based on these clinical nursing experiences, begin to develop and allow the nurse to guide her professional actions (Benner, 1984).

Entering the third stage, the nurse gains more experience over two to three years on the job in the same clinical area, or in similar day-to-day situations, resulting in the development of professional competency. This would also be evident during the medication administration process. During this stage, the nurse develops long-term professional goals. A nurse at a competent stage is still developing speed and flexibility in daily activities identifying important aspects of a situation, and can independently cope and manage in clinical nursing (Benner, 1984).

The fourth stage encompasses a nurse who has developed a proficiency in perceiving and understanding a situation as a whole, rather than as a chain of individual events. This ability to see the whole picture is secondary to a nurse's understanding of the meaning of long-term goals. This viewpoint allows for improved decision-making and allows the nurse to learn from experiences, specifically, predicting what will occur in a situation, and the best response. The proficient nurse uses maxims as guides. A maxim reflects the specific gradations of the nurse's experience, and allows the proficient nurse to make reflective decisions in a particular situation (Benner, 1984).

The last stage presents an expert nurse who no longer relies on principles, rules or guidelines to connect a situation with a specific action. The expert nurse has ample clinical exposure and has developed an intuitive grasp of many and varied clinical situations. This intuition gives them the ability to be efficient, flexible and highly proficient. The ability to use analytical problem solving allows the expert to reassess a situation when the outcome was not as anticipated. The expert nurse has an advanced and developed situational awareness of their environment (Benner, 1984).

A nurse who is administering medications could be at any one of these stages. Ideally, the nurses at the beginning level have a mentor guide them through this high-risk process. As nurses move through these stages, from novice to expert, they are confronted with many clinical situations, allowing them to develop situational awareness of the process. Situational awareness is the ability to perceive what is going on in a finite circumstance, and includes perception of time and space leading to an understanding the situation and a subsequent ability to extrapolate these perceptions into the future (McIlvaine, 2007). When giving medications, the nurse relies on intuition with the process. In administering

medication, the nurse relies on situated experience or “intuition.” This tacit skill is developed over years of experience, education, and immersion in clinical care. The clinical experiences of the nurse are situational and based on experience with acquired skill development.

Benner’s theory states that the nurse moves from a novice to an expert as they work and are immersed in the nursing profession. This concept would flow into the medication administration process where the nurse who is a novice may be more at risk to have medication errors as they are practicing using medication guidelines that are seen as inflexible and limited to this novice. For example, the novice nurse may miss subtle changes in their patients that an expert nurse may hold giving a medication and alert the practitioner (Benner, Sheets, Uris, Malloch, Schwed, & Jamison, 2002). This research will look at the years of experience, the educational level and reporting of errors related to the medication administration process.

2.3 Promoting a Culture of Safety

2.3.1 Reason’s Error Model

James Reason’s system approach assumes that where humans are involved, errors will occur. Work processes and systems can be analyzed using Reason’s “Swiss Cheese” Model of Defenses. In this theory, each slice of cheese represents a stage of the work-process. The holes in each slice of cheese represent imperfections in individual safeguards or defenses against error. These holes are dynamic and unpredictable. As processes unfold, holes in defenses may line up, which allows an error to be propagated across stages (Reason, 1990).

Reason defines errors as active or latent. Active failures occur in situations where the actions of the individual have a direct and often immediate impact on outcomes. Active failures are also called a “sharp end of the system” error, meaning that they occur on the front line of human-to-human or human-to-system interaction. Active failures are commonly a consequence of a complex system interaction, such as when an individual overrides a system error-message or develops a workarounds for a standardized process (Reason, 1990).

A latent error or condition (Reason, 1995; Helmreich, Merritt, & Wilhelm, 1999) usually stems from an individual action or technology that causes an error that remains undetected through subsequent stages of work. These errors may lie dormant in a system for an extended period of time without apparent failure. But when these coincide with a break in the system defenses, the latent error is translated into an active failure (Reason, 1997). In medication administration, latent errors may not cause a problem in and of themselves, but when combined with distractions, lack of drug knowledge, poorly designed technology, or overworked conditions, an active error can be triggered (Hughes & Belgen, 2008). For example, consider a nurse dealing with a patient who is equipped with a cardiac apnea monitor, a device that monitors the patient’s vital signs. This type of alarm should never be put on silent because if an emergency situation arises, the nurse may leave the bedside before resetting the alarm, meaning that future alarm-states are missed. The organization must anticipate errors where humans are involved. We need to design technology systems with adaptive error checking, to prevent latent errors from being propagated (Zirkle & Robinson, 2004). This is more effective than a shame and blame culture. In this type of culture, errors and near misses will not be reported and the

opportunity to learn from these situations will be missed if the nurse fears retribution. Systems cannot be improved and processes cannot change under a negative organizational culture (Reason, 2005).

This research will look at the medication administration process through the lens of how latent and active errors occur. It will also examine the role of technology systems in propagating latent errors across process stages or preventing such errors from becoming active. An important mechanism for detecting and proactively seeking out latent errors is provided by the Toyota Production System approach to total quality management.

2.3.2 Toyota Production System

Developed after World War II by Taiichi Ohno, Toyota developed mechanisms for effective monitoring of manufacturing systems in post-war Japan. It focused on a total quality management approach, where workers and managers at all levels and stages of the manufacturing process collaborated to eliminate mistakes and minimize waste. Toyota's vision emphasizes that nothing is perfect and that continual evaluation is required in order to detect latent errors in the process (Liker, 2004). The Toyota Production System (TPS) process is rooted in the 5S principles: Sorting (everything has a place), Simplify (only have what is needed to complete the job), Sweep (habitually review work areas for improvement), Standardize (everything in a place, the process is standardized around best practices) and Self-discipline (everyone agrees to follow the standardized process) (Ohno, 1988). The key to these ideas is that standardization produces a work environment that is organized to minimize errors. The medication administration process and the physical layout of medication storage and supplies would both benefit from standardization. Nurses do not have to waste their energy working out where things are or

what to do next. This provides the conditions for self-awareness (known as “Hansei” or self-reflection in the TPS– an important error-detection mechanism).

In early 2000, the Virginia Mason Medical Center (VMMC) applied these principles to medication administration. VMMC observed the entire medication administration process, from beginning to end, and reviewed hospital records to determine the causes of medication errors. The end result was that the medication room was standardized, visual signs were posted to promote quiet in the medication room, and a dedicated hour for administering medications was established. These changes led to a huge reduction in the number of medication errors (Kenney, 2011).

2.3.3 Patient Safety Model

Returning to the integrated view of Figure of 2.1, it can be seen that all three of these theories combine to provide the conditions for error prevention and detection at the point of care. Benner’s (1984) theory links the capacity for error detection to education and clinical experience. Reason’s (1995) theory of latent errors argues that errors are propagated when process and technology systems do not promote self-awareness. The TPS (Liker, 2004) emphasis on standardization provides a means to error prevention and the conditions for self-awareness. Taken together, these three theories explain how to provide a culture of safety in medication administration.

2.4 The Medication Administration Process

The process of administering medication and keeping patients safe is a multidisciplinary process (Ulanimo, 2007). The key participants in the medication process include the ordering provider, the pharmacist, the nurse, and the patient. This multidisciplinary approach is unique and must be performed seamlessly to ensure

positive patient safety outcomes. Stages in the process of medication administration include the ordering of the medication, the transcribing and verification of the medication, the delivery of the medication to the floor, and the administration and evaluation of the effects of the medication on the patient (Aspden, 2007; Davidhizar & Lonser, 2003). In order to develop an understanding of the nurse and the medication administration process, an overview of the steps from the provider ordering the medication until the medication is administered to the patient will be discussed.

Leape (1995) found failures in four areas of medication administration and that nurses found over 80% of the medication errors. The three stages most error prone appear to be the physician ordering stage, transcribing of the orders, and the nurse administration stage (Aspden, 2007; Nguyen et al., 2009; Partin, 2006). Factors that contribute to potential medication errors by nurses include incomplete information, multiple medications prescribed to individual patients and various “hand offs” of patient information within the hospital (Donahue, Brown, & Fitzpartrick, 2009). In the nurse administration stage, administration of the wrong drug was the most common error (Tang et al., 2007; Zhan et al., 2006). Other examples of nurse administration errors include administration at the wrong time, administration of the wrong dose, missed doses, and administration of extra doses (Tang et al., 2007; Zhan et al., 2006).

The first step of administering medications is prescribing: the act of ordering the medication for the patient. At this initial step in the medication process, an error could arise by the prescribing the wrong medication, the wrong route, or omission of medication or dose information (Cohen, 2007; Hicks, Cousin, & Williams, 2004). Lack of patient information (such as weight and drug allergies), or lack of knowledge of the

medication being ordered are problems in the prescription step (Wolf, 1989). Other problems occur when the provider uses unacceptable abbreviations that potentiate errors. This occurs commonly with handwritten orders, where, for example, “unit” is written as U or u. Unit 4 could be written as 4U or 4u, which has been mistaken in the past for 44 or 40. This kind of mistake could clearly lead to a medication error. The current best practice is to write out the word “unit” and refrain from using the “U” abbreviation (Joint Commission, 2004)

Once the order is written, the second step in the medication administration process is the transcription of the order (Cohen, 2007; Davidhizar & Lonser, 2003). If the order is handwritten, it must be transcribed. Once transcribed, it is sent to the pharmacy to be filled. Errors may arise in reading the handwriting of the provider incorrectly. The transcriber may be the nurse, the unit secretary or the pharmacist filling the order. In this manual stage, there is a potential for human error transcribing the medication over to the pharmacy order sheet (Kelly, 1995). Orders may also be missed, which leads to an omission of that order. If the health system is using a computerized ordering system, many errors could be avoided as the medication order is transmitted to the pharmacy automatically, where the order is checked against allergies and drug-to-drug interactions. After verification, the medication order is then filled and sent to the floor (Keohane et al., 2008).

The pharmacy process of dispensing the medication is the third step. According to the American Society of Health-System Pharmacists (ASHP, 1993), a hospital pharmacy should be open 24 hours a day to allow for continuous medication supply as demands come in. If there is not a 24 hour pharmacy, pharmacists must be on call. Accuracy,

system interaction and timeliness in getting medication to the floor are areas that must be evaluated in this step of the process (Skibinski et al., 2007). Lack of standardization in the pharmacy process, drug delivery, drug stocking and design deficiencies are the most error prone areas (Leape, Epstein, & Hame, 2002). The most critical aspects of these issues include identification of similar packaging labels and double-checking when look-alike drugs are ordered to avoid error in this portion of the process (Wolf, 1989). In the pharmacy, if bar coding technology is available, the medication order is scanned against the patient's medical record to ensure that the correct medication has been ordered for the diagnosis, that the correct dose has been ordered based on the patient's weight, that the drug will not run afoul of any known patient allergies, and that the drug works within the context of any critical lab values that may be important with the medication to be administered (ASHP, 1993). In some hospital settings, the inclusion of pharmacy personnel on patient rounds is expected (Ibrahim, Bahgat-Ibrahim, & Reeves, 2010). Some pharmacy programs now include a clinical component to allow students to understand the concepts of patient 'rounds' and the sharing and transfer of information to improve patient outcomes (Ibrahim et al., 2010).

The fourth step is administration of the medication by a nurse. This step constitutes 59% of medication errors (Nguyen et al., 2009). When administering medicine, the nurse must follow the "rights of medication administration" for each patient. These rights are taught to nurses in undergraduate programs and include the right patient, route, time, dose, and drug. The rights of medication administration prevent latent errors (Reason, 1995) by providing a mental checklist that evaluates the outputs from stages 1 to 3 of the process shown in Figure 2.2 leading up to stage 4 of the medication administration

process. These rights have expanded from just five jumping to eight rights of the medication process steps. These "rights" focus on the individual's behavior during the process, but fail to consider system variables that contribute to errors (Cohen, 2007). These eight "rights" of medication administration are:

(1) the medicine is administered to the *right patient*;

(2) the patient is administered the *right medication*;

(3) the medication is administered in the *right dose*;

(4) the medication is administered through the *right route*;

(5) the medication is administered at the *right time*;

(6) the medication is administered for the *right reason*;

(7) the medication is administered after a *right assessment*; and

(8) the nurse completes the *right documentation*.

Even when a nurse correctly follows these rights, errors still occur (Cohen, 2007). Due to the lack of effective safeguards at this step in the medication administration process, there are innumerable ways an error can occur. Common errors include the administration of the wrong medication, administration to the wrong patient, administration of the wrong dose, administration through the wrong route, or administration at the wrong time (Davidhizar & Lonser, 2003; Eisenhauer et al., 2007). In the administration of the medication, studies have shown that interruptions, distractions, fatigue, lack of nurses working on the unit, inadequate equipment, environmental factors, and workplace designs can alter a positive outcome for patient safety (Hinshaw, 2008; Nguyen et al., 2009; Pape et al., 2005; Trbovich, 2010; Zhan et al., 2006). Hicks et al. (2004) found that the MedMARX reported error of wrong medication administration

technique was most often associated with patient injury. Nursing is the last safeguard in the medication administration process. According to Leape (1995), nurses intercept approximately 85% of the potential errors from other practitioners who are involved in the patient care. Despite this relatively high interception rate, there are still safeguards that can be implemented to ensure that even fewer errors result in unfavorable patient outcomes.

In the fifth and final step, implementation and documentation, the most common error is that the nurse may not return to evaluate if the medication was effective. In the implementation and documentation stage, the nurse must verify and document the effectiveness of the medication, verify side effects of the medication, document the date, time, and dose, and any critical lab values or parameters that are critical to the medication and the patients (Keohane et al., 2008). The concept of "failure to rescue" is critical in the medication administration process (Aiken, Clarke, Sloane, & Sochalski, 2002). According to Aiken et al. (2002), failure to rescue occurs when a nurse was not able to prevent an adverse event that negatively affects a patient. Failing to return to a patient's room and failure to properly assess the effects of the medication may lead to patient compromise or a failure to rescue situation. In the fifth step of the medication administration process, if the workload fatigue, educational knowledge are compromised, errors may occur (Hinshaw, 2008). In steps four and five, the nurse must make key decisions diligently in order to be effective in the medication administration process and promote patient safety.

Figure 2.2 summarizes the literature to date with respect to errors in the medication administration process. It is clear that the majority of nursing errors occur at the

medication administration stage. This puts the nurse at the sharp end of the process (Flanders & Clark, 2010; Hughes & Belgen, 2008). However, the nurse can act as a source of error-correction, if the process and technology provide support. One means of support would require standardization of the complex process of administering medications.

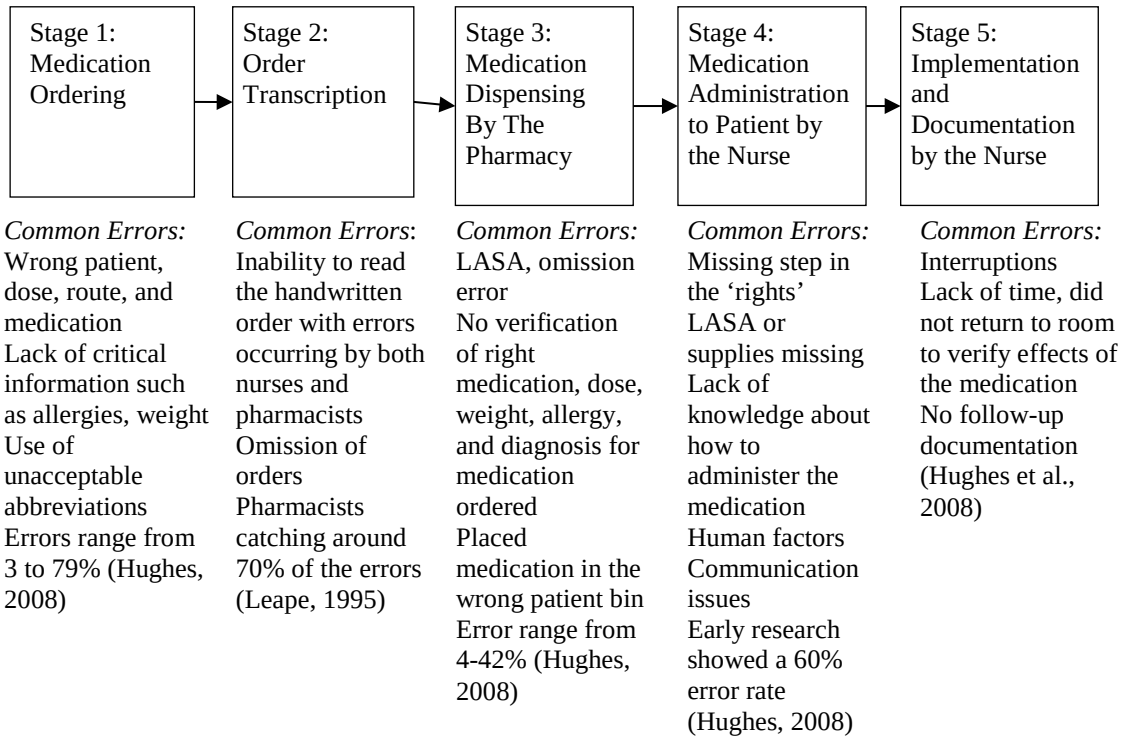

Figure 2.2: Sources of Error In The Medication Administration Process

The administration process needs to be setup to decrease medication interruptions, medications being ordered during the change of shift and increase the availability of supplies where they are needed to allow nurses complete the setup without a shift in focus, in addition to fostering systems that allow for quick and thorough access of

information at the point of care (Bates, 1999; Beyea, 2007; Hinshaw, 2008; Hughes & Belgen, 2008; Leape et al., 2002; Pape, 2003; Wolf, 1989). This standardization process must thread from the undergraduate nursing education seamlessly into the practice of nursing to promote patient safety.

The need for standardization has led to the increasing use of checklists for process quality in recent years (Davidoff, 2007). The checklist is a tool used by other disciples, such as aviation and production companies to decrease errors and improve performance (Hale, 2006). The use of simple checklists provides a visual reminder of the proper process (Kenney, 2011; Davidoff, 2007; Hales & Pronovost, 2006). In the medication administration process, a checklist may act as a visual display to assist with cognitive function during this high-risk activity (Hale, 2006). Checklists are entering the nursing field in areas like mechanical ventilation bundles and central line bundles (Berenholtz et al., 2004). These best practices have been developed to improve patient outcomes with invasive yet necessary procedures (Costello et al., 2008). Still, research is lacking in regards to nursing checklists and standardization during the medication administration process. The rights of medication administration are the standard of practice for administering medications. With the introduction of technology, these rights need to be improved to integrate the technology into a formalized checklist for the nurse. There are checklists for just in time learning, information that a nurse may not use all the time and would find beneficial to have just in time learning at the point of care. For example with equipment use or during a critical incident, there are checklists to assist the nurse with these situations not often used. But what about a checklist in the medication room, on the computer screen to keep the medication administration process streamlined? Pape et al.

(2005) research included the MedSafe® protocol of the seven rights, no discussion, double check of patient identity and taking the MAR to the bedside. Research is analyzing the use of checklist and procedures to decrease distractions, but there is limited research on the implementation of checklists and safety vests in hospital settings.

In addition, nurses need education regarding reporting of near misses and errors. A near miss is a process that may have caused an error but was found and corrected either intentionally or by chance without the error occurring (Berntsen, 2004). These types of errors may not be perceived by the nurse to be a medication error, yet they are critical to continue improving patient safety outcomes. Because of nursing's perception of near misses as "not errors" there is a significant challenge in gathering data on near misses. According to Kelly (2004), not all medication errors actually reach the patient due to safety valves in the medication administration process, coupled with the vigilance of providers. Yet errors occur for nurses most frequently in the administration of the medication and the subsequent monitoring of the client after the administration. Armutlu et al. (2008) noted that the nurse's knowledge of medication errors and reporting behaviors should be reviewed annually, regardless of the years of practice experience for any given nurse.

Therefore, additional research is required to determine what conditions and standardizations work to reduce errors. Research would also help solidify the role of technology in supporting or enforcing process standardization. Continued research could also attempt to identify common factors that lead to an error-prone medication administration process. Finally, future research must consider what changes can be made

to ensure the ability of nurses to detect and correct errors are not undermined by process design, standardization or technology.

2.5 Contributing Factors to Medication Errors

The previous section concluded that most errors occur when nurses administer medication to patients. However, research has also noted that nurses are an important resource for error detection and correction (Cohen, 2007). To understand how nurses intercept errors, the factors that most contribute to errors that occur during administration must be determined. There are many studies examining types of medication errors that occur (Cohen et al., 2007; Nguyen et al., 2009; Pronovost, 2010; Westbrook, Woods, Rob, Dunsmuir, & Day, 2010;), but in practice, the "rights" of medication administration discussed above (e.g., right patient, right medication, right route, right time, right dose, right assessment, right documentation) may not always be checked. The types of errors are discussed below.

2.5.1 Failure to Follow Standardized Processes and the Nursing Rights of Medication Administration

Standards of practice are implemented to ensure and promote favorable outcomes. For example, high alert medications require a specific standard of practice in the context of medication administration. High alert medications are medications that could cause a sentinel event (Cohen, 2007). Medication errors continue to be among the top 10 most frequently identified root causes of sentinel events by the Joint Commission, a non-profit organization that accredits and certifies hospitals in the United States (Joint Commission, 2011). Medication use, leadership, communication, human factors, and assessment are the top five root causes of the sentinel events. A sentinel event is a particularly egregious

situation, such as baby abduction, or the death of a mother after delivery due to the administration of the wrong blood type. An example of a high alert and sentinel situation is the administration of the medication Heparin to the neonatal patients utilizing the adult dose vial. This particular problem is rooted in the similar label (Otoya, 2008). Heparin is a medication that thins the blood; the newborn dose vial is 10 units per milliliter. The adult dose vial is 10,000-units per milliliter. This constitutes a significant dosage difference. With the immaturity of the newborns system, administration of the adult dose could have life threatening consequences. In order to prevent this problem from continuing to occur in NICUs around America, hospitals have begun to use force functions (ISMP, 2007). The standard of practice is that all high alert medications must have two nurses' signatures before the medication can be administered (Cohen, 2003).

When administering medications, nurses must follow the "rights" of the process, as outlined above: the right person, time, medication, dose, route, assessment, intervention, and documentation. These rights are taught to nursing students early in the educational process. At any point in the process, it is possible that a nurse could breach these rights resulting in an error as 79% of the participants polled in a 2002 survey responded (Cohen et al., 2003). In 2007, Cohen sent the same survey again and 89% of the participants felt that by missing a step in the rights of medication administration, an error could occur. According to Ulanimo et al. (2007) the most common error is a nurse's failure to check the patient's name band with the patient's medication records. Cohen's research found that nurses value the rights of medication administration, and adds that even when these rights are followed, errors may occur due to system failures (Cohen & Shastay, 2008). Reinforcement of the rights of medication administration must occur from administration

down to ensure that the standards of practice are the same for all patients. This is an area where research needs to focus on how to improve the process for the floor nurse. Questions were added to the survey, to gather more information about how to improve the process.

2.5.2 Interruptions to Medication Administration Process

Medication errors may occur as a result of distractions or slips in attention, which can cause a stop in productive work (Leape, 1994; Westbrook et al., 2010). Interruptions appear in many forms, such as the working conditions in a medical environment, information overload; a patient calls for help, or nurses not having the requisite knowledge for the task at hand (Cohen, 2007; Kelly, 2004; Mayo, 2004; Pape, 2003; Tucker & Spear, 2006). In their research Potter, Wolf, and Boxerman (2005) discussed the shifts in cognitive thoughts with interruptions during and between tasks, which lead to disruptions in the nurse's thought process. When a distraction occurs, it may negatively affect the ability of the nurse to stay focused on the current task, putting the patient at risk for an error (Beyea, 2007; Pape et al., 2005; Tucker & Spear, 2006). Research by Trbovich (2010) showed nurses who were administering chemotherapy were interrupted up to 14 times an hour. Westbrook et al. (2010) research found that the significance of interruptions in two major Australia teaching hospitals resulted in clinical and procedural failures resulting in errors. The 2004 IOM report (Page) discussed that when not under stress, humans make a math error 3% of the time. Added stress of an ill patient, a new medication and interruptions to the process may increase the risk of error (Flanders & Clark, 2010). Nursing colleagues are the most common source of interruption, but IV pump alarms, call bells and family questions are also common interruptions (Pape, 2003;

Flanders & Clark, 2010). These interruptions may lead to procedural failures, such as not checking the patient's name band prior to administering the medication, to clinical failures, such as giving the wrong medication to the patient via the wrong route (Flanders & Clark, 2010).

The healthcare industry has been considering concepts adopted in the aviation industry and the effects these concepts have on error rates. Early in the 1980s, the aviation industry implemented the concept of a sterile cockpit after some deadly accidents that were the result of distractions. The concept of a sterile cockpit required that when the aircraft was in a critical phase of flight, such as taxiing, takeoff, and landing, and any time the airplane was less than 10,000 feet, the crew was not to be discussing anything that was not vital to the flight (Federal Aviation Administration, 1981). Implementation of a "sterile cockpit" in the hospital setting, where no one disturbs the nurse during the medication process, may decrease errors. However, this has not become a standard of practice (Clifton-Koeppel, 2008; Pape, 2003). Hohenhaus & Powell (2008) developed a healthcare sterile cockpit plan that may begin the shift in the culture of nursing in the hopes of reducing errors and improving patient safety. One way to change the process is to educate nurses to be more aware of potential distracting situations such as ringing phones or call bells. Nurses could also alert their peers that the nurse will be drawing up medications and not engaging in conversation (Pape et al., 2005). Westbrook et al. (2010) found that the rate of major potential medication error increased by 50% with four or more interruptions. As the nurse acquires improved perceptual awareness by living through experience discussed by Benner & Wrubel (1982) the ability to organize, prioritize and avoid the pitfalls of frequent cognitive shifts may be improved. Further

research on the frequency and types of interruptions as well as the reporting of near misses secondary to interruptions will allow for further support of the nursing profession to change processes and systems to protect the patient.

2.5.3 Design of Work Environment and Rework

The process of administering medications is a high-risk area and needs the respect of all participants in order to protect the patient (Flanders & Clark, 2010). Research has shown that one needs to look at the patient's acuity, the volume of patients the nurse is caring for during the shift, whether the nurse is working overtime and the skill set of the nurses working on the floor in order to gauge risk (Aiken et al., 2002; Dean, 2005; Hall, Doran, & Pink, 2004; Leape et al., 1995; Rogers, 2004). When patients are complex in their needs, there is a higher use of nursing resources (Hall et al., 2004). Research has shown that having a higher mix of RNs on the floor will lower the errors in the medication administration process and improve patient outcomes (Aiken, et al., 2001; Hall et al., 2004). The use of mandatory overtime, coupled with fatigue from working too many days in a row, has been shown to contribute to patient errors (Aspden, 2003). Another reason cited for errors is not taking an adequate break or lunch during a shift (Jones, 2010). The setup of the unit may also contribute to errors. These include loud noises, phone calls into the medication room and design of the medication delivery systems (Pape, 2003). The medication room design should be standardized as disorganized rooms have been shown to contribute to medication errors (Armitage & Knapman, 2005; Carayon et al., 2010; Pape, 2003; Pape et al., 2005). Elganzouri et al. (2009) research found that by bringing the medication and supplies closer to the patient;

the risk of distractions and interruptions will diminish. These stressors, in addition to the setup of the environment can lead to potential errors.

Two areas of the work environment that continue to be problematic are the look alike/ sound alike medications and handwritten transcription of medication orders. Medications that look alike, sound alike (LASA) or are packaged alike all are potential risk factors in healthcare. McCoy (2005) discussed the need to not only have a hospital review of look alike, sound alike medications, but also review medications that come in similar packaging. An example of LASA drugs is zyrtec (a medication for allergies) and zyprexa (antipsychotic medication). Both of these medications could easily be confused due to the close sounding and looking names. The use of Tall Man wording ZyrTEC/ ZyPREXA is the correct way to write the medication order (Filik, Purdy, Gale, & Gerrett, 2006). Early after the IOM report was released, straightforward corrections, such as the addition of the additives to the IV bag, were moved into the pharmacy and omitted from the nurse's medication cart. This removal of the concentrated electrolyte additives from the stock medication in the mediation cart has shown to decrease the risk of error (Rosen, 2004). When reviewing the transcription of orders, the time it takes from the writing of an order to the process of the medication and delivery to the patient can vary, but has shown to take more time when the order is handwritten than a computerized order. The lack of pharmacy interface in addition to the inability to check off the medication from a list, all provide the potential for error (Staggers, Kobus, & Brown, 2007). Errors may also occur with handwritten orders that are difficult to read. Error producing situations such as distractions and interruptions all lead to errors. The transcriptions of handwritten orders into the medication administration record (MAR) can be inadequate due to the poor

handwriting or use of unauthorized abbreviations. An example of this type of error is the tragic story from Duke University Medical Center in 2003; when a 17 year old was given the wrong blood type heart-lung transplant resulting in her death (Campion, 2003). In this case, the patient blood type was O and the donor tissue type was A with an assumption made that the blood types were checked prior to being placed into the patient. As a result of this disastrous outcome, new systems are in place to for redundancy when checking organs for compatibility before transplant.

Nurses are at the bedside 24/7 and have a good understanding of patients' status and are a key element in patient safety. With the introduction of new systems, the need to evaluate the change in patient care workflow must be evaluated. Workarounds are behaviors utilized by people when they want to avoid a system insufficiency instead of "fixing" the problem. The unanticipated outcomes of the introduction of new technology will have an impact on the social and organizational flow in a unit (Patterson et al., 2002). Computer systems are excellent at some tasks such as storing data, but are not flexible and able to quickly act in a complex patient situation (Pingenot, Shanteau, & Sengstacke, 2009). The technology utilized must allow for the care to flow seamlessly with the medication administration process. If integration is not seamless, there is a higher risk for the development of workarounds or reworks (Schaeffer, 2009). When the systems prevent the nurse from completing their work in the 30-minute rule, nurses may utilize a work around (Mason, 2008). As a result, a workaround becomes part of the culture of the floor that allows the errors to continue to occur (Rich, 2008). Vaughn (1996) calls this "normalized deviance" or a deviation from the standard practices which

may become the status quo for the nurses working on the floor. This shift in culture to the new ‘norm’ may compromise patient safety issues.

2.5.4 Communication Errors

Communication is a critical component in patient care. Everyone who is involved with patient care is looking at a common goal of improvement for the patient. Yet, since each profession within the medical community is educated in a silo type format, there is a lack of interdisciplinary knowledge regarding the goals and duties of each profession. Team building requires an understanding of the roles of the team members, an understanding of what the team does, and accountability to the team objectives (Pruitt & Liebelt, 2010). Hospitals need to develop a culture of team building, including interdisciplinary communication and respect to improve patient safety outcomes (Leape et al., 1995). Root cause analysis of medical errors has shown that miscommunication is a common problem in the daily activities of hospital interactions (Pingenot et al., 2009; Pruitt & Liebelt, 2010). Utilizing crew resource management (CRM) program has been effective in promoting effective communication with healthcare professionals (Helmreich et al., 1999; Reason, 1995). CRM was coined by the airline industry to decrease the rate of errors as well as utilize the personal on the flight deck. This information flow is critical in coordinating the care to the patients and preventing errors. Inaccurate communication has resulted in approximately 15.8% of the reported medication errors (Pepper, 1995; Phillips, Beam, & Brinker, 2001; Pruitt & Liebelt, 2010). Research has shown that closed loop communication (read back-feedback) such as the pilots utilize during flight is a skill that should be implemented as well as vigilant awareness of detection of near misses,

errors and decision making errors (McKeon, Cunningham, & Oswaks, 2009). For nursing this read back is critical for verification of the orders (Cohen, 2008).

In order to promote a positive outcome, all team members should be willing to learn skills in leadership, communication and have the ability to promote mutual support. Competency in these areas will enhance performance, attitudes and overall patient outcomes. These elements are part of the TeamSTEPPS model. TeamSTEPPS is a program that was developed by the Department of Defense and the Agency for Healthcare Research and Quality (AHRQ, TeamSTEPPS). It has been used to successfully educate providers about the importance of communication and teamwork in promoting patient safety. The visual model used for this program shows the three critical concepts of knowledge, performance and attitudes for positive team outcomes and improved patient safety. Individuals should have skills in leadership, communication, situation monitoring and mutual support to promote the positive team outcomes. In addition to staff communication, one needs to educate the patient and public to develop an active role in their care, and adopt standardized tools and language to enhance teamwork and communication amongst healthcare professionals (Leonard et al., 2004; Partin, 2006).

Another high-risk area in healthcare communication is a handoff of patient care. According to the Joint Commission (2010), a handoff is “the transfer and acceptance of patient care responsibilities achieved through effective communication”. A hand-off process involves “senders,” the caregivers transmitting patient information and releasing the care of the patient to the next clinician, and “receivers,” the caregivers who accept patient information and care of the patient (Joint Commission Center for Transforming

Healthcare, 2010). During this transfer of responsibility for the patient between healthcare professionals, information exchanges occur. These information exchanges require excellent communication skills to avoid errors rooted in substandard communication. Arora et al. (2005) research on communication failures in patient sign-outs or handoffs found omitted content or communication failure lead to problems with decision making for patient care.

Communication during medication reconciliation is critical for patient safety. Medication reconciliation is the process of reviewing and validating all of the patient's medications, including the names of the medication, dose, and route and how often the medication is administered. Further, the reconciliation process requires the practitioner to be sure that the medication list follows the patient during every transition in care (Joint Commission, 2006; Varkey, 2007). Research has shown that in facilities without a medication reconciliation process account for approximately 46% of medication errors (Varkey, 2007). These errors range from omissions, duplications and medication interactions (Joint Commission, 2006).

Researchers at the Virginia Mason Medical Center found that for two hours after shift handoff, nurses did not have a good handle on patient information. To improve this relay of information, shift handoff now occurs at the bedside, allowing for brief interactions with the patients and families and also providing the nurse with time to do high medication checks and review key patient information. This change in process resulted in nurses having crucial patient information at the beginning of the shift and thereby improved patient safety outcomes (Kenney, 2011). Another improvement that was implemented at VMMC was the implementation of nursing hourly rounds to each patient.

This process allowed nurses to proactively anticipate the patient's needs. The results show that prior to the hourly rounds, nurses were spending approximately one third of their time with the patient, yet after implementation nurses spend 90% of their time with the patient (Kenney, 2011).

2.5.5 Lack of Opportunity to Make Informed Decisions to Correct Errors

Access to information at the point of care is important for patient safety. Applications for immediate access such as Epocrates or Lexicomp provide decision support at the point of care for the nurse to make informed decisions (Aspden, 2007). With the infusion of mobile technology in healthcare, the rate of errors has decreased by as much as 80% by having the information to check for side effects of the medication or any drug-to-drug interactions that must be identified (Bate, 1999; Leape et al., 1995).

According to the IOM reports *Keeping Patient Safe*, (Page et al., 2004) math errors will occur without stress approximately 3% of the time. Nurses who are giving medications are usually in an environment where interruptions are frequent. These interruptions can shift the cognitive load, which may affect the ability to accurately calculate (Potter et al., 2005). Medication errors also occur as a result of faulty mathematical calculations. Nursing programs review medication calculations during the education process, yet studies show medication errors continue and may be unreported as the nurse may not even recognize that an error has occurred (Bliss-Holt, 1994). A common medication error is a mathematical error; such as the 10-fold error. The 10-fold error is a mistake where the misplacement of a decimal point can result in a 10-fold change in the dosage of medication to be administered. This is specifically critical in the premature infant, as their physiological system is not fully developed. Utilizing

technology such as a BCMA, CPOE and automatic medication cabinet with a computer program, hand held device or a simple calculator may lower the incidence of these errors (Clifton-Koeppel, 2008).

2.5.6 Categorization of Errors

The preceding section has covered a variety of errors that have been categorized according to common causes. This research study starts with the following taxonomy of errors arising from nursing practice:

Failure to Follow Standardized Processes and the Rights of Medication Administration -- failure to take additional precautions with high-risk medicines or medical situations or follow the rights of the medication administration process such as the right time, does or route.

Interruptions To Medication Administration Process – errors introduced when the medication administration process is interrupted by distractions or the need to perform other tasks.

Poor Design of Work Environment and Rework – work conditions, hours worked, environmental factors, the confusion of different medications with similar names or packaging. Errors introduced by poor handwriting, the use of unauthorized abbreviations, or other local conventions that are misunderstood when the order is filled. Nurse developed workarounds to compensate for constraints on the process that are introduced by inappropriate technology or procedure design.

Communication Factors – errors introduced when medication needs or constraints are not communicated effectively.

Informed Decisions to Correct Errors – point of care access

The following sections discuss how the design of operating environments and technology affect these categories of error.

2.6 The Role of Technology in Medication Administration

2.6.1 How Technology Affects Medication Administration Processes

Human factors engineering is the process of looking at how human beings' abilities and limitations can be successfully applied to systems (Boston-Fleischhauer, 2008; Vincent, 2003). The previous section developed a taxonomy of errors that occur for a myriad of reasons, including insufficient of knowledge of the medication, providers that are unfamiliar with the process of administering the medication, faulty delivery systems or devices used in the medication administration process, forgetfulness, distractions, violations of the medication policies by the nurse during the process, problems monitoring the patient during the medication administration process, lack of standardized process with medication and equipment stocking that impact nurses workflow, environmental issues, and poor communication skills (Bliss-Holtz, 1994; Cohen, 2007; Pape, 2003; Pingenot et al., 2009). This section considers the impact of technology on the medication administration process.

Looking again to aviation, the industry has successfully incorporated many safety initiatives, several of which healthcare is developing similar systems as modified for the healthcare context. Commercial airlines have a successful safety record due to an industry-wide focus on design systems that have safety at the forefront. The use of a "sterile cockpit", which allows the pilot to stay focused on the job at hand when the plane is flying at less than 10,000 feet may be utilized within the medication administration process, as noted above (Pape, 2003).

Just as the airline industry prototyped and redesigned its systems in order to increase and improve safety, healthcare must follow suit by developing systems that utilize the current workflow of nursing with medication administration (Pingenot et al., 2009). Critical to a successful flight is teamwork and good communication skills. It is expected that airline personnel following standard policy and protocol, from the preflight checklist to safely taxing to the gate at the end of the flight (Helmreich & Merritt, 1998). It is imperative this these kinds of expectations apply to the healthcare field as well. Bates (1995) stated that for every medication error that causes harm to a patient, there are about 100 medication errors that go undetected. To address this issue, one must identify unsafe practices, communication errors and where the errors are occurring within the process (Mewshaw, White, & Walrath, 2006). However, even upon identification of these trouble spots, this information and the gleaning of future information will only be able to improve the quality of services when it is not used as a tool for blame (Leape et al., 1995). The profession can then learn from the errors by considering the root cause of the problem. Root cause analysis (RCA) is the process of reviewing what happened with respect to a given error and how that error can be prevented in the future (Bagian, 2002).

Nurses are working in an ever changing, fast paced environment, the need for decision support and access to information at the point of care is critical to making informed decisions (Escoto, Hallock, Wagner, & Karsh, 2004). There are studies that cite specific technology that will help decrease the potential for medication errors, such as bar coding, computerized medication ordering systems, access to information at the point of care and having pharmacy on hand for medication questions (Scarsi, 2002). A new process utilized in several forward-thinking hospital facilities is participation of a clinical

pharmacist in hospital rounds (Scarsi, 2002). Unfortunately, these solutions can be expensive; accordingly, not every hospital can afford these options. Additionally, these options do not provide a perfect fix: even at the hospitals that have implemented these tools, errors are still occurring (Davidhizar & Lonser, 2003; Patterson, Rogers, Chapman, & Render, 2006).

Because adding additional tools to the system is not a fail-proof plan, a second question arises: what is the nursing policy on medication administration? Research has addressed the aforementioned rights of medication administration and the systems that are utilized with the medication administration, but there is a disconnect between these two contributing factors, as errors continue to occur when nurses are following the rights of medication administration and using the systems that are in place at the hospital. An area that may need further review is the possibility of a medical technology system that is not flexible to the dynamic nature of the nursing profession.

2.6.2 Technology Systems To Address Major Types of Errors

2.6.2.1 Systems that enforce standardization processes and checklists

The rights of medication administration include patient identification. The need for two identifiers was incorporated in the rights of medication administration (Balas, 2004). The introduction of technology with use of automatic drug cabinets and bar coding allowed nursing to verify the right medication for the right patients at the right time (Helmons, Wargel, & Daniels, 2009). Bar coding also allowed the pharmacy to verify that the medication ordered was the appropriate medication. Meadows (2002) stated that the use of a bar coding system could prevent up to 78% of presently occurring errors. When bar coding systems are in place, many of the errors that occur after the bar coding

process tend to be from failure to double-check the patient's identification and issues with the alarm sound, as the BCMA device alarm sounds the same when there is an error or a successful medication choice. One of the problems with standardization of bar coding technology is that it leads to new system errors, such as workarounds that practitioners engage in in order to complete the work in the allotted timeframe (Patterson et al., 2006).

The scope of medical errors spans all domains and ages in the client spectrum (Keohane et al., 2008). Individuals who are working in these complex systems need to have the ability to stop the process if there is a problem or near miss error. Such a process would allow for improved patient safety outcomes on a national scale.

Figure 2.3: Bar coding Medication Administration System (BCMA)

Figure 2.3 depicts the format of the bar coding system: a computer set up with the mouse to the right and a bar code handheld device that is not tethered to the computer so it is easily able to be relocated to the patient's wrist for scanning. If this system set up on a wireless network, it would allow the nurse to access critical information at the point of

care, such as medication compatibility when multiple IV lines are hanging and relevant lab values that may impact whether the medication can be administered.

2.6.2.2 Systems to support no-interruptions to medication administration process

Nurses spend as much as 40% of their shift administering medications (Armitage & Knapman, 2003). Graham et al. (2008) research showed that nurses were not properly utilizing the rights, discussed above, during medication administration. The commonly reported causes of medication errors were due to distraction, interruptions and time restraints. Most nursing medication administration errors occurred during the administration process with the wrong time, wrong rate, or wrong medications were administered to the patient (Bates et al., 1995). From the moment the nurse leaves the medication room, until the moment she reaches the patient's room to administer the medication, there are many opportunities for disruptions to occur (Pape, 2003; Pape et al., 2005). Each disruption causes a cognitive shift in the nurse that increases the chance of an error occurring.

Pape (2003) compared the airline industry safety practices to the safety mechanisms in the medication administration processes. If nurses worked in the equivalent of a sterile cockpit, the opportunity for disruptions would be nullified thereby greatly increasing patient safety in the medication stage of the process. Pape (2003) discussed the option of having the nurse wear an inexpensive identification vest that would inform others that the nurse was involved in medication administration and thereby prevent distractions. Pape et al. (2005) results found that nurses found the visual cues and standards developed from her study-improved focus and reduced distractions.

Technology systems can compensate for interruptions by standardizing the medication administration process from the initial medication order until the time that medication is administered to the patient (Skibinski et al., 2007). Latent errors or conditions (Helmreich et al., 1999; Reason, 1995) usually occur as a result of human factors in the system. Human factors include interruptions that may precipitate an error and affect patient safety. These conditions may be dormant and present in a system for a long time without failure, however upon interaction with a break in the defense of the medication administration process, an active failure can result (Reason, 1997) These errors or conditions may not cause a problem alone, but when combined with an active failure such as distraction, lack of drug knowledge, poor equipment, or overworked and understaffed conditions, a patient safety error during the medication administration process could be triggered (Hughes & Belgen, 2008). In order to redesign the system to account for these dormant system errors, the profession must determine how often nurses are interrupted and the source of these interruptions. From this information, redesign of systems may occur.

Conrad et al. (2010) discussed the “medication room madness” that typically exists in most hospitals. The medication room tends to be filled with distractions. The physical layout of medicine rooms is not well organized and often there are not adequate systems in place to prevent errors. A healthcare information system can be designed to compensate for interruptions by providing a standardized checklist of the medication administration process that allows the nurse to return to the patient if a disruption occurs (Tucker & Spear, 2006).

Looking at the nurse's perspectives with respect to these interruptions can assist the nurse and hospital administration in promoting changes in the environment to improve patient safety. However, without hard data, it is difficult to present a sound plan.

2.6.2.3 Technologies to avoid rework and workaround

Integrating a system where medication order and delivery can be computerized may improve patient safety outcomes (Lorenzi et al., 2008). The *integrated* system may have a computerized physician order entry program (CPOE) that provides (a) legible orders in a format that is the standard for the hospital, (b) a decision support system that checks drug-to-drug capability, and (c) integration of hospital protocols. The library within this computerized system can contain up to one hundred institutional specific drugs (Wilson & Sullivan, 2004). When a CPOE system is combined with bar coding and an automated medication system, the aggregate medication system will have additional layers of protection for patient safety. Yet, this safety system layering is not typically implemented in most institutions. As institutions are currently situated, both the design process and the implementation may cause an increase in errors with medications (Grissinger & Globus, 2004). Critical points of consideration for hospital administration when evaluating a new system for the hospital setting include analyzing the vendor, the embedded programs, the present workflow and nursing management in the context of the proposed system (Nelson et al., 2004).

According to Ash et al. (2007), technology has eight potential unintended consequences for the nursing profession: (1) more work or new work, (2) change in workflow, (3) system demands, (4) changes in communication, (5) new types of errors, (6) shifts in power within the profession, (7) dependence on technology, and (8)

emotional demands. Every key individual who will use or implement a new process should be involved in the development of the system. These key individuals include hospital administrators, nursing executives, informatics officers, nursing managers, nursing staff, and any other employees who would use the technology. When evaluating the technical work of the health professions, such as the systems that are involved in the medication process, prior to implementation of a new approach, institutions must evaluate the human factors that could affect the design of a computerized system for nursing (Staggers & Kobus, 2000). Systems may provide improvements to patient safety, but they do not reduce the time spent on medication administration (Sensmeier, 2003). Thus, nurses may develop workarounds to ensure that medications can be administered in the short amount of time allocated to this task. This is a significant problem that could compromise patient safety and must be addressed upon the implementation of new patient safety systems.

Errors also occur as a result of the poor design of the environment for human processes, such as an inappropriate set up of a medication room, medication computerized libraries, or distractions in the distance travelled from the medication room to the patients' room (Schaeffer, 2009). Escoto et al. (2004) argued that preparation of the medication within the medication room is a complex process that has many areas where system breakdown could occur, such as an uncharged bar coding scanner or missing supplies necessary for medication administration. Poor design can also affect bar coding, as a nurse may not be able to bring the computer into the patient's room. In these situations, the RN may be at a disadvantage since the BCMA process will not be able to work effectively. In medication administration, problems generally arise due to the need

for a better system. Easy system fixes are available to any institution, like placing the medication delivery system near the equipment necessary to administer the medication (i.e., IV tubing, cups, and refrigerator for the cold medication). Institutions should also have a phone available to verify orders. There should be easy access to the policy and procedure for medication delivery, as well as a database of the specifics of each medication. Practitioners should have easy access to the patient's medication administration record (MAR) (Bohomol, Ramos, & D'Innocenzo, 2009). These simple changes can lead to an environment that is free from distractions. Braswell & Duggar (2006) stated that using "gotcha" moments could aid to convincing practitioners to embrace technology. A "gotcha" moment is a teaching moment when technology was able to prevent a potential error. Pointing out the effectiveness of the technology to the practitioners is a convincing means to gain acceptance of the safety systems. A relevant consideration is whether nurses report these gotcha moments (near misses), which did not lead to an error but may be a system problem. If these moments are not reported, they cannot be effectively used to train other practitioners.

2.6.2.4 Systems to support safe medication administration

The 1999 IOM report recommended the implementation of a computerized physician order entry (CPOE) system in every institution. This implementation would allow the physician to place a patient's order via a computer. The process eliminates the handwritten order, which caused errors with transcribing. The intent was that the use of CPOE would decrease the incidence of errors. This projection was correct. Bates et al. (1998) found that the use of CPOE decreased errors by half in all stages of the medication administration process. As noted above, CPOE allows for automatic allergy warnings to

assist the provider (Smetzer, 2002). An ideal medication administration system is one that integrates the clinical information system, a user friendly interface, a pharmacy information system that includes medication lists for adult and pediatric populations (Mahoney et al., 2007), in addition to lab, finance, and database structure with accessibility for satellite offices. Having health information systems that earn the IOM's seal of approval, may improve patient safety, but do not address the disconnect between nursing processes and practices and workflows required by these systems. Each department within a health system operates in its own unique way, with specific and different systems that results in a lack of integration or information sharing between the departmental systems (Jordon, 2006).

The National Patient Safety Goals introduced by the Joint Commission included the introduction of bar coding to the hospital setting by 2007. Bar coding medication administration (BCMA, see Figure 2-3) is the use of a computerized program to assist in the administration of medications. Use of BCMA allows nursing to use the eight rights of medication administration while promoting safe patient care (Cohen, 1999). The process of BCMA begins with an order entered via a CPOE. The burden then passes to the pharmacy, which will verify the order, drug-to-drug interactions, and the patient's allergies and diagnosis. The medication then has a specific patient bar code scan placed on the label. This medication is placed in the patients' drawer in the automated medication cart (Kohn et al., 2000). One of the first proponents of this technology was Veterans Administration Hospitals (Johnson, 2004). Now many facilities are utilizing this technology, and more institutions are adopting this process.

Bar coding and medication administration requires the nurse to follow a set format for the administration process. The use of bar coding with medication administration appears to result in reduction errors by 50% during the dispensing and administration stages (Hemen, Coyle, & Hamilton, 2003). Errors continue even with technology, due to the fact that the alarm sound is the same for both correct scanning of the medication or patient and the incorrect information. There are facilities that have disabled the sound to force practitioners to actually view the eMAR to verify the medication prior to administering the medication to the patient. The time spent on medication administration did not change significantly with the introduction of bar coding technology, but the efficiency of the bar coding system did, in some circumstances, free up some of the time that nursing had previously spent on the administration of medication (Poon et al., 2010).

As shown in Figure 2.4, the Pyxis is a stationary medication dispensing system. To decrease interruptions for facilities low on funding, red tape may be placed on the floor in front of the ADC and a visual cue above or around the ADC when medicine is being dispensed. These visible cues can alert others that the nurse is involved in a high-risk process and should not be disrupted short of a life-threatening emergency. This will allow the process to be completed without interruption, thereby lowering the risk for error.

Figure 2.4: Automated Dispensing Cabinet (ADC) Commonly Called a 'Pyxis'

Syringe pumps (Figure 2.5) are utilized when medications that must be administered over a set period of time at a specific rate for patients. In these situations, the syringe pump above would be an ideal option. The pumps come with the ability to program, alert you when the medication is completed as well as alert you if there is air in the line. There are some pumps, which will store the infusions for previous uses as well as have a library of common medications that maybe infused.

Figure 2.5: Syringe Pump

Smart pumps (Figure 2.6) are beginning to be utilized at the point of care. These IV pump are more than the traditional pump where the nurse hangs the IV, threads the tubing through the pump, turns on the pump and sets the rate. A smart IV pump in addition, has an internal library with dosing high and low limits for frequently used medications. This computerized process is a double check for the nurse after the nurse has set the IV pumps for the patient's medication infusion rate (Carayon et al., 2010).

Figure 2.6: Smart IV Pump

2.6.2.5 Access to information at the point of care

Technology can be used as a tool to help maintain accuracy of medication records and aid in proper and accurate dispensing of medication (Skibinski et al., 2007). Utilizing information at the point of care with the medication administration process will allow for improvement in the quality of care. Implementation of an ADC (automated dispensing cabinet) medication delivery system should include both nursing and pharmacy, as they are the two biggest stakeholders in this process (Institute of Safe Medication Practices, 2008). Yet there are many facilities that cannot afford these systems to support the medication administration process. However, there are alternative, more cost-effective, ways to help the nurse in safer medication administration. Simple systems, such as a calculator for validating doses prior to the administration of medications due to the frequency of errors, especially 10-fold errors, can be easily and cheaply integrated into any existing system. The Internet also serves as a ubiquitous tool already available in medical institutions, and can be used for decision support, access to medication information and updates and information related to the patients' condition. Another

simple, yet effective tool is a handheld device (Figure 2.7), such as a smart phone or a mobile handheld device, which is small enough to hold in your hand and access information at the point of care. A mobile handheld device allows the nurse to download applications with algorithms and medication references. It also provides the nurse with the capability to ask a question and have articles and information pushed back with the next sync (Greenfield, 2007). A more detailed information tool is an integrated computerized physician order entry program, where information is available with the click of a mouse. Having the ability to access these decision support tools is vital in safe medication administration (Ulanimo et al., 2007).

Figure 2.7: Mobile Technologies at the Point of Care

Another more nuanced tool that an institution may have at the medication cart is an advanced calculator for algorithms and more complex calculations, such as dopamine administration. These can be loaded onto the handheld if the facility does not have an electronic library. Yet, these devices are only as reliable as the individual entering the data. Having a second nurse complete the complex calculation will reduce the error potential through simple double-checking (Preston, 2004). Use of an independent double check is a redundancy that should be policy with all nursing units (Preston, 2004). These

calculation concepts should be combined with safer practices, build error reduction strategies at every stage of clinical practice and recognition that knowledge workers who look at many bits of information to come to a decision. This systems approach to work flow safety will help with the coordination of patient care and medication administration.

2.6.3 Technologies For Error Detection and Correction

Decision-making is a critical component for the nursing profession. Simon (1987) discussed decision making as evaluation of the situation and choosing between alterative actions. This process necessitates attention to detail and requires a practitioner to utilize available resources, such as decision support at the point of care. Bounded rationality, a concept developed by Simon (1991), stated that a human is limited to the information on hand, the finite amount of time provided make a decision and their specific human limitations. Thus, Simon theorized that decisions are made by this bounded rationality, i.e., within the constraints of the resources available to the person. A decision maker bounded by the above constraints is satisficing, or making a fair decision, not the optimal one. This view may not provide for the best outcome when looking at the process of medication administration. The process of nurses administering medication involves many phases, from the new medication order being written, to the administration of the medication, to assessing the effect of the medication, ending with a follow-through and documentation (Patterson et al., 2002).

This research study addresses disconnect between medication administration and current healthcare information systems. Even with systems in place, administration failures will occur stemming from variables such as interruptions, noise, similar name, similar packaging, and problems with the technology (Pape, 2003). Leape (1995) found

that medication errors occurred when the nurse did not have adequate access to information. Human engineering is important in medication administration. The standardization and simplification of information retrieval coupled with standardized error-preventing equipment is one solution to help minimize errors (Kenney, 2011; Nance, 2008; Rogerson, 2004). However, it is equally important that nurses have the ability to access relevant patient information, employ experiential patient assessment skills, and formulate and evaluate decisions to offer quality care to the patient (Offredy, 1998). Technology design must provide support for the decision-making that occurs at each step in the medication administration process. Having a clear understanding of the decisions made at each step in the process may facilitate the development of a decision-making algorithm for medication administration. The medication administration system should provide the ability to safely give medications to the patients while integrating decision support at the point of care (Sensmeier, 2006). The system needs to allow workflow for the nurse to gather medications not only for an individual patient, but also for any given patient in a unit getting medication during the same time frame (Pingenot et al., 2009).

Patient safety is the critical consideration at each step in the process. At every level of the medication administration process the nurse makes decisions that are based on information in a real-time environment. The nurse is evaluating the patients' clinical status and variables, such as laboratory values, need to be checked prior to administration or after the administration of the medication. The nurse must also assess information relevant to the administration of the medication (such a heart rate and blood pressure). These are a few examples just a few of the variables that depict how much information

must be taken into consideration around each medication administration (Buckingham & Adams, 2000).

2.7 Culture of Safety

The environment within healthcare must be one to allow for change to occur by incorporating safety in every practice and procedure (Hudson, 2003). One way to obtain this culture is by looking at the nurses' perceptions of error reporting. Does the nurse have a comfort level when an error occurs to report the error and not fear losing their job? Another critical component to this is evaluating the nurse's perception of what constitutes a medication error. Education of this process must begin at the undergraduate level of education and be continually reinforced in the workplace. If the culture of the institution is one of a culture of blame and shame, the near miss errors and medication errors from distractions and interruptions may not be reported with the frequency that they should. Nurses should be encouraged to report errors and near miss situations to allow change to occur in the process and prevent a latent problem from becoming a critical patient safety risk (Smetzer, 2007).

Gladstone (1995) looked at medication errors over the course of a year in an acute care hospital in the United Kingdom. Her questionnaire considered nurses' ranking of the causes of medication errors, their view of what constituted a medication error within four discrete scenarios, and the process for reporting a medication error. There were 102 nurses selected to complete the survey with 81 returns for a 79% response rate (Gladstone, 1995). After completion of the survey, 14 of the participants were interviewed (Gladstone, 1995). The results of her research showed that there is no clear-cut delineation as to what nurses consider a medication error or when a medication error

should be reported. In addition, the fear of blame contributed to why medication errors were not all reported. The reasons that Gladstone extracted explaining medication errors were distractions, poor handwriting and failure to identify the patient.

In 1999, Osborne et al. modified Gladstone's survey with an additional scenario as to what constituted a medication error. Osborne et al. (1999) validated the modified instrument's reliability by having the instrument reviewed by a panel of nurse managers, clinical nurse specialists and pharmacists. The instrument reliability was established at 0.78 using the test-retest method. Osborne et al. (1999) utilized this reliable tool, sending it to 92 registered nurses in one southern state hospital, with 57 nurses completing the survey for a 61.9 % response rate. Her results showed 84.2% knew what was a medication error, 86% knew when an incident report should be filled out, and 86% may not always report an error because they are afraid of the consequences (Osborne et al., 1999). Osborne et al. (1999) found that the most common reasons for errors in medication administration were failing to identify the patient, fatigue, and poor handwriting.

In 2004, Mayo utilized the Gladstone questionnaire and again modified the tool with an additional scenario question. The tool then consisted of six scenario questions regarding what constituted a medication error. Mayo (2004) sent the tool to 5,000 RNs and gathered a larger sample size of 983 nurses for a 20% response rate from multiple hospitals in a western state. Mayo's (2004) results showed that the nurses stated that they knew what constituted a medication error, as there was high agreement within the scenarios provided, with the top reasons given for medication errors being poor handwriting, distraction, and fatigue.

In 2007, Ulanimo et al., utilized the modified Gladstone questionnaire and including two additional questions about the effects of CPOE and BCMA technology. She sent the study to 61 nurses, with 27 responses for a 44% response rate (2007). Ulanimo et al. (2007) study concluded that the number one cause of medication errors was not checking the patient's identity. Additional reasons included fatigue and prescription of the wrong dose. The findings from these studies show similarities in the results, with patient identification and fatigue as critical reasons for error. These nurse researchers verified that there is still work to be done in defining what nurses' perceive as an error and why there is still concern with error reporting.

2.8 What The Literature Tells Us – And What It Does Not

A human factors approach may aid in identifying technologies and systems that are the cause of errors (Rogerson, 2004). The healthcare industry must commit to implementing systems that will promote the culture of safety in the medical profession (Wilhoit, 2006). To do this, technology support must ensue, ensuring that nurses can utilize the rights of medication administration - *right patient, right medication right dose, right route, right time, right reason, right assessment, and right documentation* - safely and effectively (Schaeffer, 2009). Information systems that can offer point of care resources, just in time learning and decision support at the point of need are critical to the medication administration process.

One theory argues that technology must compensate for fallible human factors. Inadequate or incomplete patient assessment, inadequate clinical judgment and an inability to recognize implications presenting signs and symptoms may lead to additional errors (Benner et al., 2002). As Sensmeier (2003) stated, nursing will benefit from the

utilization of technology to improve patient safety. System redundancies are critical to patient safety goals (Smetzer, 2002). Examples of system redundancies include independent double checks with high alert medications and bar coding for medication administration.

A second school of thought argues that the most effective system is one designed to support human potential for experiential judgment and decision-making. Outcomes may not always be as expected pursuant to the introduction of new technology with medication administration: there may not be a change in errors or new errors may be seen (Skibinski et al., 2007). Patterson et al. (2002) addressed the problem of introducing new errors into a system with the introduction of new technology. Those problems include confusion, decreased coordination between the nurse and physician, a need to reprioritize workload, and problems with routine sequences of patient care. The additions of these "foolproof" systems may show an improvement in patient safety, but the need for the support of clinical decision making at the point of care remains the biggest challenge for the healthcare profession (Winterstein et al., 2004). The use of nonintegrated systems into a nursing unit may cause a workflow change that can lead to potential errors (Schaeffer, 2009).

There is obviously a conflict between the two theories outlined above. The nursing profession evaluates medication administration technology support to determine how the basic technology support systems are utilized, specifically how systems fit within the workflows and human-centered process evaluation (Henriksen, Dayton, Keyes, Carayone & Hughes 2008). The relationship between nursing processes and medication systems must be analyzed to identify potential weaknesses and threats to patient safety.

Healthcare information technology can aid in monitoring the standards of care, assisting in the improvement of implementation of electronic health records and implementation of clinical decision supports with all aspects of the system (Kilbridge & Classen, 2008). *But technology use is broader than the use of systems.* Equipment use may precipitate a medication error, by a pump error, an input error to a device, a malfunctioning piece of equipment or human error. This may cause the medication to be administered too quickly or deliver in inappropriately high quantities (Schaeffer, 2009). We therefore need to examine the *range* of technologies that are used in the medication administration process to understand the effects of technology on the process.

The literature reviewed in this chapter has provided characteristics of medication errors and has revealed several causes of these errors. It is clear that the majority of medication errors occur during the administration of medication by nurses. It is equally clear that the profession is far from understanding why these errors occur and how to prevent them. Nursing is the final step in the medication administration process, and therefore the last stopgap in error prevention. The profession must determine how to best utilize nurses' reservoir of expertise to prevent specific types of errors, while standardizing the processes of medication administration sufficiently to prevent other types of error. Communication and interruptions continue to be critical factors in medication administration errors, even with standardized processes and support technologies to prevent such errors.

Nursing is a profession where the dynamics change often. The environment is fluid, yet much of the technology is rigid. Rigid technologies are not able to flex as the nurse, a knowledgeable worker, must flex to any given situation in front of them. Due to the

complexity of the healthcare system, the nuanced tools of the trade and the significant involvement of humans with technology, there will always be errors in the system. These errors can hinge on innumerable factors, including the complexity of human beings in the system, the illness of the patient and the immense array of technology available to assist in the diagnosis, assessment and evaluation of the medical process. We must consider how to minimize these errors. This literature review has resulted in the following conceptual framework on which the detailed research questions are based.

Although there are many studies on medication errors gaps are present in the literature. The literature addresses many critical types of problems and systems that may lead to medication errors. Second, the focus of the literature on medication errors in nursing has been on the issues with negative impact on patient safety. The literature is not as rich in looking further to the perception of these errors from the nurses who are working on the floors where the systems and medications are being utilized. There was not much research about the input from nurses into how to improve the work environment and technology to decrease on potential situations that may lead to the patient safety errors. The proposed research study intends to rectify those gaps in our knowledge.

This leads to the following detailed research questions, constructed to investigate the three high-level research questions.

Research Question 1: How do nurses perceive the factors that contribute to medication errors originating during the medication administration process?

The sub-questions resulting from this literature review are:

RQ1.1 How is the medication administration process facilitated by a nurse's education?

RQ 1.2 How is the medication administration process facilitated by a nurse's professional experience?

RQ 1.3 How is the medication administration process facilitated by organizational (management) support?

RQ 1.4 How do interruptions affect the medication administration process?

Research Question 2: How can interactions between nurses and technology be improved to support the medication administration process?

The sub-questions resulting from this literature review are:

RQ 2.1 Does the physical layout of medication and supplies storage conform with best practices for medication administration?

RQ 2.2 What technology systems are used to support medication administration?

RQ 2.3 How do the technology systems used affect nurses' workflow, in medication administration?

RQ 2.4 How does the use of various systems increase or reduce errors in nursing medication administration?

Research Question 3: How does the hospital culture affect the reporting of medication administration errors and what types of errors are not reported?

The sub-questions resulting from this literature review are:

RQ 3.1 Do nurses understand what constitutes reportable vs. non-reportable medication errors?

RQ 3.2 Why do nurses fail to report medication errors?

RQ 3.3 Does the local culture or working environment prevent nurses from reporting medication errors?

This research study investigated the questions above by means of the methods discussed in Chapter 3.

CHAPTER THREE: METHODOLOGY

3.1 INTRODUCTION

This research sought to identify, describe and understand nurses' perceptions of the medication administration process, in order to understand the causes and context of errors in medication administration. The investigation was carried out using mixed methods as these allow findings to be "triangulated" between parts of the study (Johnson et al., 2007). The study used a three-phase approach:

Phase 1: Exploratory interviews were conducted, to explore issues from the literature review and to identify issues of concern missing from prior research

Phase 2: An online survey of Pennsylvania nursing professionals was conducted, to understand their perceptions of medication administration processes, the role of technology, and the organizational context and culture of medication administration.

Phase 3: Follow-up interviews were conducted with a sample of nurses who volunteered contact information, to explore issues arising from the survey in more detail.

Each of these studies in discussed separately below.

3.2 PHASE 1: THE EXPLORATORY STUDY

3.2.1 Participants and Method

The reasons behind medication errors are varied for individuals. Additionally, nurses' perception of what constitutes an error is not standardized. The questions for the pre-survey questionnaire were developed based on a review of the literature that has been published since the 1990s.

An exploratory study was conducted to explore the medication process utilized by nurses currently working in urban and suburban hospitals. Eight nurses with varying

degrees of clinical expertise, located at different types of hospital were interviewed about the medication process. Two of the nurses were male and six of the nurses were female, with ages ranging from 25 to 55 years of age (Appendix A). One nurse worked in a suburban setting; the other seven worked in urban settings.

Semi-structured interviews were conducted, to permit exploration of critical issues. Data were collected until information obtained from the respondents revealed no new issues (Lincoln & Guba, 1985). Interview questions were based on the research questions resulting from the literature review:

1. *Investigation of the medication administration process.* These questions sought to capture the process, hospital protocol, nursing policy, and patient safety of the process.
2. *Investigation of systems impact on the medication administration process.* These questions delved into significant depth with respect to the complicated actions and processes tied to utilizing systems and technology in the administration of medication.
3. *Investigation of perception of medication errors*. These questions explored details and elicit specific circumstances of errors, the administrative process after the discovery of an error, and the significance of the error with respect to patient safety.

These elements provided the ten detailed questions listed in Appendix A. However, the questions were of less importance than the focus. With semi-structured interviews, other topics could be discussed that were of importance to the subject. This open, flexible format allowed for additional questions to be suggested for the survey (Kvale, 1996). The

interviews explored the processes of administering medications, the tools utilized in the process, the benefits and detriments of using that specific process or tools, overrides and workarounds developed with respect to the tools, patient safety procedures in place (including the rights of medication administration), hospital policies regarding medication administration, error-causing issues with the technology, errors that have occurred in the process and "SBAR" (situation, background, assessment, recommendation). SBAR is a process of communication that allows for a standardized format in the sharing of patient information to ensure consistent communication practices.

Interviews were conducted either in person or over the phone, lasting between 20 to 35 minutes (depending on the time constraints of the nurse). The interviews were conducted as a normal conversation, with the intent of gathering data and utilizing the questions above in the process (Kvale, 1996). The interviews were conducted either over the phone or in person, covered the aforementioned 12 questions, and ranged in duration from fifteen to 35 minutes in length.

3.2.2 Exploratory Study Findings

Detailed responses to the interviews are summarized in Appendix A. This section summarizes the issues that affected the survey design.

3.2.2.1 Investigation of the medication administration process

All of the nurses mentioned the rights of medication administration that included the rights of patient, route, drug, dose, and time. Five were not aware of the right of assessment, but understood the logic of including it in the rights of medication administration. The nurses' noted that these steps were critical to follow in the

medication administration process. The nurses in the exploratory study are similar to the national average; the majority was female, with at least a BSN or Master's education that were all utilizing the mental checklist of the rights of medication administration. To evaluate the additional rights that have been added to the mental checklist, all will be included on the survey design.

The nurses stated that the morning and evening patient medication administrations were the largest in terms of volume. During the rest of the shift, nurses also administered medications an additional three or four times a day (such as medication for pain management), but not at the same volume as the morning and evening rounds. When looking at the large volume of medications during the two busy times of the shift, a question follows: is there a link between this time and the errors, the days worked in a row, the shift the nurse is working? The survey questions investigating hospital support in terms of working conditions were expanded, to explore these issues (questions 8-14).

3.2.2.2 Investigation of systems impact on the medication administration process

Of the nurses sampled, four used a pen-and-paper technique to manage and record the medication administration process while four nurses used a computer–based system. For the nurses who were utilizing a computerized system, three had a computer on wheels. One had wall-mounted computers near patient rooms, which allowed the nurse to look at the eMAR (electronic medication administration record) as well as provider orders for each patient. In the survey design, questions 19 and 29 were included to see what technologies and systems the nurses were using at the bedside.

Once in the patient's room, another patient safety procedure used by all of the nurses was to verify the patient by two unique identifiers (such as name and date of birth). One nurse went on to say:

> *I feel as though I am constantly being pulled in so many directions during medication rounds. I want to be a good nurse, give good care, answer everyone's questions, but there comes a time when I must focus on the task at hand, double-check the medication dose and IV calculation before giving the medications and just need that uninterrupted time. I have not figured out how to make this happen (Nurse 7).*

A change in practice was noted with some nurses using technology as they no longer ask the patient for their name, or double-check the medication by reading the labels to check expiration dates. By including questions (Questions 15 and 16) regarding the rights of medication administration, open-ended questions regarding errors as a result of technologies, this area can be further explored with a larger population.

One unexpected discovery was the issue of waiting for double checks with high alert medications. Here it was not the technology that was causing problems, but the procedures and policies associated with the medication administration process. One of the nurses stated that the double check policy distracted her during patient interactions:

> *While I understand the concept of having another nurse check my Heparin calculation so I don't harm my patient, the biggest problem is not having a nurse nearby who can do the check. Then I spend time waiting and waiting for someone to come to the nurses' station. Of course during that time, I am answering the phone, my patient cell phone, and still waiting (Nurse 1).*

Because of this finding, an open question was added to the survey to explore the role of standardized procedures in medication administration (Question 18).

The process described by nurses in the exploratory study appeared prone to interruptions and distractions. Despite consistently occurring interruptions and

disruptions during the medication administration process, the nurses were less concerned as they felt these issues were merely a part of their daily job and did not affect medication errors. These included the interruptions and distractions, as the literature has documented that this is a source of errors during medication administration. This question deserves more attention, as the technology is ever changing and nurses are therefore constantly adapting to the new technology. This led to a greater emphasis on survey questions to explore the issue of interruptions in more detail and to understand if nurses more widely perceived interruptions as just part of their daily routine (Survey Questions 24 to 28).

It is important to draw a distinction between the issues related to the technology such as a forced practice versus issues related to failure of the technology. An increasing number of medical facilities are integrating information systems and technology at patients' bedside. Due to the increased amount of technologies that were added to the daily activities, the interview responses indicated that the technologies used added to nurses' perceived workload and adversely affect workflows. However, these advancements present another set of problems and issues. Questions 30 and 31 on the survey are related to workflow and open-ended question on workflow changes.

The nurses interviewed were candid in their discussion of the medication administration process, the problems they found in the process and ideas on how to promote patient safety. All of the nurses expressed their desire to give excellent patient care, while simultaneously expressing frustration when technology hinders patient care. The need for products that are consistent and fail-proof was expressed as most of the issues with technology were with the failure of the system. One nurse stated "…that even with the technology, it is critical not to let yourself go to autopilot but to continue to stop

and think about what you are doing at each step in the administration process" (Nurse 1). This lead to the development of the survey questions 32 and 33 related to whether the technology has caused an error.

3.2.2.3 Investigation of perception of medication errors

A consistent theme throughout the nurses' interviews was that communication of errors was of utmost importance. The topics of communication to be discussed were of any reported safety incidents that occurred on the nursing unit. Communication and education were offered as strategies to prevent errors. The discussion of medication errors was enlightening, as many of the nurses did not view a near miss as a reportable error. One nurse shared an example about a near-miss situation "…I realized that I was in the wrong room. I was answering a question but had not begun the process of administering the medication, so it did not constitute an error" (Nurse 2). Questions 34 and 35 of the survey were to review the responses of the nurse regarding what is a medication error and when is a medication error reported.

The nurses did report that they understood when an error should be reported. Additional research on how to educate nurses in error prevention may improve nurses' reporting, not just of errors, but also of near miss incidents that may lead to a patient safety breach. This led to a change in wording, to investigate these issues with error reporting (Questions 36 to 39).

3.2.3 Use of Findings in Survey Design

The findings from the exploratory study that affected the survey question development included the process of administering medications including the rights of medication administration, standards of practice included in the process such as two

nurses checking high alert medications. Interruptions and distractions were included in the survey with the nurses' discussion of interruptions from patients, professionals as well as issues with the technology. Along with the interruptions from technology issues, workflow issues occur with technology introduction and questions were included in the survey. Nurses stated that the process of error reporting is cumbersome and some nurses hesitate to report both errors and near misses, so survey questions were developed to explore this further.

3.3 Phase 2: Survey Of Nursing Professionals

3.3.1 Survey Design

The survey was designed based on a review of literature review relating to the medication administration process and errors in nursing practice, supplemented by issues raised by the exploratory study. Three major areas of concern emerged from the literature review these were expanded into detailed research questions to be explored in the survey. The issues raised by the exploratory study suggested specific ways of conceptualizing or operationalizing the detailed research questions from the literature review and allowed these to be grouped in ways that would make sense to respondents:

- The demographic section, focusing on education, years working as a nurse, and years working on the floor, type of unit and hospital were included to investigate Benner's (1984) theory that nursing capability depends on these elements.
- The questions regarding shift work, days worked, and breaks were included as they look at the organization support for nursing process. In addition, when a nurse is working long hours, many days in a row, or working through meals and

breaks, this may result in latent errors, causing the holes in the “Swiss cheese” of process workflows to line up and present an error (Reason, 1995).

- Questions related to the medication administration process, technology systems and tools were included to better understand the process and evaluate where the process can be standardized, as standardization such as that used in the Toyota process is critical to process safety (Liker, 2004).
- Combining standardization with a culture of trust could significantly improve error reporting, which translates into improved patient safety. Seven questions exploring the culture of medication errors were included in the survey. In the literature as well as interviews and anecdotal discussions with healthcare professionals, the rate of error reporting does not correspond to the volume of medications administered. Six of the medication error questions explored this issue. These questions were taken from Gladstone’s (1995) validated survey instrument, with permission from the author.

Tables 3.1, 3.2 and 3.3 summarize how the detailed research questions were conceptualized and operationalized as survey questions as a result of this understanding.

Table 3.1 Survey Design for Research Question 1

How do nurses' perceive the factors that contribute to medication errors originating during the medication administration process?

Research Question	Conceptualization	Operationalization
RQ1.1 How is the medication administration process facilitated by a nurse's education?	The nurse's education was conceptualized as the highest formal nursing degree qualifications held. The medication administration process was conceptualized as combination of: a) Whether the respondent used the standardized checks known as the "rights" of medication administration. b) Whether standardized checklists or procedures were employed to support medication administration.	The nurse's education was operationalized as Survey question 2: What is your highest level of schooling or the highest degree held? The medication administration process was operationalized by means of: a) Survey question 15: Do you follow the rights of medication administration each time your administer medications? b) Survey question 16. If you do not follow the rights of medication administration, which steps do you utilize? (Select from: Right patient / Right time / Right route / Right drug / Right dose / Right assessment / Right evaluation / Other, please specify) b) Survey question 17: Do you utilize a standard procedure during medication administration (Such as an insulin checklist)? c) Survey question 18: Please describe the standardized procedures used with medication administration.
RQ 1.2 How is the medication administration process facilitated by a nurse's professional experience?	The medication administration process was conceptualized as for RQ 1.1. The nurse's professional experience was conceptualized as combination of: a) The number of years' experience that a nurse possesses b) The primary healthcare location in which the nurse works.	The medication administration process was operationalized as for RQ 1.1. The nurse's professional experience was operationalized by means of (a) Survey question 3: How many years have you been working as a nurse? Survey question 4: What is the length of time you have been working on the present unit? (b) Survey question 5: What is the bed size of your hospital? Survey question 6: What is the location of your hospital? Survey question 7: What is your primary hospital work setting?

Research Question	Conceptualization	Operationalization
RQ 1.3 How is the medication administration process facilitated by organizational (management) support?	The medication administration process was conceptualized as for RQ 1.1. Organizational (management) support was conceptualized in terms of the working conditions for medication administrators (nurses). The operationalization of this question was related to issues raised in the exploratory study.	The medication administration process was operationalized as for RQ 1.1. Organizational (management) support was operationalized by means of: Survey question 8: Which shift do you typically work? Survey question 9: Do you work a permanent shift? Survey question 10: Do you rotate shifts? Survey question 11: What type of shift do you typically work? Survey question 12: How many days do you typically work in a row? Survey question 13: Do you work without breaks during your shift? Survey question 14: Do you ever work through meal breaks?
RQ 1.4 How do interruptions affect the medication administration process?	The medication administration process was conceptualized as for RQ 1.1. Process interruptions were conceptualized in terms of types of interruptions, frequency of interruptions, at what point in the medication administration process interruptions occurred, and whether nurses interrupted their own process. The operationalization of this question was related to issues raised in the exploratory study and issues raised in the literature.	The medication administration process was operationalized as for RQ 1.1. Factors nurses perceive lead to errors in the process was operationalized by means of: Survey question 24: Have you ever been interrupted during the medication administration process? Survey question 25: How many times during one patient medication prep or administration have you been interrupted? Survey question 26: At what point in the medication administration process was the interruption? Survey question 27: Have you ever self-interrupted during the medication administration process? Survey question 28: How did you self-interrupt?

Table 3.2 Survey Design for Research Question 2

How can interactions between nurses and technology be improved to support the medication administration process?

Research Question	Conceptualization	Operationalization
RQ 2.1 Does the physical layout of medication and supplies storage conform with best practices for medication administration?	Typical physical layout and storage systems were explored through the literature and the exploratory study, to define a standard set of arrangements for medication administration support.	Physical layout was operationalized by means of the following questions: Survey question 19: What are the sources of medication storage on your floor? Survey question 20: Is your medication cart kept in a closed, locked room? Survey question 22: Are the supplies necessary for the medication administration located in the same place as the medications? Survey question 23: Please describe the location of the supplies needed to administer medications.
RQ 2.2 What technology systems are used to support medication administration?	Typical technology systems were explored through the literature and the exploratory study, to define a standard set of common technologies.	Operationalized through a list of common technologies used elicited from exploratory study: Survey question 29: Do you utilize any of the following technologies with medication administration? BCMA (barcoding) CPOE (computerized order entry) Automated dispensing machine (Pyxis) Smart pumps (with electronic library built in) Syringe pumps Computer on wheels Other (please specify) – open-ended question
RQ 2.3 How do the technology systems used affect nurses' workflow, in medication administration?	The issues of technology-instigated workflow interruptions, diversions or workarounds were identified as critical issues from the literature review and the exploratory study.	Operationalized through: Survey question 30: Do the technologies utilized with the administration of medications affect your workflow? Survey Question 31: Please describe how the workflow has changed.
RQ 2.4 How does the use of various systems increase or reduce errors in nursing medication administration?	The occurrence of errors was ascertained by asking the nurse to self-report. The occurrence of an error was related to the use of technologies found in RQ 2.2.	Systems that increase or reduce errors in the process was operationalized by means of: Survey question 32: Has the use of technology during the medication administration process caused a medication error? Survey question 33: Please describe how the technologies utilized with the medication administration caused an error.

Table 3.3 Survey Design for Research Question 3

How does the hospital culture affect the reporting of medication administration errors and what type of errors are not reported?

Research Question	Conceptualization	Operationalization
RQ 3.1 Do nurses understand what constitutes reportable vs. non-reportable medication errors?	Understanding of medication errors was conceptualized as a combination of: Definition of what is an error When to report an error	Nurses' understanding of medication errors was operationalized by means of: Survey question 34: I am usually sure what constitutes a medication error. Survey question 35: I am usually sure when a medication error should be reported using an incident report/electronic submission.
RQ 3.2 Why do nurses fail to report medication errors?	Reasons why medication error are not reported was conceptualized from the literature, as a combination of: The error is not serious enough to warrant reporting Other reasons why an error may not have been reported.	Reasons for failure to report medication errors was operationalized by means of: Survey question 38: Have you ever failed to report a medication error because you did not think the error was serious to warrant reporting? Survey question 40: Have you ever failed to report a medication error for any other reason and why?
RQ 3.3 Does the local culture or working environment reporting prevent nurses from reporting medication errors?	Ensuring that nurses report errors was conceptualized in terms of the culture of the reporting and the fear of reaction from: Management Co-workers Retribution.	Ensuring that nurses report errors was operationalized by means of: Survey question 36: Some medication errors are not reported because of the reaction from management Survey question 37: Some medication errors are not reported because of the reaction from co workers Survey question 39: Have you ever failed to report a medication error because you were afraid that you would be subject to disciplinary action or even lose your job?

The survey was designed around closed questions for most issues, with open-ended questions used to obtain suggestions from respondents concerning the reasons for medication errors, suggestions for policy changes, and technology support issues (Appendix B). The online survey included matrix format questions with related concepts (Munhall & Chenail, 2008).

In the development step, content domain, sampling, and development of a usable format are identified and applied. According to Lynn (1986), reliability is the ability of

the tool to produce consistent information that can be repeated. The survey was assessed for clarity and reliability by eight nurses who were directly involved in the medication administration process. Small changes to wording and the ordering of questions were made as a result of this evaluation.

3.3.2 Survey Data Collection and Analysis

The survey for the research was developed in Survey Monkey® and launched via a state nursing website over the Internet. A survey allows for an aggregate data assessment of perspectives and issues surrounding the topic of research (Fink, 2006). The survey invitation was sent as an email with a short explanation intended to describe the purpose of the survey of potential participants were advised that the survey sought objective information about medication administration rather than personal information as this was thought likely to increase the response rate (Fink, 2006). The introductory information explained that the survey was anonymous; the respondent did not have to complete the survey. The end of the survey contained an additional link, which took the respondent to a different page where they could agree to a post-survey interview. This separated any personally identifying information from survey responses.

The researcher contacted the Pennsylvania State Nurses Association where the researcher resides to determine interest in data from their constituents concerning technology, issues, and processes in administration of medication and the culture of error reporting amidst the medication administration process. The PSNA (Pennsylvania State Nurses Association) emailed the introductory letter (Appendix C) which included the Survey Monkey® link to1500 PSNA members. Respondents were given three weeks to complete the study with 70 nurses responding to the survey. Due to the low response rate,

a second email was sent out with an additional 25 surveys completed. Subsequently, three days later a Facebook® link and a posting of the survey on the home page of the PSNA increased the final survey respondents to 112 after being open for five weeks. The return rate (number of invitations sent in relation to the number of completed surveys) on the Internet survey was 7.5%. Of the 112 members who started the survey, 22 nurses offered to participate in the post survey interview request. Twenty respondents did not complete the survey, stopping their responses before the medication administration questions. These results were removed prior to data analysis.

Several factors may have affected the response rate to the survey. The survey was regarding medication administration and the technology, but the introductory letter did not clearly state the need for a current knowledge of medication administration processes. The letter assured anonymity, but some of the nurses may not have completed or participated in the study looking at medication technologies and errors due to fear of exposure.

Data collected from the survey were analyzed to produce summary statistics. These permitted an analysis of the relationships between concepts suggested by the literature review and summarized in Tables 3.1, 3.2 and 3.3 above. Open-ended questions were coded qualitatively, using content analysis to categorize themes and issues related to the research question concepts. Findings from the survey are reported in Chapter 4.

3.4 Phase 3: Post Survey Interviews

3.4.1 Post-Survey Participants and Method

The post interview survey questions were conducted over the phone. In seeking participants to complete the post-survey interviews, the survey was structured such that

the last question of the online survey asked if the nurse would be willing to participate in an interview to delve into further detail about the survey. Of the 112 survey respondents, 22 nurses agreed to a follow up interview. One of the respondents did not give full contact information and was unable to be contacted and five nurses stated they are not involved with medication administration and could not answer the questions. Of the remaining 16 respondents, seven of the nurses were called four times without any ability to make contact. Nine nurses agreed to the post survey interview and were happy to assist with the research. Of the nine individuals who agreed to be interviewed and completed the survey, seven are currently administering medications bedside. One is in a surgical center and one is a volunteer with community immunization outreach.

3.4.2 Post Survey Interview Focus and Analysis

The last question of the online survey that the nurses participated in asked if they would be willing to be interviewed to go into further detail about the survey information. The nine nurses who agreed to a follow-up interview were from the 92 nurses who completed the survey. All of the interviews were conducted by telephone. The interview process asked the subjects to tell rich stories of their work with medication administration, focusing on issues of concern to them. These stories were analyzed to provide themes of interest and to explore in more detail the research questions summarized in Tables 3.2, 3.3 and 3.4. Analysis of the data involved meticulous review and re-review to identify emerging themes. This information was categorized and coded by research question (Appendix F). Findings are reported in Chapter 4.

3.5 Ethical considerations

The process of engagement with nurses, who are speaking about a topic that is sensitive such as medication errors, requires that the researcher create an environment that treats them with the respect and dignity as they share their stories. Prior to beginning the presurvey interviews, the respondents were informed that the information would be anonymous and their privacy maintained as there would be no personal identifiers in any of the data. On the paperwork that has been retained, the interviews are coded with initials, adult or pediatric population the nurse interviewed cared for and type of hospital location such as city or suburban. For the post survey interviews, the information requested their name and a means of contact but only their initials were on the form. To garner a sense of trust with the participants the discussion opened with general questions such as the medication process and when the time was right, inserted the questions about more sensitive questions such as medication errors. Because of the sensitivity of the topic, participants were advised that they could withdraw from the study at any time. The participants were also informed that the results of the study may be published in the future, and no identifying individual information would be used. Interview data were analyzed qualitatively to determine which issues merited the most attention in the survey and to confirm that the participants understood the survey terminology as intended.

3.6 Summary

In an effort to understand nurses' perceptions of the impact of technology on the medication administration process professional nurses were interviewed to explore the issues relevant to the main part of the study, an online survey. Themes and issues arising from the survey were explored in rich interviews that allowed nurses to tell stories of their perceptions of the medication administration process and the impact of processes, technology systems and hospital culture on patient safety.

CHAPTER FOUR: FINDINGS

This study was guided by three specific research questions:

Research Question 1: How do nurses' perceive the factors that contribute to medication errors originating during the medication administration process?

Research Question 2: How can interactions between nurses and technology be improved to support the medication administration process?

Research Question 3: How does the hospital culture affect the reporting of medication administration errors and what type of errors are not reported?

4.1 FINDINGS FROM SURVEY

Survey respondents were drawn from members of the Pennsylvania State Nurses Association (PSNA). 85.9% of survey respondents were female and 13% were male with one survey participant abstaining from the gender question. These findings correlate with a 2012 PSNA members survey were 91.9% of respondents were female and 8.1% male (PSNA, 2012) and are representative of the United States nursing population in general.

Over 82.6% of the nurses who participated in this study have a four-year degree or above. This may be related to qualities of the members of the PSNA or this may be attributed to their desire to help out a fellow nurse with research.

Originally, 112 respondents started the survey. By question 15 of the survey, 20 of the respondents had stopped or sporadically answered questions. Therefore, these data were excluded from data analysis. Some questions analyzed were not answered by 92 nurses; this changed the total number of responses examined for specific questions.

The survey data summary for each question is shown in Appendix E. The responses to the open ended questions have been coded and are listed under the themes column. The themes were summarized and are listed by frequency of responses from higher to lower. The specifics of the findings will be addressed further in this chapter.

4.1.1 How is the Medication Administration Process Facilitated by Nurses' Education?

In reviewing survey question 15, "Do you follow the rights of the medication process each time a medication is administered," 83 of the 92 respondents answered "yes". Nurses reported that they utilize the rights of the medication administration process regardless of their educational level as noted in Table 4.1. The Associate degree nurses were found to follow all of the rights of medication administration.

Table 4.1 Responses to Rights of Medication Survey Question

Education	**Right of Medication Administration?**		**Right that was followed, for those that did not follow the complete rights *(answered No to previous question)***						
	Yes	No	Right patient	Right time	Right route	Right drug	Right dose	Right assess ment	Right evaluat ion
Diploma (n = 8)	6	2	2	2	2	2	2		
Associate (n = 8)	8	0							
BSN (n = 29)	26	3	3	1	1	2	2		
MSN (n = 38)	35	3	2	1	2	2	2		
Terminal (n = 9)	8	1		1					
Totals	83	9	7	5	5	6	6	83	9

The information in Table 4.1 shows that nine of the 92 nurses did not follow the rights of medication administration. Of these nine nurses, a Masters-prepared nurse and a nurse with a PhD in nursing responded they were not able to accurately follow the

standard of time. For one BSN nurse, the right of the correct patient was the only right followed during the medication administration process. For a MSN prepared nurse, no answer was given as to what right was followed. The nurses who did not follow the rights of medication administration varied by educational degrees.

In Table 4.2, the use of standardized procedures is related to the respondent's highest educational degree. The standardized procedures identified by comments from the nurses within the survey are listed on the right side of the table. There are six procedures listed by nurses from all educational levels which may imply that can identify standard practice. The rate of standardized procedures was identified at a higher frequency by nurses who have obtained a four-year degree and higher which may be related to the number of respondents with a four year degree. This may mean that this educational level is more likely to identify a standard practice.

Table 4.2 Education and Standardized Procedure

Education	**Standard procedure**		**Describe standardized procedure**					
	Yes	*No*	*2 patient identifiers*	*Rights of medication administration*	*BCMA*	*Double check high alert medications*	*Hospital policies*	*Washing hands*
Diploma (n = 8)	3	5	1	1	1		1	
Associate (n =8)	2	6			1	1		
BSN (n = 29)	10	19	2	3	4	4	2	1
MSN (n = 38)	16	22	9	8	8	5		
Terminal (n = 9)	3	6	1	1			1	1
Totals	*34*	*58*	*13*	*13*	*14*	*10*	*4*	*2*

4.1.2 How is the Medication Administration Process Facilitated by Nurses' Professional Experience?

The largest number of nurses worked greater than 21 years, which corresponds with current national statistics on working nurses. When examining nurses with greater than 21 years in the profession, over 30 have been on their current unit for greater than 10 years. Nine have been on the unit less than one to two years.

Nurses with 10 to 15 years of experience most often worked in suburban locations; on adult health units; two worked on the same unit since they were originally employed as RNs. Nurses who worked in rural settings were under represented in this survey except in the greater than 21 years of working category.

The second subquestion was analyzed examining the years worked and the use of a standard procedure with the process for the 92 nurse respondents (see Table 4.3). Thirty-four nurses indicated they followed a standard procedure. Twenty-five of these nurses worked on adult hospital units.

The nurses working greater than 21 years group stated an average of 1.16 standard procedures each, the 16 to 20 year group stated 1.75 each, the 10 to 15 year group stated 2.0 each, the 3 to 5 year group stated 1.6 each and the 1 to 2 year group stated 1.33 each. The greater than 21-years working group identified more instances of standards overall but there are far more of them than any other group. For those nurses who have been working greater than 21 years, there were more procedures that were considered a standard. For those who are working less than one year, there was no procedure that was a standard.

Table 4.3 Years Working and Standard Procedure

Years working	**Standard procedure**	**Describe standardized procedure**					
	Yes	*2 patient identifiers*	*Rights of medication administration*	*BCMA*	*Double check high alert medications*	*Hospital policies*	*Washing hands*
<1 year	1	1		1			
1-2 years	2	1	1	2			1
3-5 years	5	1	2	2		1	
6-10 years	1				1		
10-15 years	2	1	1	1	2		
16-20 years	4	2	1	3	3		
>21 years	19	7	8	5	4	3	1
Totals	*34*	*13*	*13*	*14*	*10*	*4*	*2*

When looking at the years the 34 nurse has worked, the bed size of the hospital and if the nurse utilized standardized procedure, two nurses worked in hospitals with a bed size greater than 700. There are seven hospitals in the state with over 700 beds. Eleven of the 34 nurses who utilized standard procedure worked in a 300 to 500 bed hospital and there are 22 hospitals with bed sizes of 300 to 500 in the state. There is standardized practice at all bed sizes for the respondents in the survey.

4.1.3 How is the Medication Administration Process Facilitated by Organizational (Management) Support?

The support from administration was addressed in the survey questions that looked at shift work, breaks, and meals during the nurses' shift as research has shown medication errors can be attributed to fatigue. The shift patterns revealed by these responses are shown in Figure 4.1.

Three who did not answer the shift question (Survey Question 8) did answer the related questions of rotating shifts and permanent shifts (Survey Questions 9 and 10).

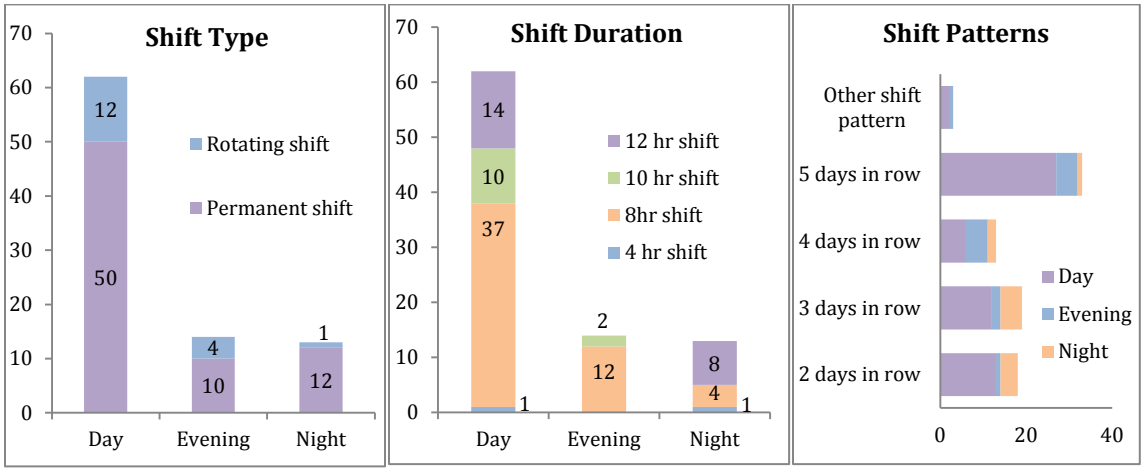

Figure 4.1. Patterns of Shift Work, By Type of Shift

Seventy-nine percent of the respondents working day shift did not rotate shifts and 59% work an eight-hour day shift, 43% work five days a week and 79% have worked at least one shift without a meal break (Table 4.4). On the evening shift nurses, 71% of the nurses rotate, 85% work an eight-hour shift, and 19% have worked at least one shift without a meal break. On the night shift, 92% of nurses work a permanent shift, 61% work 12-hour shifts, and 61% worked a shift without breaks and 92% have worked a shift without a meal. Comments regarding breaks from the nurses included "The workload is too great, I will not receive a break;" "Always work through meal breaks;" "At times, there have been nights when I have not been able to take a meal break."

Table 4.4 Meals and Breaks by Shift Work

	Work shift	**Miss occasional breaks**	**Miss occasional meals**
Number of respondents working Day shift	63 (68.5%)	29 (46.0%)	50 (79.4%)
Number of respondents working Evening shift	13 (14.1%)	10 (76.9%)	12 (92.4)
Number of respondents working Night shift	13 (14.1%)	8 (61.5%)	12 (92.4%)
Number of respondents not reporting shift	3 (3.3%)	2 (15.4%)	2 (15.4%)
Totals	92	49	76

There was variety in the responses for breaks and meals, but the practice of not taking a break or meals does not allow the nurse to refocus, recharge and may contribute to near misses, medication errors, and mistakes during the nurse's shift. There were also two nurses who followed standard procedures, did not rotate shifts, and did get breaks and meals, an ideal situation to promote patient safety.

4.1.4 How Do Interruptions Affect the Medication Administration Process?

91 of the 92 nurses stated they have been interrupted during the medication administration process (Figure 4.2), which may have a negative impact on patient safety (Westbrook et al., 2010).

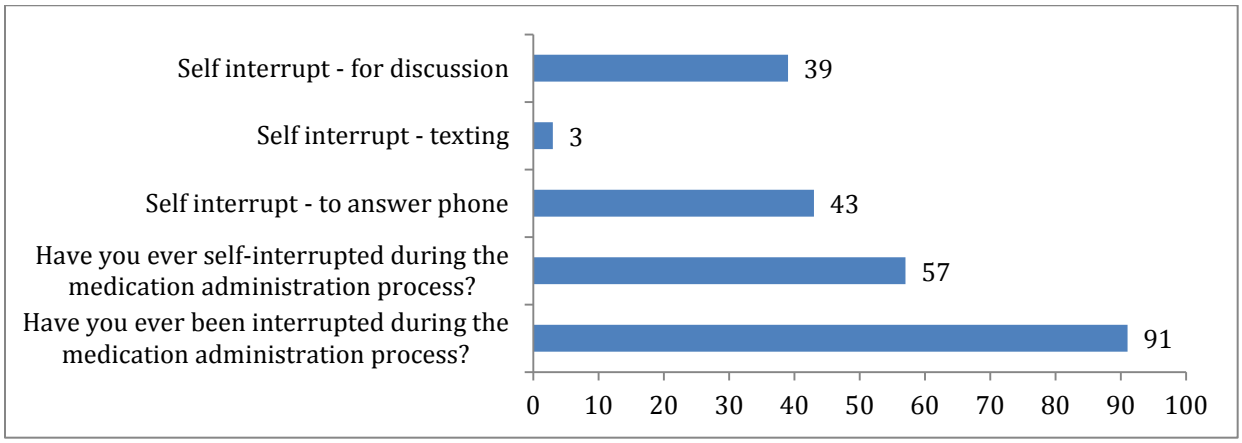

Figure 4.2 Reasons For Interruptions

Nurses were asked how many times in one medication pass they were interrupted. In Figure 4.3, the results show interruptions during the medication administration process. The majority, 89 nurses, had been interrupted at least two to three time during one patient medication administration pass. Thirteen nurses stated they had been interrupted a maximum of greater than six times in one medication administration pass to a patient.

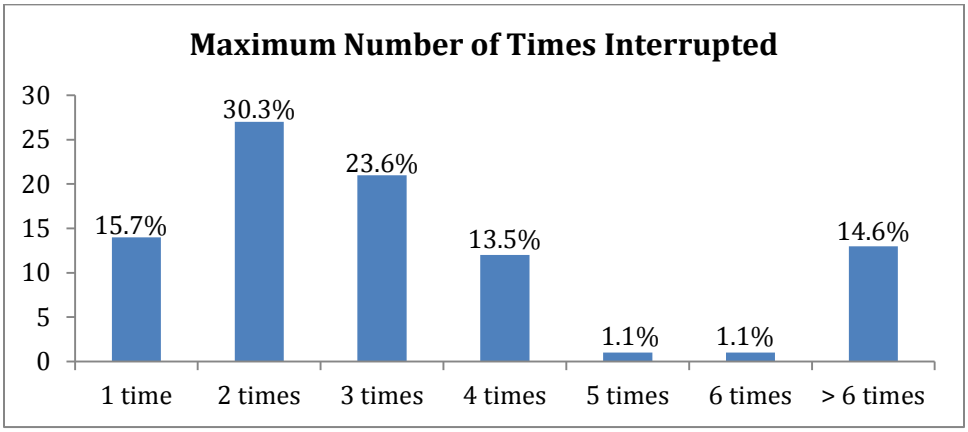

Figure 4.3 Maximum Number of Interruptions During Medication Administration

Nurses were asked at what point did interruptions occur during the medication administration process. In Figure 4.4, the most frequently mentioned locations for interruptions were at the medication cart and walking to the patient's room. Entering the room seems to be the lowest point in the interruption process. Once in the patient's rooms interruptions occurred at a lesser frequency.

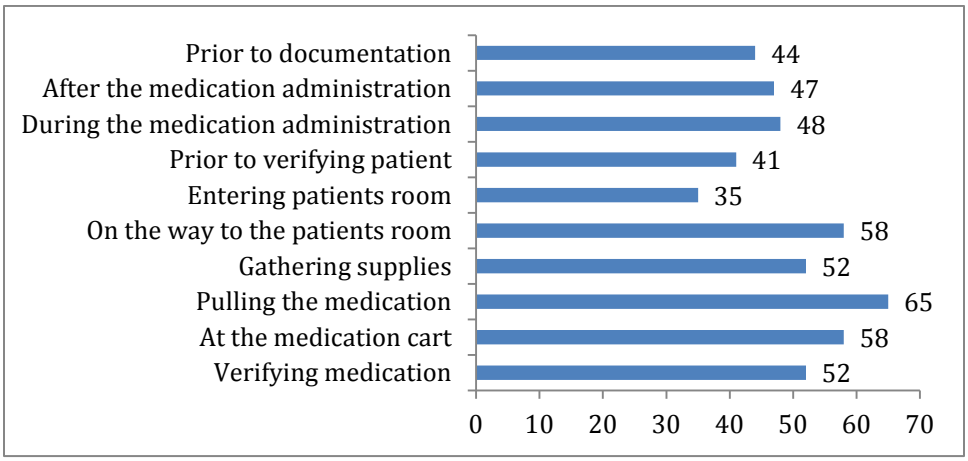

Figure 4.4 Timing of Interruptions During Medication Administration

When asked to describe typical interruptions, the responses were rich with content from the nurses. There were three themes that emerged; helping others, answering questions from patients and families, and asking or answering questions about patients whom the

nurse cared for. Many of the activities that required nurses to stop might be delegated to auxiliary staff. This could allow nurses to focus on the medication administration process. These two responses illustrate typical interruptions:

> *I could not begin to describe these interruptions. We have multiple patients and multiple interruptions. (Nurse 111)*

> *A busy hospital ED, with frequent interruptions that include phone calls, overhead pages, patients and visitors looking for information. (Nurse 33)*

In addition to being interrupted by others during the medication administration process, self-interruption appeared to be a problem, with nurses using cell phones and technology at the bedside. Many nurses had a work-issued phone that allows patients to reach the nurses immediately. This technology resulted in nurses fielding many calls, during high-risk procedures such as medication administration. In addition to the work phone, most nurses had a personal mobile phone as well. So they may well be picking up their personal phone as well.

Figure 4.2 displays self-interruptions, answering the phone and discussion of non-medication issues as the main sources of interruption for many respondents. Three nurses stated they texted while involved in the medication administration process, an act that distracts from direct patient care. Fifteen nurses added comments to the question of how they self-interrupt. Six were patient-or-family related distractions, such as answering questions, call bells, bed alarms (this type of alarm is placed on the top of the bed mattress, directly under the linen with the intent to alarm and alert the nurse if a patient is trying to get out of bed and is common for patients considered a falls risk). A falls risk is an identification (usually identified with a yellow patient wrist band, or yellow slippers) that is used for a patient who may be unsteady on their feet, is confused or unable to

ambulate without assistance. Additional reasons were assisting fellow nurses, answering the phone at the desk and answering student questions. There were no specific responses that the distraction was a personal reason.

4.1.5 Physical Layout of Medication Storage and Supplies

The survey question presented respondents with a list of possible options: storage automated dispensing machine (Pyxis is a common source), a medication cart, stock medication, a refrigerators as well as providing the option to write in responses. The nurses could select all that apply in their answer choices. The overall findings show an even split from the 92 nurses in the findings for storage of medications (Table 4.5).

Table 4.5 Sources of Medication Storage

Storage	Yes
Automated dispensing machine (Pyxis)	53
Medication cart	38
Stock medication	29
Refrigerator	44

There are a variety of storage options for medications, on the patient units, with a Pyxis utilized by 53 respondents. Interesting, the numbers reverse for the nurses with a medication cart and those with a Pyxis. It appears the refrigerator was very similar to those who had them on the floor and those who did not. It would be interesting to see what medications are utilized on the floors with and without the refrigerator as there are some common medications requiring refrigeration. In the write-in option, 22 nurses responded. Eight nurses indicated that patients' medications were in a locked drawer or cabinet in the patients' room, five nurses indicated that medications were in a locked cabinet. All of the nurses stated the medications were kept locked, which is a good factor for patient safety.

Forty nurses noted that the medication cart was kept in a closed locked room and 49 nurses indicated it was not. Regarding the question on location of the medication cart, 33 nurses reported it was in a locked area. This can decrease some interruptions (Table 4.6). For the other 55 responses, the location of the medication cart was located in high traffic zones such as the nurses' station and hallways.

Table 4.6 Medication Cart Locations

Cart Location	Responses	Additional responses
Locked medication room	30	Most respondents stated medication room was only accessible with ID swipe or locked room
In nurses' station	31	The location within the nurses station varied from a locked medication cart, to a no walk zone reserved for nursing, to the center of the unit
In patient's room	6	Locked drawer in patient's room
Locked in the hallways	16	The medication carts stored in the halls, but locked between use
Other	11	Varies from client to client; Don't use a med cart

Most medications require additional equipment and supplies to be utilized during the administration process. Seventy-one respondents indicated that medication supplies were kept in the same place as the medications. This could reduce interruptions during the administration process and allow the nurse to stay focused on the task at hand.

Table 4.7 Location of Supplies When Not in Same Location as Medications

Location	Total responses	Additional responses
Across the hall	5	In a closet, at either end of the hall in a locked room, the adjacent locked supply room, and clean utility room
In the patients room	3	Bedside carts, locked drawers next to the patient bedside
In the nurses' station	3	In drawers, in supply storage cabinets
Close by	5	In various locations such as storage supply cabinets flushes in med room, in the kitchen for food/drink, in the IV storage stock, in the Pharmacy IV stock, stock the patients room with supplies, but no set location,
Other	2	N/A

Twenty respondents stated supplies were not stored in the same location as medications. Table 4.7 describes the location of supplies as stated by 18 nurses.

It was reported that the rate/number of medications to be administered to patients over the course of a shift is a major issue for nurses. This was reinforced when conducting the post survey interviews when a nurse stated that the medication tools help the nurse with safety and following the rights of medication administration. But unfortunately the process has gotten very cumbersome with interruptions and distractions and over 70 medications for patients over the course of the shift.

4.1.6 Technologies to Support the Medication Administration

From the literature review and exploratory study, the tools included in the survey were barcoding, CPOE, Pyxis or automated medication cabinet, a computer on wheel, smart pumps and a syringe pump. There were 14 nurses who did not utilize any of the technologies listed, and 10 nurses who used all of the listed technologies. More than 85% of nurses are using a Pyxis; 71% utilize computer on wheels, 58% use smart pumps, and 48% utilize barcoding for the medication administration process. The majority of the nurses are using some group of technology and systems for medication administration with 29 nurses using both BCMA and CPOE. Fifty-six of the nurses used the computer on wheels with another technology. There were 23 nurses who used only one or two technologies to administer medications. For the nurses who chose the “other” section in survey question 29, examples included the use of paper medication administration combined with an electronic process, the use of bar coding with computers at the patient bedside and that a computer on wheels locks the medication drawers after five seconds as a safeguard.

Concerning the nurses who utilize technology, follow a standard and follow the rights of the medication administration process, 32 utilized both the rights of medication administration and a standardized process. These respondents' responses were compared to the technologies utilized with the medication administration process. In Table 4.8, three of the 32 nurses utilized the rights of medication administration and a standard process using all of the technologies, which include BCME, CPOE, a Pyxis, syringe pumps, smart pumps, and a computer on wheels. Two nurses did not use any of the survey examples of technologies while using the rights of medication administration and standardization. Fifty-one respondents utilized the rights of medication administration, but did not use standard procedures; 10 did not report use of any technologies listed.

Table 4.8 Technologies Used By Nurses Using Rights or Standardized Procedures

Technologies employed	**Aspect of medication administration standardized by technology**	**Rights AND standardized procedure**	**Rights but NO standardized procedures**	**Standards used, but NO rights**
BCMA	Bar code medication to ensure correct med. is administered	19	17	
CPOE	Relates patient data to diagnostic results	20	22	
Pyxis	Automates medication dispensation to ensure right medication and dose	26	35	
Smart pump	Automates dose of medication with internal medication library information	18	23	
Syringe pump	Automates dose of medication for small volumes of medications	9	13	
Computer on wheels	Allows nurse to retrieve patient information check order, and enter time and dose of meds administered	25	25	
Total No. of Respondents	***Note:** Many respondents reported use of multiple technologies so some may appear "double counted"*	*32*	*51*	*0*

A common factor is the utilization of the mental checklist of the rights of the medication administration among nurses who utilize technology and those who do not.

There are similar number of nurses who are using technologies along with standardized procedure and rights of medication administration and those not using standardizations.

4.1.7 Effect of Technology on Workflow in Medication Administration

The question of workflow changes followed the types of technology utilized by nurses during the medication process. Sixty-one of the 92 respondents were affected by technology utilized in the medication administration process. Ten did not respond to the survey question. These 10 nurses did not utilize any of the technologies listed and did not answer the question regarding workflow issues with the technologies. Nine who had workflow changes utilized all of the technologies, with 52 nurses using a variety of technologies during medication administration. Seven of the nurses who used all of the technologies except the syringe pump with one nurse stating the technology was slower and more time consuming while at the same time safer for the nurse. For one of the five nurses who uses barcoding, CPOE, Pyxis, and the computer on wheels the process is slower with technology, the need to have some medications double checked and the waiting for a free computer on wheels or access to the Pyxis slows down the process. At the same time, the technology has given the nurse security as a fall back mechanism for patient safety.

Twenty-one nurses reported they did not notice changes in workflow with technologies. Six did not use any technologies listed. Seventeen did not utilize the listed technologies and did not have workflow issues. To summarize, 75 nurses using technology and 61 of the 75 or 81% experienced workflow changes.

Survey question 31 was an open-ended item for the workflow changes; 42 respondents noted the medication administration process became slower. Themes

identified were: the first was the process was slower because the technology was slower, failed, or there were issues with the scanner; process was more complex; technology required additional steps; adequate computers were lacking; nurses resisted using technology; additional time was required to enter data into computers; and positive impact on workflow changes. Workflow changes may have a negative impact on patient care as described by respondents:

> *I feel like I am "nursing" the computer on wheels instead of the patient. (Nurse 5)*
>
> *All of the medication checking and waiting until another nurse is available definitely interrupts the flow of my operations, it takes so much time!!! (Nurse 28)*
>
> *Have to wait to use two med dispense machines (Pyxis), contents are not same in either machine and sometimes have to go to both machines to obtain meds for one patient. (Nurse 107)*
>
> *…I honestly don't know how the staff nurse gets through med administration without errors. It is time-consuming. And, nurses seem to more frequently be the answer to solve system or other department problems. It's a tough world out there for bedside nurses. (Nurse 108)*

Fifteen nurses described the medication administration process safer due to decreased errors and improved workflow:

> *On most days, workflow has improved. When the technologies work correctly, the rights of medications are done with more ease and speed and help with accuracy. When they do not work, they consume more time cause frustration and may affect medication administration. (Nurse 77)*

These positive changes to the workflow utilizing the tools for administration focus on the safety aspect of the process such as a faster and more efficient process.

4.1.8 Systems Increase or Reduce Errors in Medication Administration

Eighty-four nurses answered the survey question related to technology cause a medication error. Sixty-seven nurses reported the technology did not cause a medication

error while 21 indicated the technology did cause errors. Twenty-two percent of the nurses who worked at least a shift without a break or a meal responded that yes to this question. Six percent of the nurses who answered “yes” to this question worked off shift. (Appendix D). Eight nurses did not answer the question and four of these eight nurses did not use any of the technologies listed (Table 4.9).

For the 21 nurses who stated the technology caused an error, 66% were using a CPOE, 80% use a Pyxis and 61% use a computer on wheels. Thirty-eight percent were use the Pyxis, CPOE as well as a computer on wheels when administering medications. Fourteen percent are not using any of the technologies listed. Four general themes for the causes of errors include; the dispensing or medication administration technology caused an error, the dispensing or medication administration technology caused a documentation error, the medication technology and the packaging lead to an error and latent (human) errors obscured by technology. Specific technology that was discussed in the comment section includes the Pyxis with incorrect medications being placed in the drawers, and the wrong drawers opening for the nurse. These appear to be human error or may be related to a lack of redundancy from the pharmacy. For the CPOE, the errors appear to be related to learning the technology, as well as non-specific errors. Latent errors such as barcoding errors were related to the inflexibility of the system in relation to time, scanner broken or not able to scan. Three respondents did not utilize any of the listed technologies but did indicate they lead to an error.

Table 4.9 Types of Error Cause or Prevention, By Technology-Type

	BCMA	CPOE	Pyxis	Computer on wheels	Totals
Causes errors					
The dispensing or administration technology causes medication errors			3		3
The dispensing or administration technology causes a *recording* error		2		1	3
Latent (human) errors are obscured by the technology		5	4		9
The medication technology or packaging leads to errors	2	2	3	3	11
Unexplained error reported				1	1
Prevents errors					
The dispensing or administration technology enforces checks on medication administration	3	2	3	2	10
The medication technology or packaging leads to fewer errors	1	1		1	3
Technology leads to safer process	4	8		7	19

There were 14 nurses who stated the technology prevented errors or improved patient safety. Interestingly, one of the nurses was not using any of the listed technologies, but addressed the medication packaging as a patient improvement. Eighty-five percent of the nurses use CPOE; 71% were using a computer on wheels and 71% use a Pyxis. Of the 14 nurses, 57% are using CPOE, Pyxis and a computer on wheels.

The three general themes for preventing errors during the medication administration process were with the dispensing of medications from the pharmacy and administration technology enforces checks during the medication administration process, as well as the medication technology and packaging labels lead to fewer errors and the technology has lead to safer process.

4.1.9 Reportable vs. Non Reportable Errors

In reviewing the questions on culture of error reporting, 88 of the respondents were usually sure what constituted a medication error and when an error should be reported, as seen in Figure 4.5.

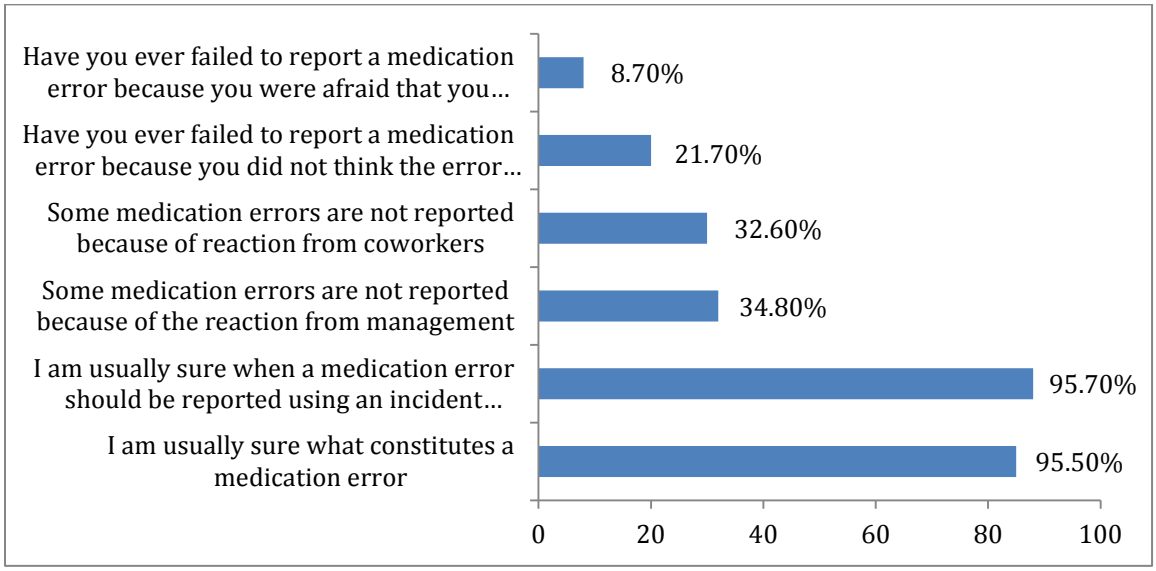

Figure 4.5 Issues With Error Reporting

The rights of medication administration are standard medication administration activities. One nurse summarized these the challenges of correct performance in clinical situations:

> *I may have done #35 (survey question of sure when a medication error should be reported.).... What constitutes a medication error? Given at the wrong time? What is the wrong time? Giving it other than what pharmacy staff put it in for? Or giving it at a time for the patient that it would do the patient the most benefit? For example, isosorbide (used to treat angina) and levothyrozxine (a thyroid medication) should be given before breakfast, so if I given them at 0600 and they are ordered for 1000, is that a med error? (Nurse 26)*

In addition, many commercial incident reports fail to elicit interruptions as a cause of medication administration errors.

4.1.10 Failure to Report Medication Errors

Twenty respondents noted that they would not report an error if it was not deemed a serious error. It follows that nurses may judge seriousness of errors differently with patients possibly in jeopardy.

> *...I do not think my institution is particularly abusive. But I do think nurses fear retribution. No, I have not. And, I do not think my institution is particularly abusive. But I do think nurses fear retribution. Probably one of the most important areas for reporting that is under-reported is the 'almost' med error. Errors prevented by nursing or pharmacy, but it's too busy (and don't think of causing overtime) for nurses to take the time to fill out the form to report a potential error. But, that is where process changes can take place and is probably the important piece of med error reporting. (Nurse 108)*

Twenty reported their medication error. Four reported that they did not discuss the error for fear of repercussions from other nurses and /or managers (or administrators).

When asked if they had ever failed to report a medication error and why, 34 nurses responded (Question 40). For the 12 nurses who had an error not reported, themes of fear of repercussion, near misses, too busy to report, pulled two pills but the patient only wanted one pill, and not updated in the charting were the common reasons for errors.

4.1.11 Does the Local Culture Prevent Reporting of Errors?

To examine the nurses' work culture, three questions addressed the reporting of errors and responses from coworkers and administrators (or managers) and fear of repercussions. About 30% of the nurses answered yes to the questions that an error would not be reported due to the response from management and co-workers. Eight respondents stated yes that an error might not be reported due to fear of losing a job. For the nurses who are at the level of advanced beginner or below, greater than 34% answered yes.

Three nurses answered "yes" to all of the reporting questions, noting they do not report due to the fear of co-worker or manager reactions, fear of job loss or uncertainty over whether an error was serious enough to require reporting.

4.2 Findings from Post-Survey Interviews

Of the 92 survey respondents, 10% volunteered to participate in a follow up interview. Of the nine respondents interviewed, seven are currently administering medications at the bedside, one nurse is working in a surgical center where there are pre and post operative medication administration and one nurse is a volunteer with community immunization outreach with multiple vaccine administrations to community members. All survey data for these nine nurses was included in the survey results. The post survey interviews questions were introduced dependent on the flow of information and rich stories the nurses shared. (Appendix F). The analysis revealed the following major themes and issues related to the research questions (Appendix D).

4.2.1 Medication Administration Processes and Tools Utilized

Seven nurses interviewed are using scanning and computerized medication administration technology at the bedside. When the nurses were answering the question about the medication administration process, the tools utilized with the process flowed into the information that was shared. This process utilizes the tools of a computer on wheels or a computer at the bedside, a scanning device, either mobile or tethered to the computer on wheels. All utilized an IV pump that was electronic and had programmable information within the system such as a medication library.

All of the nurses working at the bedside utilized a computer and scanning capabilities at the bedside to complete the process. The nurses all stated that when the scanning process works, it works well. It allows the nurse to speed up the medication administration process, utilize the “rights” of medication administration, while assuring they are giving safe care to their patients. All of the nurses stated that if there was

anything specific that needed to be documented with the medication administration, such as where on the abdomen the Lovanox (subcutaneous medication given by injection to prevent blood clots) was administered, the nurse would tap on the chart icon and document the specific information such as site location. The process that these nurses described did not vary much from nurse to nurse, and correlates with the literature and survey results on the medication administration process utilizing the technologies available.

4.2.2 Patient Safety Procedures in Medication Administration Processes

Each nurse stated that the technology is utilized in tandem with the 'rights' of medication administration. A nurse stated that while scanning the patient bracelet (with the patient medical record number on it), the nurse asks the patient their name and date of birth (use of two unique patient identifiers per the standard of practice). In addition, while scanning the medications, the nurse will discuss with the patient each of the medications and conduct any necessary patient education that may be needed.

A nurse shared the story of the administration of regular Insulin, a high alert medication prior to the days of double check for Insulin, which is now considered a high alert medication. The nurse had a bottle of Insulin that was scanned and drew up 13 cc of Insulin (a much higher dose than the 1.3 cc of Insulin that was to be given to the patient). Since we did not have double checks back in the day, the nurse made a "common" math error and the patient was given a much higher dose of medication than ordered (Nurse 7, post survey interview). This is a serious medication error that would have a negative impact on the patient. As a result of errors such as this, high alert medications such as

Heparin, Insulin and chemotherapeutic medications are double-checked and co signed with a second RN before the medication is given to the patient.

The nurses who were interviewed discussed the rights of the medication administration process, as well as the standards of care, double check with high alert medications, and two unique identifiers with patient identification as noted from the survey and literature review. These themes are all standards of the medication administration process that should be followed by nurses administering medications to patients.

4.2.3 Process Checks and Standardization

SBAR and communication are incorporated within the medication administration process. The nurses, in their discussion of the process, stated how they interact with the patient during the medication administration process by answering any questions and educating the patient about the medications they were on, the reason why they were on the medication, and the expected and unexpected outcomes. Nurses also stated they would speak with pharmacy, laboratory, and primary care providers regarding questions that may arise as a result of the medication process for an individual patient.

> *When I am in the room pouring out the medications into the soufflé cup, I state what each medication is for the patient. This is my third check to myself of the medication and it allows the patient to hear what is being put in the cup. Many times the pills may not look the same as the pills they take at home, so this is a check for the patient as well. If at that time any education needs to be done, it opens the window of opportunity. (Nurse 9, post survey interview)*

In the survey the nurses stated they spent time on the phone with verification of orders, medications, questions, responding to questions from others and this information correlates with the survey responses.

4.2.4 Impact of Hospital Policies on Patient Safety

One nurse described the process at the facility that only one person is expected to be in the medication room at any given time to decrease interruptions and promote patient safety. The nurse stated that although this is the policy it is difficult to enforce "…the staff numbers are down, so there is no way we could just have one person in the medication room at a time, it is a good idea, but not at this time…." (Nurse 5, post survey interview). This is in part due to the increase workload for the nurses due to the decrease in nurses on staff employed.

For four of the nurses interviewed, interruptions and working without breaks or meals are commonplace. Nurses stated they support each other during the course of a shift, care for each other's patients, with only one or two nursing assistants on the floor. In an attempt to meet the needs of the patients working with the staff on hand, the practice of working without breaks or meals, should be looked at from hospital managers and administration as it may impact patient safety negatively

4.2.5 Benefits and Cons of the Technologies

For the nurses interviewed, the benefits of utilizing the technology were that it became easier to give the correct medication, correct dose and follow the rights of the medication administration. The nurses also felt safer when using the technology. This was especially evident for one nurse after she caught herself in an "ah-ha" moment. The technology helped this nurse realize she was in the wrong room to give the medication. Additionally, the knowledge that pharmacy has completed a double check on the medications is a reassurance to the nurse. All of the nurses stated that being able to read

the information right from a computerized screen, and not from handwritten paper orders, has been a tremendous help in preventing errors.

The cons for the use of the technology are that the computer sometimes shuts down due to overuse or the battery may die, causing the computer to freeze up and forcing the nurse to restart it. Two of the nurses described difficulty with Internet connectivity due to wireless signal issues. The need to have to open up the documentation area of the medication administration system to see the parameters that must be entered before administering the medication (such as heart rate or blood pressure) is an issue for some of the nurses. In the past, documentation was a smooth and well-known process that did not require additional steps.

Issues with the bar coding scanners included device malfunctions, dead batteries, the need to switch out scanners, smeared bar codes on the medication labels and patient bracelets, difficulty scanning curved bottles (like IV bottles), difficulty scanning wrinkled bar codes (as on ointment bottles) and having to manually input in the bar code number.

The nurses stated that there are not enough computers on wheels on the floors for the nurses, especially on day shift when there may be more demands for the computers from nurses in orientation and student nurses. When there is a computer downtime, the nurses must go back to paper documentation. For example, if there is downtime on night shift and the nurses used a paper medication administration form to document the administration of medications, a nurse who is working on days would log onto the computers and see the night medications missing and highlighted in pink. The day shift nurse would have to put down that the medication was documented in the paper MAR in the patient charts. These paper pages would later be scanned and become part of the

electronic chart upon discharge. For new practitioners who have only used electronic technology for the medication administration process, one nurse questioned if they are looking at the medication and the label as well as verifying the expiration date before administering the medication.

4.2.6 Overrides of the Medication Administration Systems

Overrides or workarounds did not seem to be an important problem with the nurses interviewed. One nurse shared that in two units within the hospital they are trying to control all overrides of the system. The only exception to an override would be a rapid response (a nurse would call for the rapid response team if the patients condition is deteriorating). One nurse stated that the potential for errors might occur if a nurse bypassed the intended usage of the technology. Another stated that in the past there would be nurses who would scan all of their patients' medications for one time period ahead of the scheduled medication administration time utilizing some of the older technology system. Now with newer systems, this cannot be done without first scanning the patient.

4.2.7 Issues with the Tools That Lead to an Error

One nurse stated they had documented on the computer on wheels with the BCMA system, where on the abdomen the Lovanox was given, but when they went in for the afternoon medication pass, there was nothing in the chart regarding the morning documentation. The system should have picked that up there was no documentation with the medication administration of the Lovanox. The nurse called the RN in charge, manually scanned the correction, emailed the IT department with the situation as well as completed an incident report. One nurse stated a concern with the technology when

scanning an IV bag that may have additives within the bag. One IV bag with two items presents difficulty scanning both items individually.

Another story was that the errors emanate from pharmacy, specifically errors related to packaging. The nurse had a LASA (look alike- sound alike) medication in the drawer and when the nurse looked at the medication, scanned the medication, which let the nurse know it was the wrong medication in the bin. The medication was labeled for the correct patient: a pharmacy error. Another situation was where the bar code on the bag containing the medication for the patient, but the medication within the bag was incorrect. The nurses stated pharmacy errors might be due to pharmacy drop off (putting the medication in the wrong drawer). As a result, one of the nurses stated this reinforces why you have to continue to read the labels and the orders and not to assume anything and continue with the rights of the administration process.

One nurse questioned the issues with the technology with regard to the storage of the low risk medication in the Pyxis, and not in the patient's room with the other routine low risk medications. These are not the routine medications stored in the Pyxis but low risk medications such as Tylenol or Colace (a stool softener). This causes an increase in interruptions when the nurse has to leave the patient room, retrieve the medication from the Pyxis and return to the patient. As one nurse stated, an RN can not walk a straight line to do this process, because on the way back to retrieve the medication there are requests to help a fellow nurse, answer a call bell, or a similar routine request, all of which can cause the nurse to get distracted or interrupted from the task at hand. This nurse stated that if she was timed out from her initial patient and medication scanning due to the time she spent helping others on her way to get her Colace, she would have to begin the

scanning process from the beginning by scanning all of the medications again, scan the patient which increases the time to administer medications.

4.2.8 Reportable vs. Not Reportable Errors

With the electronic reporting systems, the process is not as cumbersome as days of old with paper-and-pen submissions; the intent is not to point fingers but about what went wrong, as one nurse stated. With reporting, this nurse feels that an improved attitude has been seen with reporting of all errors. According to one nurse "the medication process has become cumbersome with the interruptions with up to 25 patients to give out medications per shift" (Nurse 7, post survey interview).

Most of the nurses stated that a person would have to "try very hard" to have an error with the current computerized technologies utilized on the patient floors. They stated that missing one of the rights of the medication administration process would constitute a reportable error. For example, one nurse stated:

> *…I completed the process of hanging the antibiotic Ancef, the IV tubing was primed, the IV bag was hung, the tubing placed within the IV pump, the pump was plugged into the wall, the patient's IV site was checked for patency and all was ready. I returned at the end of the scheduled time of the medication to realize the IV pump was not turned on, the medication had not infused and the patient had not received their scheduled dose. An incident report was completed for this error because it was my fault. (Nurse 5, post survey interview)*

Two of the nurses interviewed stated that if they caught themselves before a near miss occurred, they would not constitute that as an error, as they felt they were distracted but they did not follow through with the activity, therefore, no harm, no foul.

4.2.9 Failure to report medication errors

Six of the nurses interviewed have not had to complete a medication incident report, as they have not had a medication error but were able to describe when to report an error. The two nurses who had completed an incident report stated that they reported errors with inappropriate waste of narcotics, and one incident that occurred when the pharmacy could not get the medication to the floor during the time it was scheduled for the patient. The nurse stated the incident report was completed "…to improve the process moving forward, not to get anyone in trouble" (Nurse 3, post survey interview).

The nurses felt that if the medication administration process was followed, technology used correctly, and near misses and actual errors were reported the process would improve. One nurse stated that standardizing the process for waste of narcotics and increased awareness of when an incident report must be completed has improved reporting at their facility. Another nurse stated that having more of the 'standard' medications, such as Colace, in the patient drawer and not locked up would decrease the number of interruptions during the medication administration process.

> *"I know the patient and did not pick up the scanner' as one nurse explained why when she did not pick up the scanner and was going to just give the patient the medications. This nurse 'knew' the patient and did not stay on task of following the steps in the process of administering medications, which could lead to a potential error by not following the standardized steps" (Nurse 9, post survey interview).*

4.2.10 Summary of Post Survey Interviews

The post survey interviews asked the nurses to discuss the process of administering medications at their facility. During the course of the interviews for many nurses, the factors that contribute to medication errors originating during the medication administration process were brought up. Topics that were included were the

organizational support and interruptions that may have an affect on the medication administration process.

When questioned on the standardization and process checks, communication was a critical element stated by the nurses interviewed. Nurses in the surveys and the post survey interviews brought up the topic of the use of double checks with high alert medications. Many of the nurses raised the issue of communication but the formal use the acronym SBAR was not stated by each nurse in the post interviews. This may explain why there were no survey responses on the use of SBAR as a standard method of communication.

In regard to organizational support to promote safety with the medication administration process, the impact of a distraction free environment to administer the medications, such as a locked medication room was important to the nurses. Yet with the lack of sufficient numbers of nurses per patient ratio, this concept cannot be initiated. As a result, the problem of interruptions and the effect on the medication administration process will continue to cause a problem with patient safety. The chapter acknowledges that nurses perceive workflow issues caused by broken tools, missing or wrong medications in the patient drawers, as a key factor contributing to medication errors in the medication administration process.

Nurses stated the technology offered the layer of safety and support that the paper-and-pen system could not. Yet the technology had its own set of issues, such as time, distractions, and potential errors secondary to the systems. The nurse stated that overrides are not acceptable practice; they also stated that if a nurse wanted to bypass a process, there was probably a way but this was not part of his or her personal standard of practice.

The nurses questioned some of the logic with the systems and the process that actually increased the workload for the nurse, such as the need to have low risk medications Colace in the Pyxis and not in the patient drawers. The nursing practice needs to work with the system to be in tandem for the medication

The post-survey interviews themes on the aspect of errors, error reporting, and the culture of the environment show that nurses are usually reporting the errors, but that there are situations where errors are not being reported due to time constraints or in the nurses opinion didn't feel the situation was not an error.

This chapter presented the results and interview findings addressing the research questions. The results show that many nurses are working with the best equipment available to administer medications, yet there is still much to be done to protect both the patients and the nurses. The technologies have been improving the process of administering medication and promoting patient safety, but the nursing profession has not kept pace with the infusing of the technologies into the medication administration process.

CHAPTER FIVE: DISCUSSION OF FINDINGS AND CONCLUSIONS

5.1 Summary of the Main Findings

5.1.1 Research Question 1: How do nurses perceive the factors that contribute to medication errors originating during the medication administration process?

This question was separated into four parts dealing with nurses' education, professional experience, organizational (management) support, and interruptions to the medication administration process.

RQ1.1 How is the medication administration process facilitated by a nurse's education?

With respect to education, nine nurses surveyed had a doctoral degree, 32 were masters prepared, 29 were BSN prepared, eight had an associate degree in nursing, and eight had a nursing diploma degree. Regardless of the nurses' degree, an overwhelming majority of the nurses stated that they followed the rights of medication administration. Nine nurses said they did not follow the rights, and those nurses' education levels ranged from diploma to doctoral. Therefore, this portion of the survey allows us to conclude that most educated nurses follow the rights, yet, when nurses did not follow the rights, it is not a function of their level of education. However, with respect to standardized procedures, nurses with a four-year degree or higher tended to be more consistent in following standardized procedures.

RQ 1.2 How is the medication administration process facilitated by a nurse's professional experience?

The number of years a nurse has worked does marginally affect the medication administration process. There were 23 respondents at the novice or advanced beginner stage and eight of them (30%) responded they are using a standard procedure (Benner, 1984). For the 34 nurses who responded that standard practice was employed during the

medication administration process, 70% worked in hospitals with a bed size from 300-700. More experienced nurses tend to identify additional standardized procedures than novice nurses, due to the fact that which may because they have a more nuanced ability to synthesize and apply other information to a process.

RQ 1.3 How is the medication administration process facilitated by organizational (management) support?

The contributing factors of organization support in regard to shift work, breaks and meals were also included in the survey. Of the 89 nurses who answered the question about shift work, 80% worked a permanent shift and did not rotate shifts. This would combat the fatigue that occurs from shift rotation, which has contributed to human errors (Jones, 2010; Hinshaw, 2008).

Fifty one percent of the nurses worked at least one time a shift without a break and 82% worked a shift without a meal break. This is a concern for patient safety and information related to this phenomenon should be assessed and presented to the facility organization to support change.

RQ 1.4 How do interruptions affect the medication administration process?

The final facet of question one focused on interruptions and the effect on the medication administration process. Ninety-nine percent (n = 91) of the respondents reported that they have been interrupted at some point during the medication administration process. In addition to others interrupting the nurse during the medication administration process, 62% reported that they have self-interrupted, often due to answering the phone or engaging in discussions. The maximum number of times that a nurse was interrupted during a medication administration process varied, some being interrupted only once, with others being interrupted more than six times in a single

administration of medication. The interruptions were spread over the entire administration process, with the most occurring at the pulling of the medication, which may be in the medication room, or at the medication cart. These interruptions maybe related to discussion of non-medication issues, asking medication related questions or receiving phone calls about a patient.

In summary, education and professional experience appear to play a marginal role in the medication administration process with nurses from all educational backgrounds following the rights of medication administration. Other information has surfaced that warrants further investigation that may impact patient safety. These include ensuring that nurses take meals and breaks as well as putting into place processes that eliminate the detrimental effects of interruptions.

5.1.2 Research Question 2: How can interactions between nurses and technology be improved to support the medication administration process?

This question was separated into four parts dealing with the physical layout of medication and supplies storage, types of technology system, the impact of technology on nurses' workflow, and the impact of technology on medication errors.

RQ 2.1 Does the physical layout of medication and supplies storage conform with best practices for medication administration?

Research question two was divided into three parts dealing with storage, technology, and systems. Based on the statistics garnered from the survey responses to questions 19, 20, 22, and 23, the current physical layout of medication and supplies storage does not conform to the TPS of waste reduction, keeping motion, interruptions and waste to a minimum, and therefore presents a risk to patient safety. Eighty-nine nurses responded to survey question 20, which asked whether the medication carts were kept in a closed,

locked room. Forty-three percent stated where they are working their medications were in a locked medication room. The rest of the nurses were preparing medication for administration in the nurses' station, patient's room or the hallway. As noted in the literature, errors may decrease when the nurse works in an atmosphere free from distractions (Pape, 2003; Clifton-Koeppel, 2008). This environment can be provided to the nurses with an interruption free, locked medication room. Less than half of the respondents reported that they are provided with this kind of environment, which presents the nursing profession with a significant area of concern that needs to be addressed.

The survey responses as to where supplies were located were quite varied. Some nurses had to walk to the end of the hall for supply storage (25%), 12% could pick up supplies in carts at the patient's bedside and 25% had to pull supplies from different locations depending on the supply required. This lack of streamlined storage for supplies causes a waste of motion, time and may lead to distractions and consequently compromises patient safety. Based on these numbers, one can conclude that medication and supply storage configuration does not conform to best practices.

RQ 2.2 What technology systems are used to support medication administration?

Next, research question two asked what technology systems are used to support medication administration, and how the technology systems used affect nurses' workflow in medication administration. All respondents (N = 92) identified specifically which technology they are currently using for medication administration. The survey found that 41% of respondents are using BCMA technology, 51% are using CPOE, and 72% use a Pyxis. As detailed in the research by Carayon et al. (2007), the use of technology like barcoding, computerized systems, and automated dispensing cabinets tend to increase

patient safety, as they do many of the “rights of medication administration” for the nurse. Respondents reported that the technology was both help and a hindrance in the medication administration process. The nurses felt safer, especially after having an experience where the technology prevented an actual or potential error. Nurses felt the technology improved the medication administration process.

RQ 2.3 How do the technology systems used affect nurses’ workflow in medication administration?

Twenty percent of the nurses reported workflow changes directly related to the introduction of technology (with the technologies including BCMA, CPOE, Pyxis, smart pumps, syringe pumps, and computers on wheels). Importantly, 51% of the nurses explicitly stated that the medication administration process was slower due to the technology while 21% of the nurses found the process to be safer. Twenty percent of the respondents complained that their focus was on the technology instead of the patient when administering medications. Respondents stated the technology provides important safety factors like double and triple checks and many of the rights of medication administration. This response to workflow spurs the question: is there a fundamental disjoint between the technology used and the current best practice?

RQ 2.4 How does the use of various systems increase or reduce errors in nursing medication administration?

There were 84 nurses who responded to survey question 32 with 25% stating an error occurred secondary to the technology. Of these respondents, 22% had worked at least one shift without a meal or break and 6% worked off shift. For the 25% respondents who stated there was an error, 76% were using multiple technologies of CPOE, barcoding, and a computer on wheels, Pyxis or an IV pump. These nurses stated the errors were related to dispensing or medication administration technology caused an error, the dispensing or

medication administration technology caused a documentation error, the medication technology and the packaging lead to an error and latent (human) errors obscured by technology.

Sixteen percent of the respondents stated that the technology had prevented an error or improved patient safety during the medication administration process. Ninety-two percent of these nurses were using multiple technologies during the medication administration process.

The use of multiple technologies was a factor in both causing and preventing of a medication error. This topic would be interesting to delve deeper into more specifics about if it is the combination of technologies, a specific technology, or may it relate to the workflow as a reason nurses stated the technologies helped or caused a medication error.

5.1.3 Research Question 3: How does hospital culture affect the reporting of medication administration errors and what types of errors are not reported?

This question was separated into three parts dealing with reportable and non-reportable errors, reasons for failing to report errors, and the local culture's role in reporting errors.

RQ 3.1 Do nurses understand what constitutes reportable vs. non-reportable medication errors?

The survey results with respect to nurses' understanding of reportable vs. non-reportable medication errors showed that 92% of nurses understood what constituted a medication error and 95% understand when an error should be reported. These figures may indicate an improvement in the hospital culture. Nurse 5, in the post survey interview, stated that management has encouraged self-governance in the process of error reporting and that this has improved the reporting of errors.

RQ 3.2 Why do nurses fail to report medication errors?

Further research is needed into why errors are not reported. Nurses perceived that they understood what constitutes a reportable error yet 21% nurses stated that they would not report an error if it was not "serious" to warrant reporting (Question 38). For the 32% who responded that errors are not reported due to negative reactions from coworkers, culture and support from patient safety officiers and management should be researched. Perhaps the errors that are not currently reported present a missed opportunity to further the understanding of the phenomena and help in the improvement of standard work, identify latent errors and therefore decrease waste and promote patient safety.

RQ3.3 Does the local culture or working environment reporting prevent nurses from reporting medication errors?

Fear of reaction from management was the reason that 34% of respondents stated errors are not reported. A significant minority, almost 9% of respondents to the survey, said that they personally had failed to report errors for fear of losing their job or disciplinary actions. Given the sensitivity of this topic, this number maybe underreported. Based on these responses, it appears that the local culture may prevent nurses from reporting errors, but many non-reports also appear to stem from time constraints or the complex process of error reporting.

5.2 Discussion and Implications of the Study

5.2.1 Research Question 1: How do nurses perceive the factors that contribute to medication errors originating during the medication administration process?

The responses to questions on the rights of medication and standard practice provided insight into understanding how nurses perceive factors that contribute to medication errors. None of the factors identified by the literature as predictive - the nurse's level of

education, length of professional experience, size or location of the healthcare facility- appear to affect nurses familiarity with the rights of medication administration and use of the standardized procedures to prevent errors. Ninety respondents (98%) followed the "rights" of the medication administration. Thirty-seven percent of nurses employed other standardized procedures for error prevention. This adherence to the rights of medication administration may have been because the majority of respondents highly educated (82.6%) had a four year undergraduate degree or greater. The IOM report argues that a four-year undergraduate degree should be required for entry into the nurse profession by 2020 (Shalala, 2011). Pennsylvania appears well positioned to meet this goal (Appendix E).

On the surface the findings of this study do not appear to support Benner's stages of clinical competency theory (Benner & Wrubel, 1982; 1984, Benner et al., 1992) as no association was found between the nurses' length of professional experience and clinical exposure and the application of standardized procedures (such as the rights of medication administration and high risk medication double-checks in practice). This is likely due to Benner's position that novice nurses are rule driven since they lack the clinical exposure and experiences; hence the use of standardized procedures and technological support reduces the influence of clinical experience and knowledge in the medication administration process. In fact, the findings support Benner's theory because when nurses use technology that is rule-based, this brings the novice nurse to the level of an experienced practitioner. The technology may act as a substitute for the novice nurse's lack of clinical experience. With increased clinical exposure and continued rule based use of technology, the less experienced nurses may have the time to gain insight into the

clinical situation and develop new knowledge while allowing the technology to do the heavy lifting during the medication administration process. This is strong evidence to support having technology integrated into the medication administration process to promote patient safety.

Almost half of the nurses' report to have worked without a break during their shift and four-fifths reported having missed a meal. The majority of nurses who responded to the survey worked eight hour or 12 hour shifts. Missing a meal or break results in fatigue related errors and removes the inability to stop and reflect, that is necessary for self-awareness (Jones, 2010; Hinshaw, 2008). This is an important concern that has surfaced as a result of this research and warrants further investigation to determine: 1) Is this a common occurrence in healthcare? 2) If so, what is the impact on patient safety?

Interruptions to the medication administration process appear to be an issue of concern. All but one of the respondents had been interrupted at least once during medication administration, and 14% had been interrupted over six times in a single patient medication pass. Westbrook et al. (2010) found that risk of medication errors increased 50% with four or more interruptions. Thirty percent of the survey respondents would fall into that category. This translates into a significant number of errors that could be avoided. This finding requires further investigation to discover whether such interruptions are typical or whether they represent unusual experiences.

Overall, it appears that the factors that affect the processes of medication administration adversely, and therefore may cause errors, are more related to stressful shift patterns and interruptions than to nursing factors such as education, experience, or location.

5.2.2 Research Question 2: How can interactions between nurses and technology be improved to support the medication administration process?

The impact of technology on medication administration workflows and safety is inconclusive. Research results show technology may lead to other errors during the medication administration process, many of which are human errors or interface errors (Patterson et al, 2004). For three-quarters of the survey respondents, technology systems caused changes to medication administration workflow, often slowing down the process, or making it more complex or difficult to complete. Almost two-thirds of respondents reported a shortage of computers on wheels, causing process bottlenecks. Closer examination of infrastructure should be a priority for hospital administration (Skibinski et al., 2007; Patterson et al., 2002).

One-fifth of the respondents reported that use of technology had caused errors with automated dispensing systems (Pyxis) causing the highest number of errors, followed by computers on wheels and Computerized Physician Order Entry (CPOE) systems. Surprisingly, 20% of respondents provided an unsolicited observation that the use of technology systems had made the process safer. This suggests the conjecture that this number may be significantly higher. There were almost three-quarters of respondents who responded using multiple systems with the medication administration process. This may be a factor contributing to medication errors but warrants closer examination. Most of the errors reported by the respondents related to human factors, indicating that the design of interactive technology systems for medication administration requires improvement. A significant minority of respondents who commented on the role of technology observed that it obscured some type of latent error (Reason, 2000), such as

the wrong drawer opening to dispense a medication. This indicates a serious shortcoming in the design of medication administration systems that require further investigation.

Applying the Toyota 5S principle of process standardization is also critical to patient safety especially where there are frequent interruptions (Kenney, 2011; Nance, 2008; Rogerson, 2004). For 37% of the survey respondents, standardization was a key element of the medication administration process. Standardization and self-awareness were implemented through key elements of the medication administration process, implemented through mental checklist such as the rights of medication administration and double checks for high alert medications. The 5S principles would also dictate that the medications and supplies should be organized together in the same location to standardize access. Having a medication room which is organized and standardized, where work cell phones are not answered, where discussion is not allowed, and only one person is allowed access at any given time reduces errors significantly (Conrad et al., 2010; Pape, 2003; Pate et al., 2005; Kenney, 2011). One-fifth of survey respondents reported that supplies were not kept in the same location as medications, which must cause extra work and could potentially lead to errors. Nurses reported frequent interruptions and distractions when pulling supplies or obtaining medications. The timing of an interruption can result in the nurse forgetting critical information needed to administer the medication and complete the process safely (Beyea, 2007; Pingenot et al., 2009). The standardization provided by co-locating medications and supplies and locating these away from distractions and interruptions could significantly improve patient safety. The use of technology, systems, and a good layout for preparation to administer medications appear to have positive benefits. In addition, these improvements

in the process will continue to allow the nurse to further improve their clinical knowledge development to improve nursing practice (Benner & Wrubel, 1982). However, these practices are not widely incorporated in healthcare industry.

5.2.3 Research Question 3: How does hospital culture affect the reporting of medication administration errors and what types of errors are not reported?

In 1995, only 33% of nurses understood when errors should be reported (Gladstone, 1995). This had increased to 92% by 2007 (Mayo & Duncan, 2004; Ulanimo et al., 2007). The current study showed that almost all nurses understood what constitutes a reportable error, demonstrating a marked improvement over time. However, the local culture of reporting, including pressure from colleagues and fear of retribution, appear to be important factors in the failure to follow through and actually report errors. Discovering errors after the fact, or forgetting to report an error because of time constraints were also factors in non-reporting. The culture on the unit may not reflect the culture of the larger hospital organization, but does impact patient safety (Hughes, 2008). This culture must allow for the time and effort needed to report an incident and must ensure that the report will be reviewed and acted upon in a timely manner (Kenney, 2011).

5.3 Limitations of the Study

Several limitations of the study should be considered. It would have been preferable to conduct an observational, longitudinal study of the medication administration process. Also, the results were obtained only from the Mid-Atlantic region of the United States and therefore the results cannot be generalized. Another limitation is that the sampling may not have been representative of nursing in general as it was obtained from one state

organization. However, the demographics of both the PSNA membership and the responding sample of nurses do appear to mirror the demographic characteristics of nurses across the United States. In a future study, sending the survey to other professional nurses' organizations might provide an opportunity for a wider population to complete the survey.

5.4 Reflections On The Survey Design

Throughout this process, this researcher has learned a great deal about survey design. The survey would benefit from refinement and clarification in the following areas:

1) eligibility criteria needed to be clarified to answer the answer the survey questions;

2) additional questions regarding entry into practice degree; and

3) rewording some of the questions to provide clarity of the issue.

I would redesign the questions on medication administration errors, to better address when the medication errors occurred with a focus on the recent medication errors. I would also reinstate the open-ended questions that asked respondents to describe their medication process and to describe sources of error in this process.

In the section related to interruptions, the self-interruption questions could have defined self-interruption more clearly. This question should have been worded to ascertain how typical the reported types and numbers of interruptions were. In the technology impact section of the survey, I asked how the technology introduced errors. But I did not ask whether or how the technology *reduced* errors during the medication administration process. I also did not ask about its overall impact on medication administration processes (just workflows). Many respondents shared their views on these

issues but future studies should investigate these facets of how people perceive the role and impact of technology.

Finally, the error reporting questions might have provided more consistent data if they had all started with the same opening stem to the question. Some open with a personal "I" statement, two are general action questions asking "if the nurse" had failed to report and the last two questions ask about the hospital culture of error reporting. In a redesign of this survey, these questions should be reworded to begin with the same stem, so that responses can be related to the responses for other questions in this section of the survey.

5.5 Summary and Recommendations

5.5.1 Implications for Theory:

The process of medication administration is one where the nurse must utilize skills or the "know how" along with "know that" of knowledge acquisition of Benner (Benner & Wrybel, 1982; Benner, 1984; Benner et al., 1992). This research found that in relationship to the medication administration process, nurses at all levels, from novice to expert, followed the rights of medication administration, leading to the conclusion that other factors, such as the use of technologies that standardize the process, or checklists that reinforce process self-awareness mechanisms have a greater effect than either education or experience on the process. For those whose medication administration process included technology, these rights were reinforced due to the redundancy of the technology format. According to Benner, novice nurses are rule driven (Benner & Wrubel, 1982; Benner, 1984; Benner et al., 2002); therefore, one would expect that the use of standardized procedures and technological support reduce the influence of clinical

experience and knowledge in the process. In fact, the findings support Benner's theory because when you are using technology that is rule-based, you may bring the novice nurse to the level of an experienced practitioner. A contribution of this research is to develop Benner's theory, to argue that standardized processes and technologies may compensate for the intuition obtained from clinical experience over time..

Technology systems have previously been perceived as a significant source of error in healthcare (Kohn et al., 2000; Leape et al., 2002). But the current study demonstrates that the impact of technology on medication administration is more complex than simply acting as a source of error. The tendency of technology to obscure latent errors (Reason, 1995) appears to be a significant factor when employing technology at the point of care. Active errors (Reason, 1995) caused by technology appear to be largely due to poor human-factors design. While technology appears to make the processes of medication administration slower, there was a widespread perception that technology made these processes safer. This study did support the findings of previous empirical studies that hypothesized that a fear of retribution prevents nurses from reporting errors (Gladstone, 1995; Mayo & Duncan, 2004; Ulanimo et al., 2007). Changing the culture from one of blame to one of safety is key to improving the error reporting which will contribute to improved understanding of process changes required to eliminate medication errors. Further research needs to be done in this area to gain better understanding of the barriers to reporting.

5.5.2 Implications for Practice

Although there is increased understanding among nurses related to medication errors and when to report errors, this knowledge has not been fully incorporated into practice.

The culture and context of reporting needs additional attention from the nursing profession. Some facilities have added a patient safety officer to heighten awareness and convey organization support of this cultural shift. It is important that nurses take a leadership role in addressing this issue and participate actively in an interdisciplinary collaboration to create a culture to focus on safety rather than blame. Only then can nurses get an accurate assessment and understand of all factors contributing to medication errors and provide direction to improve patient safety.

The 5S Toyota Production System (Liker, 2004) principle of standard work should be incorporated more widely into the medication administration process to help improve workflow, standard the location of supplies, the layout and access to medication rooms, as well as providing a standard process for administering medications. With standardized work-processes, the nurse will have fewer distractions while administering medications, which will likely result in additional time for self-awareness and reflection (an important mechanism for error-prevention).

Integration of standard work processes to improve workflow should be mandated for the high-risk process of administering medications. Improving the physical layout of a distraction free medication room (Pape, 2003; Kenney, 2010) and locating frequently used supplies within the medication room may help decrease the cognitive shift from interruptions the respondents stated occurred during the process.

Ensuring that breaks are given to all nurses could further improve patient safety by allowing nurses to reflect and refocus, and assimilate all that has occurred during the shift. Integrating standard work and scheduled breaks or meals are most likely an essential ingredient for patient safety.

5.5.3 Implications for Future Research

This research has provided insight into nurses' perspectives of the work-systems and technologies utilized during the medication administration process and their impact on patient safety. The key recommendations include:

1. Standardized work processes should be incorporated more widely into nursing practice.
2. There must be a cultural shift away from blame and shame to a culture of safety.
3. Medication administration systems design must evolve to become a seamless extension of nursing care.

An issue raised by this study is the frequency of distractions and interruptions. Future research should focus on observational studies to watch the medication administration process unfold at the point of care. This will allow for better understanding of how the nurse interacts with technology, patients, and the process.

More research in error reporting is required, to understand the factors contributing to underreporting. This is an important aspect for improved patient safety.

This study demonstrated that nurses have a positive attitude toward the use of technology within the medication administration process. Future studies might explore the role of different types of technologies within the medication administration process, to suggest ways of improving workflows and patient safety outcomes.

5.6 Conclusions

A significant contribution of this dissertation study was to demonstrate that technology appears to reduce the amount of time for a nurse to move through Benner's (1984) stages as it relates to the medication administration process recognizing, however,

that the medication administration process is only one aspect of nursing practice surrounding medication administration. Mastering this aspect of nursing care promotes improved nursing practice while allowing the opportunity to focus on development of other skill sets essential to patient safety.

The standardization of processes and technology systems appears to have a greater influence on error-reduction than the nurse's length of experience. It also appears that nursing education is more effective than previously perceived. It demonstrated that nursing education is more effective than previously thought: almost all nurses understand what constitutes a medication error. However, nurses continue to under-report errors due to fear of retribution. The hospital culture must move away from blame-and-shame, and incorporate the collective responsibility culture advocated by the Toyota Production System quality principles. Fear must be replaced by the shared goal of patient safety, so that error reporting is seen as a necessary part of continual process improvement.

The study also demonstrated that the lack of opportunities for reflection and process evaluation are a cause for concern. Nurses work on the "sharp end" of patient safety – their ability to be self-aware, to reflect on problems within the process, and to detect latent errors is undermined if medication administration workflows are disrupted or stressful. These findings demonstrated that nurses are frequently interrupted by patients, visitors, other nurses or medical staff, and by their own communication needs. They work long shifts without breaks and sometimes miss meals. They struggle with poorly integrated technology systems and frequently operate within a hospital culture that is hostile to error reporting. These issues could be managed easily with a more engaged nursing management of these processes. We can minimize distractions through the use of

special vests (that inform others that the nurse is not to be interrupted), through public service announcements to prevent visitors causing interruptions, through establishing safety standards that are followed closely, and engaging nurses collaboratively in both process improvement and improving the design of technology systems. At present, these mechanisms do not appear to be prioritized in most American hospitals. While this study has shown improvements over prior studies of patient safety factors, it is clear that much work remains to be done.

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APPENDIX A: EXPLORATORY STUDY DEMOGRAPHICS AND FINDINGS

The participants in the exploratory study are all registered nurses working in urban settings.

Participant	*Setting*	*Location*	*Degree*	*Mode of interview*
P1	Pediatric inpatient hospital	Urban	BSN	Phone
P2	Adult inpatient hospital	Urban	BSN	Phone
P3	Adult inpatient hospital	Urban	MSN	In person
P4	Adult inpatient hospital	Urban	MSN	In person
P5	Adult inpatient hospital	Urban	BSN	In person
P6	Adult inpatient hospital	Urban	MSN	In person
P7	Adult inpatient hospital	Urban	MSN	In person
P8	Adult inpatient hospital	Suburban	Diploma	In person

Q1	Would you explain the medication administration process utilized at your facility?
P1	use electronic system, scan medication in the medication room and then the patient room , pyxis frig for formula and nutrients. frig for meds
P2	use eMAR and medication in med room , scanning frig
P3	next year using electronic ordering system, use Pyxis frig, stock med cart
P4	current system is paper ordering but moving towards electronic ordering system frig, stock med cart
P5	converting to all electronic I the future, now paper physician ordering frig, stock med cart
P6	In the process of converting to electronic ordering system frig, stock med cart
P7	Pyxis Medication cart frig, stock
P8	BCMA, Pyxis frig, stock

Q2	What tools do you utilize with the medication administration process?
P1	uninterrupted medication draws, use of six rights (right-- patient, time, drug, route, indication, dose)
P2	uninterrupted medication draws are supposed to happen
P3	must look up drug allergies weight, lab in three spots
P4	allergies are critical
P5	allergies are critical with paper orders there is no hard stop if there are contraindications to the medication and the pt allergy at this time
P6	5R, the policy at the hospital good communication skills
P7	5R, CPOE
P8	CPOE, eMAR, and 5 R

Q3	3. Tell me about patient safety procedures used with the medication administration process.
P1	MAR, electronic charting with direct link to the pharmacy formulary Start stop act react. Using the skills I learned in school has helped me keep my patients safe. The nursing process of assessment, planning, implement the action plan and evaluate the outcome work nicely with the rights of administering medications and become blended together as I care for my patients each day
P2	eMAR, and the pharmacy formulary readily available
P3	5R critical to the process
P4	use of SBAR and nursing process is critical; education to the patient of the medications they are on
P5	technology does not play a big issue, use of SBAR and nursing process critical
P6	SBAR and 5R critical, using common sense
P7	use of SBAR and 5 rights
P8	use of SBAR and rights of medication administration with so many patients

Q4	How well do the "rights of medication administration," SBAR, the nursing process, and systems support the medication administration process?
P1	have safety coordinators on the unit to assist with questions or issues; with the outcome to avoid the' Swiss cheese' effect
P2	this is the policy to use SBAR, the rights of medication administration and utilize hospital policy for administering medications
P3	policies implemented, education given to nursing to promote patient safety
P4	all need to be aware of policy and procedures
P5	all need to be aware of policy and procedures
P6	need education if this is occurring, not an issue on the floor where working
P7	policy and procedures
P8	well, if everyone follows them

Q5	How do you perceive the hospital medication policies promote patient safety?
P1	high risk meds, 2--way high risk medication checks with a hard stop on the eMAR until the second nurse signs off; While I understand the concept of having another nurse check my Heparin calculation so I don't harm my patient, the biggest problem is not having a nurse nearby who can do the check. Then I spend time waiting and waiting for someone to come to the nurses station. Of course during that time, I am answering the phone, my patient cell phone, and still waiting
P2	nursing double checks with high alert meds, chemo meds
P3	2 way checks for all high alert meds
P4	high risk meds need to have a 2 way checks
P5	cosigning of high risk meds such as heparin and Insulin
P6	with insulin and heparin, or other high risk medications 2 way checks
P7	high risk meds, 2 way checks
P8	high risk meds, should have 2 way checks before hanging, but difficult with staffing at times

Q6	Why do there continue to be overrides of systems used with the medication administration process?
P1	unless there is an emergency, there is no overriding allowed in the process
P2	no overriding allowed or supposed to happen
P3	not applicable
P4	not applicable
P5	not applicable
P6	NA
P7	cannot override the system per policy
P8	do not override, unless an emergency

Q7	What have been some of the benefits of these tools? Some of the cons?
P1	benefits: promotes safety, stop and think, not on autopilot, to stop and think about what you are doing at each step in the administration process critical when patients have similar names; LASA medications are written so the different part of the medication name is all in capital letters (PENTobarb vs PHENObarb) ; allows nurse to take a deep breath and look back, Lewin's theory of change cons: not always able to find a person to do the second check for high risk medications, takes away autonomy
P2	benefits are for patient safety cons are that it is sometime hard to find a nurse to cosign which holds up the medication process
P3	benefits: excited for this process as it should decrease errors cons: must look up allergies, weight and labs in three different spots
P4	benefits: decrease in errors with barcoding cons: when the system is not working or the bar scanner is not working; problems when there is an allergy and not being computerized there is no hard stop in the process to alert you to a problem.
P5	benefits: decrease in errors cons: when the system is not working
P6	benefits: are to decrease errors and when the tools do not work this impedes the benefits
P7	benefits: less errors; cons: when the tools are not functioning as they should; no alarms when using paper, so may miss an allergy or critical lab value;
P8	problem when the technology is not working I don't always hear the alarms; good to be able to access drug information, in the old days would have to run around for a book, the book may have been old, the drug may have been new and the information was in the book.

Q8	Have you ever experienced any issue with the tools that may lead to a medication error?
P1	system downtime, equipment issues
P2	problems when the system is down, bar scanner doesn't work, the patient bracelet is difficult to scan
P3	general equipment issues
P4	broken equipment, cannot hear alarms.
P5	any equipment problems that are needed for the medication administration process
P6	equipment issues, library not updated on the IV pumps
P7	no issues so far
P8	loss of time with other patient care needs

Q9	Would you explain what constitutes a medication error during the medication administration process?
P1	not using the dry weight of the patient when calculating a medication dose such as a PRN pain medication
P2	any problem with the 5R
P3	not completing the 5R
P4	missing one of the rights of medication administration
P5	any deviation from the policy, a near miss or an adverse outcome for the patient
P6	missing a step in the 5R
P7	not following the rights, being very busy with patient care
P8	busy floor, and may not follow the 5R especially time

Q10	What does not constitute a medication error during the medication administration process?
P1	a near miss would not be an error but should be discussed so others can learn from the experience
P2	probably a near miss when walking in the door, realizing I was in the wrong room and go to the correct patient
P3	a near miss or a late dose may not constitute an error
P4	near misses when you realize as you enter a room it is not the right room, but you still need to ask why
P5	near miss does not generally get reported, need education about system changes
P6	some do not always think of a near miss as an error
P7	catching the error before it becomes an error
P8	near misses

APPENDIX B: MEDICATION ADMINISTRATION SURVEY

MGG

Introduction

The purpose of the study is to look at nurses' perceptions of medication errors, the impact of technology on the medication administration process and the culture of reporting medication errors. If you are a registered nurse who is currently administering medications, thank you for completing the survey.

1. Gender

- ◯ Male
- ◯ Female

***2. What is your highest level of schooling or the highest degree you have received?**

- ◯ Diploma nursing
- ◯ Associate degree in nursing
- ◯ Bachelor degree in nursing
- ◯ Master's degree in nursing
- ◯ Master's degree in other field
- ◯ Doctor of Nursing Science
- ◯ DNP
- ◯ PhD in Nursing
- ◯ PhD
- ◯ Other (please specify)

***3. How many years have you been working as a nurse?**

- ◯ <1 year
- ◯ 1-2 years
- ◯ 3-5 years
- ◯ 6-10 years
- ◯ 11-15 years
- ◯ 16-20 years
- ◯ >21 years

MGG

***4. What is the length of time you have been working on the present unit?**

- ◯ <1 year
- ◯ 1-2 years
- ◯ 3-5 years
- ◯ 6-10 years
- ◯ > 10 years

5. What is the bed size of your hospital?

- ◯ <100 beds
- ◯ 100-300 beds
- ◯ 301-500 beds
- ◯ 501 -700 beds
- ◯ >701 beds

6. What is the location of your hospital?

- ◯ Urban
- ◯ Suburban
- ◯ Rural

MGG

7. What is your primary hospital work setting?

- ◯ Adult Critical Care
- ◯ Medical
- ◯ Oncology
- ◯ Surgical
- ◯ Labor & Delivery
- ◯ Post-Partum
- ◯ Operating Room
- ◯ Emergency Department
- ◯ Step Down
- ◯ Telemetry
- ◯ High Risk/Antepartum
- ◯ Neonatal ICU
- ◯ Pediatrics
- ◯ Nursery
- ◯ Pre op/Post op/Recovery
- ◯ Other (please specify)

8. Which shift do you typically work?

- ◯ Day
- ◯ Evening
- ◯ Night

9. Do you work a permanent shift?

- ◯ Yes
- ◯ No

10. Do you rotate shifts?

- ◯ Yes
- ◯ No

MGG

11. What type of shift do you typically work?

- ◯ 4 hour shift
- ◯ 8 hour shift
- ◯ 10 hour shift
- ◯ 12 hour shift

12. How many days do you typically work in a row?

- ◯ 2 days
- ◯ 3 days
- ◯ 4 days
- ◯ 5 days
- ◯ Other (please specify)

13. Do you work without breaks during your shift?

- ◯ Yes
- ◯ No
- ◯ Comments

14. Do you ever work through meal breaks?

- ◯ Yes
- ◯ No
- ◯ Comments

15. Do you follow the rights of medication administration each time you administer medications?

- ◯ Yes
- ◯ No

MGG

16. If you do not follow the rights of medication administration, which steps do you utilize? (Select all that apply)

- [ ] Right patient
- [ ] Right time
- [ ] Right route
- [ ] Right drug
- [ ] Right dose
- [ ] Right assessment
- [ ] Right evaluation
- [ ] Other (please specify)

17. Do you utilize a standardized procedure during medication administration? (Such as an insulin checklist)

- ◯ Yes
- ◯ No

What is the name of the standardized procedure utilized?

18. Please describe the standardized procedures used with medication administration.

MGG

19. What is the source of patient medication storage on your floor? (Select all that apply)

- [ ] Automated dispensing machine
- [ ] Medication cart
- [ ] Stock medications
- [ ] Refrigerator

Other (please specify)

20. Is your medication cart kept in a closed, locked room?

- ◯ Yes
- ◯ No

21. Please describe where is the medication cart located.

22. Are the supplies necessary for the medication administration located in the same place as the medications?

- ◯ Yes
- ◯ No

23. Please describe the location of the supplies needed to administer medications.

MGG

24. Have you ever been interrupted during the medication administration process?

- ◯ Yes
- ◯ No

25. How many times during one patient medication prep or administration have you been interrupted ?

- ◯ 1 time
- ◯ 2 times
- ◯ 3 times
- ◯ 4 times
- ◯ 5 times
- ◯ 6 times
- ◯ >6 times in one patient medication pass

MGG

26. At what point in the medication administration process was the interruption? (Select all that apply)

- [ ] Verifying the medication
- [ ] At the medication cart
- [ ] Pulling the medication
- [ ] Gathering supplies
- [ ] On the way to the patient room
- [ ] When entering the patient room
- [ ] Prior to verification of the patient
- [ ] During the medication administration
- [ ] After the administration
- [ ] Prior to documentation

Please describe typical interruptions

27. Have you ever self-interrupted during the medication administration process?

- ◯ Yes
- ◯ No

MGG

28. How did you self-interrupt? (Select all that apply)

- [ ] Answered phone
- [ ] Texting
- [ ] Discussion of non-medication administration issues

Other (please specify)

29. Do you utilize any of the following technologies with medication administration? (Select all that apply)

- [ ] BCMA (barcoding)
- [ ] CPOE (computerized order entry)
- [ ] Automated dispensing machine (Pyxis)
- [ ] Smart pumps (with electronic library built in)
- [ ] Syringe pumps
- [ ] Computer on wheels

Other (please specify)

30. Do the technologies utilized with administration of medications affect your workflow?

- ◯ Yes
- ◯ No

31. Please describe how the workflow has changed.

MGG

32. Has the use of technology during the medication administration process caused a medication error?

- ◯ Yes
- ◯ No

33. Please describe how the technologies utilized with the medication administration caused an error.

Culture of Error Reporting

Questions 34-39 were adapted with permission from Gladstone, 1995.

Gladstone, J.(1995). Drug administration errors: a study into the factors underlying the occurrence of reporting of drug errors in a district general hospital. Journal of Advanced Nursing,22(4),628-637.

34. I am usually sure what constitutes a medication error.

- ◯ Yes
- ◯ No

35. I am usually sure when a medication error should be reported using an incident report/electronic submission.

- ◯ Yes
- ◯ No

36. Some medication errors are not reported because of the reaction from management.

- ◯ Yes
- ◯ No

37. Some medication errors are not reported because of the reaction from coworkers.

- ◯ Yes
- ◯ No

MGG

38. Have you ever failed to report a medication error because you did not think the error was serious to warrant reporting?

- ◯ Yes
- ◯ No

39. Have you ever failed to report a medication error because you were afraid that you might be subject to disciplinary action or even lose your job?

- ◯ Yes
- ◯ No

40. Have you ever failed to report a medication error for any other reason and why?

Conclusion

41. Thank you for taking the time to complete this survey.

If you would consider speaking to me in further detail about the above survey, you will be directed to a new page outside of this survey where you may leave your name and contact information.

- ◯ Yes
- ◯ No

APPENDIX C: PSNA LETTER

Dear PSNA member,

Patient safety is a major concern for healthcare professionals. We invite you to participate in an important survey researching professional nurses' perceptions of the use of technologies with the medication administration process, its impact on patient safety and the culture of medication error reporting. Data from this study will be analyzed to see what can be done to improve the process of administering medications and accurate reporting of medication errors.

If you agree to participate, the survey will take approximately 15 minutes to complete. Honesty is critical for accuracy. Your informed consent is implied when you enter the Survey Monkey™ website and submit your completed survey. Participation in the survey is voluntary and you can exit at any time. However, you are unable to withdraw a completed survey and your completion consents you as a participant in the research.

At the end of the survey, you will be asked if you would like to participate in a post-survey telephone interview. This interview is voluntary and if you agree to participate (by checking yes), you will be directed to a new window that closes the survey and opens a new link. This action ensures that your survey data cannot be connected to your contact information. The post-survey interview will take about 20 minutes to complete and all data from this interview will be kept confidential and anonymous. The interview will explore issues raised from the aggregated survey data.

There are no anticipated risks associated with participation in this study. You are free to exit the survey at any time for any reason. All data related to this research study will be kept confidential with anonymization of findings. An article will be written for PSNA utilizing the data compiled from this research that will benefit all members of PSNA.

The findings of this study will contribute to the body of knowledge about nurses' perception of medication errors and the impact of technology on the medication administration process. This study has been approved by the IRB at Drexel University. If you have any questions, please feel free to contact me at the number or e-mail below. If you have any questions concerning your rights as a research subject, you may call Drexel University IRB at 215-255-7858.

Thank you for helping to advance patient safety within the nursing profession.

Sincerely,

Mary Gallagher Gordon (PhD candidate, Drexel University iSchool)
Phone: 215-762-8506
Email: mag45@drexel.edu

Survey: http://www.surveymonkey.com/s/MGG_PhD

APPENDIX D: SUMMARY OF SURVEY DATA RESPONSES

Please note: The following subjects were removed due to incomplete or inconsistent responses:

3,6,12,13,18,20,27,35,46,50,51,75,85,86,92,94,101,104,105,106.

Respondent Demographics (Q1-Q14)

ID	Q1. Gender	Q2. What is your highest level of schooling or the highest degree you have received?	Q3. How many years have you worked as a nurse?	Q4. What is the length of time you worked on present unit?	Q5. What is the bed size of your hospital?	Q6. What is the location of your hospital?	Q7. What is your primary hospital work setting?	Q8. Which shift do you typically work?	Q9. Do you work a permanent shift?	Q10. Do you rotate shifts?	Q11. What type of shift do you typically work?	Q12. How many days do you typically work in a row?	Q13. Do you work without breaks during your shift?	Q14. Do you ever work through meal breaks?
R1	F	DNP	>21 years	1-2 years	301-500 beds	Urban	Transitional Care Unit	Day	No	No	4 hr.	2 days	No	No
R2	F	Diploma nursing	>21 years	> 10 years	<100 beds	Rural	Long term care	Day	Yes	No	8 hr.	3 days	Yes	yes, but I get my meal eventually
R4	F	Master's nursing degree	>21 years	3-5 years	301-500 beds	Suburban	Educational specialist	Day	Yes	No	8 hr.	5 days	No	Yes
R5	F	Master's nursing degree	>21 years	6-10 years	501 -700 beds	Suburban	Medical	Day	Yes	No	12 hr.	4 days	Yes	Yes
R7	F	Master's nursing degree	3-5 years	3-5 years	100-300 beds	Suburban	Skilled nursing facility	Day	Yes	No	8 hr.	Schedule changes per week	Yes	Yes
R8	F	Master's nursing degree	11-15 years	1-2 years	<100 beds	Suburban	Specialty Orthopedics	Night	Yes	No	12 hr.	3 days	Yes	Yes
R9	F	Master's nursing degree	>21 years	3-5 years	<100 beds	Rural	Medical	Day	Yes	No	8 hr.	5 days	Yes	Yes
R10	F	Bachelor nursing degree	1-2 years	1-2 years	100-300 beds	Suburban	Surgical	Day	No	Yes	8 hr.	3 days	No	Yes
R11	F	Associate nursing degree	<1 year	<1 year	100-300 beds	Suburban	SNF - geriatrics	Even-ing	No	Yes	8 hr.	3 days	Yes	Yes
R14	F	Bachelor nursing degree	6-10 years	<1 year	<100 beds	Rural	community nursing, psychiatry, young adults with develop-mental disabilities	Day	No	Yes	12 hr.	6 days	No	Yes
R15	F	Master's nursing degree	16-20 years	1-2 years	501 -700 beds	Urban	Telemetry	Day	Yes	No	8 hr.	2 days	Yes	Yes
R16	F	Bachelor nursing degree	>21 years	1-2 years	501 -700 beds	Suburban	Medical	Evening	Yes	No	8 hr.	5 days	No	Yes

R17	F	PhD	<1 year	<1 year	501 -700 beds	Rural	Medical	Night	Yes	No	12 hr.	3 days	Yes	Yes
R19	F	DNP	16-20 years	1-2 years	100-300 beds	Suburban	Medical	Day	Yes	No	8 hr.	5 days	Yes	Yes
R21	F	Bachelor nursing degree	<1 year	<1 year	501 -700 beds	Urban	Pediatrics	Day	No	Yes	12 hr.	3 days	Yes	No
R22	F	Diploma nursing	6-10 years	6-10 years	301-500 beds	Urban	neuroscience	Day	No	Yes	12 hr.	3 days	No	Yes
R23	M	Bachelor nursing degree	11-15 years	3-5 years	<100 beds	Suburban	Psychiatric	Day	Yes	No	8 hr.	4 days	No	Yes
R24	F	Bachelor nursing degree	>21 years	3-5 years	<100 beds	Urban	Psych	Evening	No	Yes	8 hr.	4 days	Yes	Yes
R25	F	Master's nursing degree	>21 years	3-5 years	<100 beds	Suburban	Medical	Day	No	No	8 hr.	part time varies	No	Yes
R26	F	Bachelor nursing degree	16-20 years	3-5 years	301-500 beds	Urban	Medical	Night	Yes	No	8 hr.	4 days	Yes	Yes
R28	F	Master's nursing degree	3-5 years	<1 year	301-500 beds	Urban	mental health	Day	Yes	No	8 hr.	2 days	No	No
R29	M	Bachelor nursing degree	1-2 years	<1 year	301-500 beds	Suburban	Emergency Department	Night	Yes	No	12 hr.	2 days	Yes	Yes
R30	F	Master's nursing degree	>21 years	> 10 years	501 -700 beds	Suburban	Psych	Day	Yes	No	8 hr.	5 days	No	No
R31	F	Master's degree in other field	16-20 years	> 10 years	100-300 beds	Suburban	Surgical	Day	Yes	No	8 hr.	5 days	No	Yes
R32	F	Master's nursing degree	11-15 years	> 10 years	100-300 beds	Suburban	Telemetry	Day	No	Yes	12 hr.	4 days	Yes	Yes
R33	F	PhD in Nursing	>21 years	> 10 years	100-300 beds	Suburban	Emergency Department	Yes			10 hr.	2 days	Yes	Yes
R34	F	Diploma nursing	>21 years	3-5 years	301-500 beds	Suburban	Pre op/Post op/Recovery	Day	Yes	No	10 hr.	4 days	No	No
R36	F	Master's nursing degree	>21 years	<1 year	100-300 beds	Suburban	Surgical	Day	No	Yes	8 hr.	5 days	Yes	Yes
R37	F	Associate nursing degree	>21 years	> 10 years	<100 beds	Rural	Medical	Day	No	Yes	12 hr.	2 days	No	Yes
R38	F	Bachelor nursing degree	>21 years	6-10 years	301-500 beds	Urban	Neonatal ICU	Night	Yes	No	12 hr.	2 days	No	Yes
R39	F	Master's nursing degree	>21 years	<1 year	301-500 beds	Suburban	Surgical	Day	Yes	No	8 hr.	5 days	No	Yes
R40	M	Bachelor nursing degree	3-5 years	1-2 years	301-500 beds	Urban	Adult Critical Care	Night	Yes	No	12 hr.	3 days	Yes	Yes

R41	M	Bachelor nursing degree	3-5 years	<1 year	100-300 beds	Urban	Pre op/Post op/Recovery	Evening	Yes	No	8 hr.	5 days	sometimes	Yes
R42	M	Bachelor nursing degree	>21 years	> 10 years	<100 beds	Suburban	Pre op/Post op/Recovery	Day	Yes	No	8 hr.	Not working at present (in school)	No	No
R43	F	Masters Health Admin-istration	>21 years	1-2 years	100-300 beds	Urban	Rehab	Night	Yes	No	8 hr.	2 days	It depends upon how busy the unit is	Yes
R44	F	Diploma nursing	>21 years	1-2 years	0	0	School Nurse/Health Room	Day	Yes	No	8 hr.	2 days	Occasional ly	Yes
R45	M	Diploma nursing	<1 year	<1 year	301-500 beds	Urban	Step Down	Evening	Yes	No	8 hr.	5 days	Yes	Yes
R47	F	Bachelor nursing degree	>21 years	3-5 years	100-300 beds	Suburban	Adult Critical Care	Day	Yes	No	12 hr.	2 days	Yes	Yes
R48	F	Associate nursing degree	6-10 years	6-10 years	100-300 beds	Urban	Surgical	Evening	No	Yes	8 hr.	4 days	Yes	about 50% of the time work thru meal
R49	F	Master's nursing degree	11-15 years	> 10 years	301-500 beds	Suburban	Adult Critical Care	Day	Yes	No	12 hr.	3 days	No	Yes
R52	F	Bachelor nursing degree	16-20 years	1-2 years	100-300 beds	Urban	Long term care	Day	Yes	No	8 hr.	5 days	No	Yes
R53	F	Master's nursing degree	>21 years	3-5 years	>701 beds	Urban	Surgical	Day	Yes	No	8 hr.	5 days	No	meetings and educ prog w/ refreshments
R54	F	Master's degree in other field	>21 years	> 10 years	501 -700 beds	Urban	Emergency Department	Evening	Yes	No	8 hr.	2 days	Yes	Yes
R55	F	Master's nursing degree	>21 years	3-5 years	100-300 beds	Urban	Telemetry	Evening	Yes	No	8 hr.	clinical nursing instructor one day/week	No	No
R56	F	Master's nursing degree	11-15 years	1-2 years	301-500 beds	Suburban	Adult Critical Care	Day	Yes	No	8 hr.	3 days	Yes	Yes
R57	F	Associate nursing degree	>21 years	3-5 years	100-300 beds	0	Medical	Day	Yes	No	12 hr.	2 days	Yes	Yes
R58	F	Master's nursing degree	>21 years	<1 year	301-500 beds	Urban	Medical	Day	No	Yes	8 hr.	2 days	Yes	Yes

R59	F	Diploma nursing	>21 years	> 10 years	100-300 beds	Urban	Pre op/Post op/Recovery	Day	Yes	No	10 hr.	3 days	No	Yes
R60	F	Master's nursing degree	>21 years	> 10 years	0	0	0	Day	Yes	No	8 hr.	2 days		
R61	F	Master's nursing degree	3-5 years	<1 year	501 -700 beds	Suburban	Surgical	Day	Yes	No	8 hr.	5 days	No	No
R62	F	Master's nursing degree	>21 years	6-10 years	<100 beds	Rural	Primary Care	Day	Yes	No	8 hr.	5 days	Yes	Yes
R63	F	Bachelor nursing degree	11-15 years	<1 year	0	Rural	Adults with mild to moderate MR in a community setting.	Day	Yes	No	10 hr.	2 days	No	No
R64	M	Bachelor nursing degree	3-5 years	3-5 years	<100 beds	Suburban	Psychiatry	Day	Yes	Yes	8 hr.	3 days	Yes	Yes
R65	F	Master's nursing degree	>21 years	1-2 years	<100 beds	Suburban	Long term Acute Care	Day	Yes	No	12 hr.	3 days	Yes	Yes
R66	M	Bachelor nursing degree	16-20 years	3-5 years	100-300 beds	Urban	Telemetry	Evening	Yes	No	8 hr.	5 days	Yes	Always work through meal breaks
R67	F	Master's degree in other field	>21 years	6-10 years	0	0	School nurse	Day	No	No	8 hr.	3 days	Yes	Yes
R68	F	Master's nursing degree	>21 years	6-10 years	301-500 beds	Rural	Pre op/Post op/Recovery	Day	Yes	No	8 hr.	5 days	No	No
R69	F	Bachelor nursing degree	>21 years	3-5 years	100-300 beds	Urban	Gerontology	Day	Yes	Yes	8 hr.	5 days	Occasional ly	Yes
R70	F	Bachelor nursing degree	3-5 years	6-10 years	501 -700 beds	Suburban	ambulatory care	Day	Yes	No	8 hr.	5 days	Yes	Yes
R71		Master's nursing degree	>21 years	> 10 years	>701 beds	Urban	Step Down	Day	Yes	No	10 hr.	5 days	No	Yes
R72	F	Master's nursing degree	>21 years	3-5 years	100-300 beds	Rural	Administration	Day	Yes	No	10 hr.	5 days	Yes	Yes
R73	F	Master's degree in other field	>21 years	1-2 years	0	Suburban	non-hospital-consulting with pharma as a telehealth nurse, esp. drug events	Day	Yes	No	8 hr.	5 days	No	Yes
R74	F	Bachelor nursing degree	>21 years	> 10 years	<100 beds	Rural	Adult Critical Care	Evening	Yes	No	8 hr.	4 days	No	Yes

R76	F	Bachelor nursing degree	>21 years	> 10 years	501 -700 beds	Suburban	Pain Management	Day	Yes	No	8 hr.	5 days	Yes	Yes
R77	F	Bachelor nursing degree	<1 year	<1 year	501 -700 beds	Urban	Resource: includes medical, surgical, Oncology, Telemetry	Day	No	Yes	12 hr.	2 days	No	Yes
R78	F	Master's nursing degree	>21 years	> 10 years	301-500 beds	Suburban	Medical-Surgical with telemetry		Yes	No	8 hr.	2 days	Yes	Yes
R79	F	Associate nursing degree	3-5 years	1-2 years	100-300 beds	Urban	Pre and post cardiac intervention	Day	Yes	No	12 hr.	4 days	Yes sometimes.	Yes
R80	F	Master's nursing degree	>21 years	6-10 years	100-300 beds	Suburban	Telemetry	Day	Yes	No	8 hr.	2 days	No	However, the sandwiches are sometime not chewed, just inhaled.
R81	F	Master's nursing degree	6-10 years	6-10 years	100-300 beds	Suburban	Adult Critical Care	Day	No	No	8 hr.	2 days	No	Yes
R82	F	BSN and M.ed.	16-20 years	1-2 years	100-300 beds	Suburban	Step Down	Day	Yes	No	8 hr.	5 days	No	Once in a while I work thru meal breaks
R83	F	PhD	>21 years	3-5 years	301-500 beds	Suburban	In-patient psychiatry; also educator - BS nursing students	Night	Yes		8 hr.	2-days on the unit; 5 days as an educator	No	No
R84	F	Diploma nursing	16-20 years	6-10 years	100-300 beds	Rural	OB/GYN clinic	Day	Yes	No	10 hr.	5 days	No	Yes
R87	F	Master's nursing degree	>21 years	1-2 years	501 -700 beds	Suburban	medical surgical combined units	Day	Yes	No	8 hr.	2 days	Yes	No
R88	F	Bachelor nursing degree	3-5 years	1-2 years	<100 beds	Rural	Surgical	Evening	No	Yes	8 hr.	3 days	Yes	Yes
R89	F	Bachelor nursing degree	>21 years	> 10 years	100-300 beds	Suburban	Surgical	Night	Yes	No	12 hr.	3 days	Yes	Yes
R90	F	RN-BSN 4 classes to go	1-2 years	1-2 years	100-300 beds	Suburban	long term	Evening	Yes	No	10 hr.	5 days	sometimes	Yes

R91	F	PhD	>21 years	6-10 years	501 -700 beds	0	maternity- including l/d, nsy, pp, and antepartum.	Day	Yes	No	10 hr.	5 days	No	Yes
R93	F	Bachelor nursing degree	1-2 years	1-2 years	301-500 beds	Suburban	Telemetry	Night	Yes	No	12 hr.	2 days	No	at times, there have been nights where I have not been able to take a meal break
R95	F	PhD in Nursing	16-20 years	6-10 years	0	Urban	Adult Critical Care	Day	Yes	Yes	12 hr.	3 days	Yes	Yes
R96	F	Associate nursing degree	>21 years	> 10 years	0	0	Home Health Case Manager	Day	Yes	No	8 hr.	5 days	Yes	Yes
R97	F	Bachelor nursing degree	>21 years	3-5 years	100-300 beds	Rural	Medical	Night	Yes	No	8 hr.	5 days	No	Yes
R98	F	final year DNP student, PMHCNS-BC	>21 years	3-5 years	100-300 beds	Rural	education, I am referring to the hospital we use for clinical placement	Day	Yes	No	8 hr.	5 days	No	Yes
R99	F	Associate nursing degree	<1 year	<1 year	100-300 beds	Suburban	Behavioral health	Evening	No	Yes	8 hr.	4 days	Yes	Yes
R100	M	Associate nursing degree	6-10 years	<1 year	>701 beds	Urban	CATH LAB	Day	Yes	No	10 hr.	4 days	Yes	Yes
R102	F	Master's nursing degree	>21 years	6-10 years	301-500 beds	Suburban	Education	Day	Yes	No	10 hr.	5 days	No	Yes
R103	M	Bachelor nursing degree	3-5 years	3-5 years	<100 beds	Urban	Community Health Clinic	Day	Yes	No	10 hr.	5 days	No	Yes
R107	F	Master's nursing degree	>21 years	3-5 years	100-300 beds	Rural	quality improvement, Clinical Coordinator, Nursing		No	No	8 hr.	3 days	No	No

R108	F	Master's nursing degree	>21 years	> 10 years	100-300 beds	Suburban	Critical Care Educator; involved with some med admin and also teaching med admin via computer processes	Day	Yes	Yes	8 hr.	5 days	Yes	Yes
R109	F	Master's nursing degree	>21 years	> 10 years	100-300 beds	Suburban	High Risk/Antepartum	Day	Yes	No	10 hr.	5 days	Yes	Yes
R110	M	Bachelor nursing degree	3-5 years	1-2 years	100-300 beds	Suburban	Adult Critical Care	Day	No	Yes	12 hr.	3 days	No	Yes
R111	F	PhD in Nursing	>21 years	6-10 years	<100 beds	Rural	Adult Critical Care	Night	No	Yes	4 hr.	I am a per diem RN with a separate full time job outside of the hospital.	Sometimes	Yes
R112	M	Diploma nursing	1-2 years	1-2 years	501 -700 beds	Urban	Step Down	Night	Yes	No	12 hr.	3 days	No	Yes

Rights of Medication Administration (Q15 – Q19)

ID	Q15. Do you follow the rights of medication admin. each time you administer medications?	Q16. If you do not follow the rights of medication admin., which steps do you utilize?	Q17. Do you utilize a standardized procedure during medication admin.? (Such as an insulin checklist)	Q17(b). Comments	Q18. Please describe the standardized procedures used with medication administration.	Q19. What is the source of patient medication storage on your floor? (Select all that apply)
R1	Yes		Yes		Wash hands, identify patient with 2 identifiers, 5 rights and 3 checks, Medication cart	Medication cart
R2	No		No			Medication cart, Refrigerator,
R4	Yes		No			Automated dispensing machine,
R5	Yes		Yes	Independent Double Check for High Risk Medications	5 rights, patient 2 identifiers, 2 nurses independently confirming digoxin, insulin, dopamine, morphine PCA, always stop med administration when the pt says "That med doesn't look familiar",	Automated dispensing machine, Medication cart, Refrigerator, Patient bedside
R7	Yes		No			Automated dispensing machine, Medication cart, Stock medications, Refrigerator,
R8	Yes		No			Automated dispensing machine,
R9	Yes		Yes	We have an electronic medication system with bar scanning	scan patient scan meds to be given sign off meds when given, Automated dispensing machine, ,	Medication cart, Stock medications, Refrigerator
R10	Yes		Yes	(Does not have a specific name) but all high risk medications such as insulin must be double verified by 2 RN's	Verifying order, verifying medication with order, verifying correct patient/patient rights (our facility uses name and DOB), then verifying patient/medication/electronic order before administration on computer at patient's bedside., ,	Automated dispensing machine, Refrigerator
R11	Yes		No			Medication cart, Stock medications, Refrigerator,
R14	Yes		No			Locked cabinet.

R15	Yes		Yes	6 rights	computer on wheels with RN to PYXIS station, compare MAR from COW to PYXIS information that has been verified by RN. Pull meds, go to patient room, identify patient with 2 idenfiers, scan patient wrist ban, scan medication, verify correct medications, administer meds, accept med administration.,	Automated dispensing machine,
R16	Yes		No			Automated dispensing machine, Stock medications, Refrigerator,
R17	Yes		No			Automated dispensing machine, Stock medications, Refrigerator,
R19	Yes		Yes			Automated dispensing machine, Medication cart,
R21	Yes		No			Automated dispensing machine, Refrigerator, locked med bins
R22	No	Right patient, Right time, Right route, Right drug, Right dose	No			Automated dispensing machine, Medication cart, Refrigerator,
R23	Yes		No			Medication cart,
R24	Yes		No			Medication cart,
R25	Yes		No			Automated dispensing machine,
R26	Yes		Yes	We have standing orders for insulin, sliding scale, and Heparin	See what meds are due when for each pt on the shift. Pull meds out of pyxis. scan med(s) and scan pt band. Review meds w/patients while administering	Automated dispensing machine
R28	Yes		Yes	use of bar code scanning and needing another RN signature with high risk meds	ask name, DOB, scan bracelet, scan medication, verify the medication with the patient, ,	Automated dispensing machine, Refrigerator
R29	Yes		Yes	MAK program (**M**edication **A**dministration Chec**k** digital barcoding system)	Obtain order, verify order, retrieve medications and supplies, enter room, hand hygiene, patient identifiers, instruct patient on what I'll be doing, what meds will be given, why they're being given, perform 5 rights of medication administration, log on to MAK, scan pt, scan med, administer med, chart in mak, hand hygiene,	Automated dispensing machine,
R30	Yes		Yes			Automated dispensing machine,

R31	Yes		No	Electronic double sign protocol-insulin, heparin		Automated dispensing machine, Medication cart, Refrigerator,
R32	Yes		No			Medication cart, medications are locked in the patients room
R33	Yes		No			Stock medications,
R34	Yes		No			Automated dispensing machine,
R36	Yes		No			Automated dispensing machine, Medication cart, Refrigerator,
R37	Yes		No			Medication cart,
R38	No	Right patient	Yes	Unit policy that all medications drawn up by RN are checked with another RN.	We are expected to utilize "the rights".All medications drawn up by RN's are to be checked and signed out on a medication sticker by another RN.,	We have a pyxis machine for stock medications. IV meds are drawn up by the pharmacy and placed in a locked refrigerator which is accessed through the pyxis but as an override.
R39	Yes		No			medications are placed in the client's locked medication drawer in their room
R40	No	Right patient, Right time, Right route, Right drug	No			Automated dispensing machine,
R41	Yes		Yes		we have medication protocols,	Automated dispensing machine, Refrigerator,
R42	No	Right patient, Right time, Right route, Right drug, Right dose	No			Stock medications, Double lock narcotics box

R43	Yes		Yes	There are protocols for medications in which there is a high risk of error, insulin is one, as is k, chemo meds, narcotics used in PCA pumps. Any of these drugs require two nurses to independently check and verify utilizing the five rights.	The MAK is used to assist in the adm of medication adm.. The pts id bracelet is scanned and the pt is asked their name & DOB which should match. If the scan matches the screeen that is pulled up for that pt, a green check appears indicating that this is the correct pt..The drug to be adm is scanned and if correct a green check also appears on the computer screen, indicating that it is correct. The computer also has drug information readily available, and information about each pt. allergies, medical history, lab data, history/physical, vital signs, last nsg assessment findings., ,	Automated dispensing machine, Medication cart, Refrigerator
R44	Yes		Yes	Policy of School District	Check student's name, check medication record for student's name, medication name/dose/route/frequency.	Refrigerator, Locked cabinet for non-refrigerated medications
R45	Yes		Yes		check meds, scan meds, check meds again after scanning them, ask patient name and birthdate, scan patient, explain meds to patient, administer meds,	Automated dispensing machine,
R47	Yes		No		Automated dispensing machine, we have a pixis for some meds, and certainly controls....but we have locked bins in the wall outside of every room, we call them wall-a-roos....	Automated dispensing machine
R48	Yes		No			Automated dispensing machine, Medication cart,
R49	Yes		Yes	Not sure if this is what you want but Insulin protocol, Heparin protocol	For insulin: Need to get blood sugar first then based on that result, amount of insulin given by protocol. Same with Heparin, must get PTT and after resulted, drip changes based on that. When giving any medication, patient (if able) must provide name and birth date. If unable, name and birth date are checked with computer system. Name bracelet is scanned and then medication is scanned., ,	Automated dispensing machine, Stock medications, Refrigerator
R52	Yes		No			Medication cart,
R53	Yes		No			Medication cart, Refrigerator,
R54	Yes		No			Automated dispensing machine, Refrigerator,
R55	Yes		No			Automated dispensing machine, Stock medications, Refrigerator, locked medication cabinet in patient room

R56	Yes		Yes	Self-developed. I am a nurse educator and have developed my own checklist for use by my students.	Based on the 5 Rights: first check at the Pyxis, second check when the medication is scanned, third check when opened; overriding the computer is not allowed unless double checked by another RN; certain high risk medications e.g. insulin, require a second RN to check; students may not administer medications unless with an instructor.,	Automated dispensing machine, Pyxis denseness stock medications.
R57	Yes		No			Automated dispensing machine,
R58	Yes		No			Automated dispensing machine, medication drawers
R59	Yes		Yes			Automated dispensing machine,
R60	Yes	Right patient, Right time, Right route, Right drug, Right dose	No			Automated dispensing machine, Medication cart, Stock medications, Refrigerator,
R61	Yes		Yes	all medications are barcoded	medications are barcoded to the patient's ID band. Both the patient and the medication are scanned.,	Medication cart, Stock medications, Refrigerator,
R62	Yes		Yes		We use an electronic scanning system, BCMA.,	Medication cart,
R63	Yes		No			Stock medications,
R64	Yes		Yes		right patient. right med. right route. right dose. right time. right doc,	Medication cart, Stock medications, Refrigerator,
R65	No	Right patient, Right route, Right drug, Right dose	No			Automated dispensing machine, Stock medications, Refrigerator,
R66	Yes		Yes		Scanning the patient's ID band, followed by scanning the medication into the computer or manually entering the medication if it doesn't scan. If there is a medication such as insulin or heparin, we get a second nurse to confirm the dosage.,	Automated dispensing machine,
R67	Yes		No			Stock medications, Refrigerator, Cabinet,

R68	Yes		Yes	Electronic medication administration record and independent double check on high alert medications.	All medications are verified with the electronic medication administration record (EMAR), standard patient identification procedures are completed, allergies reviewed, and each medication is given after these have been reviewed. The electronic record and the patient identification address the 6 rights.,	Automated dispensing machine, Stock medications, Refrigerator,
R69	Yes		No			Medication cart, Stock medications, Refrigerator, Emergency box
R70	Yes		No			Refrigerator,
R71	Yes		Yes			Medication cart, Refrigerator,
R72	Yes		Yes	Bar Code Scanning and 5 rights		Automated dispensing machine, Medication cart, Refrigerator,
R73	No	Right patient, Right time, Right route, Right drug, Right dose	No			This does not apply to my work
R74	Yes		Yes	We have a second nurse verify all high risk drugs - Insulin drips, Heparin, vasopressors. also our Pyxis has double checks installed for Heparin and high risk medication	Heparin drip is calculated with weight by administering nurse, Pharmacy and second nurse to verify correct dosage,	Automated dispensing machine,
R76	Yes		Yes			Automated dispensing machine,
R77	Yes		No			Automated dispensing machine, Medication cart, Refrigerator,
R78	Yes		No			Medication cart, Stock medications, Refrigerator,
R79	Yes		Yes			We have a mak system which is computer based we scan the patient and the medication., Automated dispensing machine,
R80	Yes		No			Medication cart, Stock medications, Refrigerator,
R81	Yes		No			Automated dispensing machine, Medication cart, Refrigerator,

R82	Yes		No			Medication cart,
R83	Yes		Yes		Per hospital policy,	Automated dispensing machine, Medication cart, Stock medications, Refrigerator,
R84	Yes		No			Stock medications, Refrigerator,
R87	Yes		Yes	use of a computerized medication administration program which utilizes scanning patient bracelets and drugs to be given	patient is identified using full name and date of birth; patient's bracelet is scanned and drugs to be administered are scanned; documentation is then completed on the computer,	Automated dispensing machine, Stock medications, Refrigerator, scheduled patient meds are kept in patient's room in a locked drawer
R88	Yes		No			Automated dispensing machine, Stock medications, Refrigerator, Locked medication drawers for each patient
R89	No	Right patient, Right drug, Right dose	No			Automated dispensing machine,
R90	Yes		No			Medication cart,
R91	Yes		No			
R93	Yes		Yes	We have certain procedures for high risk medications such as Insulin Protocol and Heparin gtt protocol.	We have a barcode scanning system.,	Automated dispensing machine, Stock medications, Refrigerator,
R95	No	Right patient, Right route, Right drug, Right dose	No			Medication cart,
R96	Yes		No	In Home Health we seldom administer meds		

R97	Yes		Yes	high risk drugs, insulin, heparin, warfarin, enoxaparin >40mg verified by a 2nd nurse	we have one med nurse in the hallway so that he/she is not interrupted.,	Medication cart, Stock medications, Refrigerator,
R98	Yes		No	But in Nursing education we adhere to the three checks		Medication cart,
R99	Yes		No			Medication cart,
R100	Yes		Yes		DOUBLE CHECK WITH ANOTHER RN, e,	Automated dispensing machin
R102	Yes		No			Automated dispensing machine,
R103	Yes	Right patient, Right time, Right route, Right assessment, Right evaluation	No			Tupperware Container
R107	Yes		No			Automated dispensing machine, Medication cart, Stock medications, Refrigerator,
R108	Yes		Yes	Bar Code Process; double check for high risk meds	Identify patient with 2 patient IDs (name/birthdate stated by the patient or verified via bracelet for patients unable to answer). Barcode scan of patient's ID; barcode scan of med. Computerized MARs. Certain drips require 2 person check- insulin drips, heparin drips, PCA, chemo, (and something else!),	Patient meds in locked drawer in pt's room. Narcotics and some stock meds via pyxis.
R109	Yes		No			Medication cart, Stock medications, Refrigerator,
R110	Yes		No			Automated dispensing machine, Medication cart, Stock medications, Refrigerator,
R111	Yes		No			Medication cart, Stock medications, Refrigerator,
R112	Yes		No			Automated dispensing machine, Stock medications,

Medication Administration Logistics/Layout (Q20 – Q23)

ID	Q20. Is your medication cart kept in a closed, locked room?	Q21. Please describe where is the medication cart located.	Q22. Are the supplies necessary for the medication administration located in the same place as the medications?	Q23. Please describe the location of the supplies needed to administer medications.
R1	No	Nurses station	Yes	
R2	No	one it at the medication bar, the other is in the adjacent nurse's office. The carts are locked when not in use.	Yes	
R4	No	Middle of hall	No	central area of the unit
R5	yes	Near nurses charting area at the station in a central pod.	Yes	
R7	No	In the hallway or in the nursing station. The medication cart is locked.	Yes	
R8	yes	We have two, one is located at the nurse's station in the locked med room and the other is in the locked clean utility room.	Yes	
R9	yes	lock in a medication room	No	in the closet across the hallway
R10	yes	Medication preparation room with a key-coded door	Yes	
R11	No	The med cart is on the unit floor for which it is to be used and is locked when the RN is not standing with it.	Yes	
R14	No	In an office space, the medication cabinet is up on the wall and locked with combination locks	Yes	
R15	No	automated are sometimes in locked rooms and sometimes in an area behind a partition. Both are automated requiring a password/fingerprint to access dispensing machine.	Yes	
R16	N/A		Yes	
R17	yes	we do not use a medical cart	Yes	
R19	No		No	
R21	No	locked room only accessible with employee ID	No	bedside carts
R22	No	In the hallways, plugged into outlets. They are locked.	No	The supplies are located at the nurses station in drawers.
R23	yes	Inside locked nurses station	Yes	

R24	yes	In med room behind desk	Yes	
R25	yes	med room	Yes	
R26	yes	Each unit has one or two pyxis machines in their medication room(s)	Yes	
R28	No	behind the nursing desk	No	at either end of the hallways
R29	yes	In a medication room only accessible through badge swipe entry	Yes	
R30	yes	Medication room	Yes	
R31	No	individual locking med server carts	Yes	
R32	yes	each nurse has a computer on wheels that she takes with her, medications are located right in the patients room	No	are supplies are kept in a locked room which is at the end of the hallway
R33	No	At the nurses station; a Pyxus unit	Yes	
R34	N/A		Yes	
R36	No	hallway	Yes	
R37	yes	Locked medication room	No	
R38	No	Near the nurses station there is the pyxis machine and the locked refrigerator.	No	The supplies are located in drawers next to patients bedsides.
R39	yes	in a locked medication supply room	Yes	
R40	No	Hallway cutaway	No	Patient room
R41	No	pixis is behind nurses station	Yes	
R42	No	it is a locked cupboard in the pacu. There is no cart.	Yes	
R43	No	the med cart is kept when not in use at the nurses station. The med cart locks automatically after 30 seconds of non use. The med cart can only be opened by each nurse using an individualized personal code.	Yes	
R44	No	N/A	Yes	
R45	No	behind nurses station. Use omnicel	Yes	
R47	No	the ICU is one large square, and one hallway is a no walk zone for visitors, has linen, equipment rooms, and the pixis...	Yes	
R48	yes	LOCKED WITHIN NURSES STATION	Yes	
R49	yes	In a room that is locked and one needs a pass key to enter. The room is located in the middle of the nurse' station against a wall.	No	They are located in OmniCells in the middle of the nurses station. But some items, like needles, syringes, and medicine cups are in the med room. OmniCell contains, IV tubing and stock IV fluids and alcohol swabs.
R52	No	At nursing station	Yes	

R53	No	locked in hallway	Yes	
R54	No	center of the unit	Yes	
R55	No	Automated dispensing machine behind nurse's desk. stationary	Yes	
R56	No	In a locked medication room.	No	Due to space concerns supplies are located in an adjacent supply room which is also locked.
R57	No	MENDICINE ROOM	Yes	
R58	yes	Each Pod has a cupboard with individual drawers that are filled daily, new orders sent from pharmacy via tube system, controlled substances and stock kept in automated drug cabinet	Yes	
R59	No	central nursing work area	No	several feet away but in central work area
R60	No	Hallway and the cart is locked	Yes	
R61	yes	the medication cart is located in a locked room near the nurses station	Yes	
R62	yes		Yes	
R63	No	We utilize a medication cabinet which is locked.	Yes	
R64	yes	Nurses' room	Yes	
R65	No		Yes	
R66	yes	In the med room at the nurses station	Yes	
R67	yes	Separate room	Yes	
R68	No	We only use an automated dispensing cabinet and any additional patient medications sent by pharmacy are entered into a patient drawer in the automated cabinet. This cabinet is in the main patient care area in the PACU.	No	IV tubing is located in a clean utility room. the needles and syringes are kept in a locked cart next to the automated dispensing cabinet.
R69	yes	Separate locked room on the unit near the nursing station	Yes	
R70	yes		Yes	
R71	No	the locked cart is kept in the nurses station	Yes	
R72	No	Individual, locked nurse server carts are used and are in the hall or in a storage area when not in use.	No	In the med room, on the nurse server cart or in the clean utility room.
R73	yes	Varies from client to client		Varies from client to client
R74	No	Our Pyxis is behind a high counter top desk	Yes	
R76	yes		Yes	
R77	No	Medication carts are located throughout the hallway for each nurse. After they complete their medication rounds, these carts are supposed to be locked by hospital policy. However, this is not typically the case.	Yes	

R78	No	In the hallways with the computer work station. Pharmacy delivers new orders to a locked room, however.	Yes	
R79	yes	In our medication room where the room is locked.	Yes	
R80	yes	Unit dose are supplied in a computer on wheels , narcotics and refrigerated meds in a locked room	Yes	
R81	yes	In the medication room	Yes	
R82	No	At nursing station.	Yes	
R83	yes	Med room	Yes	
R84	yes	No med cart due to clinic. But locked med cabinet in locked room	Yes	
R87	No	we do not use a medication cart. we use a pyxsis system/shurmed system, and scheduled patient meds that come from pharmacy are kept in a locked drawer in the patient's room.	No	IV tubings are kept close by the shurmed and syringes are kept in a locked cabinet in close proximity to the shurmed
R88	yes	The stock medications, automated medication dispenser and refrigerator are in a locked medication room near the nurse's station	Yes	
R89	yes	Medication room	Yes	
R90	yes	med room	Yes	
R91	yes	Within the nursing station, in a small locked, brightly lit room.	Yes	
R93	yes	We have two medication rooms on the floor and they are accessed by swiping our ID badges.	Yes	
R95	yes	Closed locked room	Yes	
R96	N/A	N/a	No	N/A
R97	No	kept in hallway	Yes	
R98	No	Behind the nurses station counter	Yes	
R99	No	Inside nurses station where all nurses and unit staff work	Yes	
R100	yes		Yes	
R102	yes	Locked room	Yes	
R103	No	In patient areas	Yes	
R107	No	Automatic dispensing machine in alcove. Med carts locked on mobile stands with computer, Stock meds in snap-locked emergency carts.	No	Food/drinks in kitchen, pain meds, etc in Omnicell in centralized location, refrigerated meds in refrigerator attached to Omnicell, IV's in IV stock storage, or in Pharmacy IV supply.
R108	yes	pyxis in med room. combination to get into med room. routine patient meds locked in patient's drawer in patient's room.	No	not always; syringes for insulin in med room; flushes for lines in med room. sometimes we stock in patient's drawers

				for convenience but the nurse has to remember to do this first. diluents for certain meds in med room (usually in pyxis so there's a charging mechanism) unless it's a routine med for patient and then I would imagine it would come with the med exchange.
R109	No	nursing station	Yes	
R110	No	In a hallway adjoining two six bed critical care units. It does require a badge swipe or code entry to obtain access.	Yes	
R111	No	The unit is small. The cart medications are on the same cart as the computer station for the medical record.	No	The supplies are located at the nurses station.
R112	No	Nurse station	Yes	

Interruptions To Medication Administration Process (Q24 – Q28)

ID	Q24. Have you ever been inter-rupted durin g med. admin ?	Q25. How many times during 1 pt med prep or admin ?	Q26. At what point in the medication administration process was the interruption? (Select all that apply):											Q27. Have you ever self-interrupt ed?	Q28. How did you self-interrupt? (Select all that apply)		
			Verif y med	At med cart	Pullin g med	Gather supplies	Way to pt roo m	Ente r pt roo m	Prior to verify pt	During med adm	Afte r med adm	Prio r to doc	Other		Answere d phone	Textin g	Discussion of non-medication administrati on issues
R1	Yes	1		Y										Yes			
R2	Yes	1		Y	Y				Y				Another client wants some sort of attention	no	1		
R4	Yes	1				Y	Y				Y		Another nurse needing help Nurse asking questions about other patient phone calls from other staff	no	1		
R5	Yes	>6	Y	Y	Y	Y	Y	Y	Y	Y	Y		Phone paging by MD, emergency with another patient, visitors, patient vomiting and not able to take meds	no	1	1	
R7	Yes	2	Y	Y	Y	Y	Y	Y	Y	Y	Y			no	1		
R8	Yes	4		Y	Y	Y	Y		Y	Y				no	1		1
R9	Yes	3	Y	Y		Y	Y	Y	Y	Y	Y		family and patient questions. other nurses	Yes			
R10	Yes	3	Y	Y	Y	Y	Y	Y	Y	Y	Y			no			1
R11	Yes	3	Y	Y	Y	Y	Y	Y	Y	Y	Y		Another coworker has to ask me a question; phone calls from a patient's family member; approached by a patient's family member; a	Yes			

													doctor returns a phone call about a patient; a patient asks me to help look for something or asks a question about something unrelated to the medication; a problem occurs with another resident; etc.				
R14	Yes	1	Y											Yes			
R15	Yes	>6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	phone call, questions from patient, family, staff, MD, assisting patient with ADLs, assisting another patient, call bell, or falls alarms.	no	1	1	1
R16	Yes	3	Y		Y		Y	Y	Y	Y	Y	Y	phone calls from cardiac monitoring stations, MD, other departments (lab, radiology, etc) family questions room mate questions, yelling, getting OOB without assistance, bed alarm patient requests additional medications which need to be obtained	no	1		
R17	Yes	4	Y		Y	Y	Y		Y	Y	Y	Y		Yes			
R19	Yes	3		Y										Yes			
R21	Yes	3	Y		Y					Y		Y	People asking questions (other nurses), Charge and supervisory nurses introducing themselves	no			
R22	Yes	>6	Y	Y	Y	Y	Y		Y	Y		Y	Doctor's needing to speak to you. Patient families, other nurses with questions, nurse manager, phone calls, other patients needing assistance	no	1		1

R23	Yes	3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		no	1		1
R24	Yes	3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		no	1		1
R25	Yes	4	Y	Y	Y		Y				Y	Y		Yes			
R26	Yes	1		Y	Y		Y							no	1		1
R28	Yes	2		Y		Y	Y		Y					no	1		
R29	Yes	2		Y			Y					Y		Yes			
R30	Yes	6	Y	Y	Y		Y		Y					no	1		1
R31	Yes	1	Y			Y								no	1		
R32	Yes	3	Y		Y	Y	Y			Y		Y	patients family on phone, physician on phone, ancillary department on phone, monitor technician calling to let you know that a patient is off the monitor	no	1		1
R33	Yes	3	Y	Y		Y						Y	A busy hospital ED, with frequent interruptions that include phone calls, overhead pages, patients and visitors looking for information.	Yes			
R34	Yes	3			Y									no	1		1
R36	Yes	>6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		no	1		1
R37	Yes	2		Y	Y			Y					telephone interruptions, patient emergencies, interruptions by other patients	no	1		1
R38	Yes	2				Y						Y	Care is delivered at the bedside in our NICU. I may have to answer a monitor alarm or answer a parent question during med admin.	Yes			
R39	Yes	2		Y					Y	Y	Y		clients or staff members wanting something	Yes			
R40	Yes	2							Y	Y			Patient request Nurse	no	1		1

													requests				
R41	Yes	3	Y	Y	Y									Yes			
R42	Yes	1			Y					Y	Y	Y	Someone talking to you.	Yes			
R43	Yes	3											Any and all of the above, which varies from patient to patient. Doctors, other staff members, patients and family think nothing of interrupting you to ask questions, or ask you to do something. Biggest interruption, patient requesting to be toileted, or have urinal emptied, answering the phone to receive lab results, or to speak to a physician. Another big problem is having to take computer orders over the phone when the physician can POM them. Now at the institution I am working when a nurse has a suggestion for a physician a complete order is to be written then the physician signs if agreed; so that once again the nurse is doing the physician's job. I seriously question this policy legally.	no	1		1
R44	Yes	1			Y						Y	Y	Phone call, student emergency	Yes			
R45	Yes	2	Y			Y	Y		Y				phone calls, other nurses, other patients, doctors	Yes			
R47	Yes	2		Y		Y	Y		Y		Y	Y	co-workers asking for a "pull-up" for their pt.....co-	Yes			

													workers asking me to witness a waste,....and of course, emergencies in the ICU...				
R48	Yes	2			Y	Y	Y	Y		Y				no	1		
R49	Yes	1			Y	Y	Y	Y	Y		Y		Other nurses needing to have a cosigner for certain meds. Patient needs turning. Answering the phone.	no			
R52	Yes	3	Y	Y	Y	Y	Y	Y		Y		Y	PT, OT staff frequently interrupt to inquire if certain patients are ready to go the therapy gym.	no	1		1
R53	Yes	2		Y									called to phone, asked for info on a pt by md, ques by family member	no	1		1
R54	Yes	>6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Asking questions related to other patients or needs, don't have a needed item and have to go get it, IV access needs a flush,	no	1		1
R55	Yes	2	Y	Y	Y					Y	Y	Y		Yes			
R56	Yes	3	Y	Y	Y	Y	Y	Y		Y	Y		Students ready to give medications, requests for a second signature, request for help from staff nurses, patient/family concerns.	no	1		
R57	Yes	4	Y	Y	Y	Y	Y	Y		Y		Y		no			1
R58	Yes	4			Y	Y	Y				Y		I am a nursing faculty and I monitor each student as they acquire medications, ID client, and recheck medications in computer in client room. system requires scanned nameband. I will be	no			1

													interrupted at the above times, but they must wait while we are in the client room. I saw a staff member ID client and get a call to leave the bedside, he asked the student to give the meds. She sent another student to get me and I agreed that she could not give the meds because she had not removed them, entered the computer, nor scanned client. We waited until the nurse returned, if he had not I would have found him to do it, while the student watched over the meds. We told him why we couldn't pass the meds as they were out of their packages etc. . .				
R59	Yes	1		Y						Y	Y	Y		no			
R60	Yes	2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Someone stops me to ask a question - could be another patient, a visitor, a physician, another nurse I am called to go to another room to assist another patient	no	1		1
R61	Yes	1		Y									critical patient situation	no	1		1
R62	Yes	2		Y										Yes			
R63	Yes	2	Y										The young adults I work with try to get my attention when I begin the medication process.	Yes			
R64	Yes	>6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Always! Psych Unit.	no	1		1

													Unlike others....mine is OPEN. No dutch doors. Always have to be on guard to intrusion.				
R65	Yes	4	Y		Y	Y	Y	Y	Y	Y	Y	Y	called to phone questions by physicians, families, managers questions by other disciplines emergencies patient issues-need for bedpan, set up for meals, etc	Yes			
R66	Yes	3	Y		Y			Y			Y		Telephone calls from either pharmacy or family members Family members seeking me out on the unit to ask questions or voice concerns Physicians asking for charts and/or lab values on their patients. Interruptions from the ED asking to give report.	no	1		
R67	Yes	2			Y						Y	Y	Other students --teachers	Yes			
R68	Yes	2	Y	Y	Y		Y		Y	Y		Y	Asking for SBAR on another patient going into the OR. Asked to take a phone call. Getting report on a patient. Anesthesia or the surgeon coming to talk with the patient or mark the surgical site.	Yes			
R69	Yes	2		Y	Y	Y	Y			Y	Y	Y		no	1		
R70	Yes	3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Yes			
R71	Yes	2		Y	Y		Y			Y				no	1		1
R72	Yes	>6	Y	Y	Y	Y	Y						Telephone calls, questions, patient asks for something.	no	1		1
R73	Yes	4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Nurse clients report interruptions at all times,	no			1

													usually requests for information or assistance				
R74	Yes	2	Y	Y	Y	Y							Because our Pyxis is a the front desk patient families, visitors and other staff may interrupt us. Even though their is a sign stating not to. Our plan is to reconfigure desk area to provide a closed area to obtain and prepare medications	no	1		1
R76	Yes	2	Y	Y	Y	Y				Y				no			1
R77	Yes	2		Y	Y	Y	Y			Y			Questions from family, MD phone calls, reports from nursing assistants	no	1		1
R78	Yes	4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Any of these times, emergencies etc.	Yes			
R79	Yes	4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Phone calls, patients family, and call bells.	no	1		1
R80	Yes	>6											During all steps of med administration, I have been interrupted. However, the computer system will assist me in rechecking each step to insure correct dose, correct client, correct route, correct order, and most of all correct insurance.	no	1		1
R81	Yes	2			Y			Y					Co-worker in need of assistance	Yes			
R82	Yes	4					Y						Trying to administer meds to a patient and have to stop to tend to a fall or combative patient.	Yes			
R83	Yes	2		Y	Y									Yes			
R84	No	N/A												Yes			
R87	Yes	4	Y		Y	Y	Y		Y	Y	Y	Y		no			1

R88	Yes	1				Y	Y			Y				no			1
R89	Yes	2			Y		Y							no			1
R90	Yes	2			Y	Y	Y							no	1		
R91	Yes	2		Y									As an instructor with students, it happens seldom from other nsg students, but often from staff, but only for pain meds or emergency meds. If i am with a student-they try not to interrupt until we are done with process and on our way out the door to patient room.	no			
R93	Yes	3	Y			Y	Y		Y					Yes			
R95	Yes	>6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		no	1		1
R96	Yes	>6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	when I worked on the floor it was common to be interrupted anytime	Yes			
R97	Yes	>6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		no	1		1
R98	Yes	1	Y	Y	Y		Y				Y	Y	I have six to eight students so when i am with a single student, there are times when my attention is needed by another student and the issue is urgent	Yes			
R99	Yes	3	Y	Y	Y	Y	Y	Y	Y		Y	Y	Psychiatric patients are very needy. They ask for all kinds of things including water and towels while I'm clearly holding medications in my hands.	Yes			
R100	Yes	>6			Y					Y	Y	Y		no			1
R102	Yes	5	Y		Y			Y			Y		Phone calls	no	1		

R103	Yes	>6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Codes, Assaults, etc.	no	1	1	1
R107	Yes	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Questions from co-workers, family, patient. Questions. Questions. Change in priority and refocus needed for another patient or this patient.	no	1		1
R108	Yes	3	Y		Y		Y		Y	Y	Y	Y	It's tough- there is no "red zone" concept with med administration. Nurses are interrupted via intercom from a secretary; from other nurses; from other disciplines (transport, physicians, PT, etc). Med admin should be a no talk environment.	no			
R109	Yes	4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		no	1		1
R110	Yes	1		Y	Y	Y	Y				Y	Y		Yes			
R111	Yes	N/A											I could not begin to describe these interruptions. We have multiple patients and multiple interruptions.	N/A			
R112	Yes	3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Other nurses needing assistance, patients needing assistance, patient's family members needing assistance, all at all stages of medication administration.	Yes			

Use of Technology For Medication Administration (Q29)

	Q29. Do you utilize any of the following technologies with medication administration? (Select all that apply)						
ID	BCMA	CPOE	Automated	Smart pump	Syringe pump	Computer on wheels	Other (describe)
R1						Y	
R2							
R4	Y		Y	Y		Y	
R5	Y	Y	Y	Y	Y	Y	
R7			Y				
R8	Y	Y	Y				
R9	Y	Y				Y	
R10		Y	Y			Y	
R11						Y	
R14							
R15	Y		Y	Y	Y	Y	still use paper MAR
R16	Y	Y	Y	Y		Y	
R17	Y	Y	Y	Y		Y	
R19			Y				
R21			Y		Y		
R22	Y		Y	Y	Y	Y	
R23	Y	Y	Y				
R24							None
R25			Y			Y	
R26	Y	Y	Y			Y	
R28	Y	Y	Y			Y	
R29	Y	Y	Y	Y		Y	
R30	Y	Y	Y		Y	Y	

R31	Y	Y	Y	Y		Y	
R32		Y	Y	Y	Y	Y	
R33			Y			Y	
R34		Y	Y		Y	Y	
R36	Y	Y	Y	Y		Y	
R37						Y	
R38			Y	Y			
R39	Y	Y	Y	Y	Y	Y	
R40	Y		Y			Y	
R41		Y	Y			Y	
R42							
R43	Y	Y	Y	Y	Y	Y	
R44							None of above
R45	Y	Y		Y		Y	
R47	Y	Y	Y	Y	Y	Y	
R48	Y	Y	Y			Y	COMPUTERS AT BEDSIDE
R49	Y			Y	Y	Y	
R52							
R53		Y	Y	Y		Y	
R54			Y	Y	Y	Y	
R55		Y	Y	Y			
R56	Y		Y	Y		Y	
R57			Y	Y			
R58	Y	Y	Y	Y	Y	Y	
R59			Y	Y			
R60	Y	Y	Y	Y	Y	Y	
R61	Y	Y	Y	Y	Y	Y	

R62	Y						
R63							N/A
R64							None
R65		Y	Y	Y			
R66	Y		Y	Y	Y	Y	
R67							Computer access
R68		Y	Y	Y	Y	Y	
R69							
R70							
R71		Y	Y	Y	Y		
R72	Y	Y	Y	Y		Y	
R73							
R74		Y	Y	Y		Y	
R76			Y	Y	Y	Y	
R77	Y	Y	Y	Y	Y	Y	
R78		Y	Y	Y	Y	Y	The computer on wheels does lock the medication drawers after 5 seconds
R79			Y			Y	
R80	Y	Y	Y	Y	Y	Y	
R81			Y	Y			
R82				Y			
R83	Y	Y	Y			Y	
R84		Y		Y		Y	
R87	Y	Y	Y	Y		Y	
R88			Y			Y	
R89			Y	Y			
R90						Y	
R91			Y				

R93		Y	Y	Y		Y	
R95		Y	Y	Y	Y		
R96							N/A
R97	Y					Y	
R98			Y				Pyxis for some meds Hospital just going to BCMA
R99		Y	Y			Y	
R100		Y	Y	Y			
R102			Y	Y			
R103							
R107	Y	Y	Y	Y	Y	Y	
R108	Y	Y	Y			Y	
R109	Y	Y	Y		Y		
R110			Y			Y	
R111		Y				Y	
R112	Y	Y	Y	Y		Y	

Impact of Technology On Medication Administration Workflow (Q30 – Q33)

ID	Q30. Do technologies affect your workflow?	Q31. Please describe how the workflow has changed.	Q32. Has use of technology caused a medication error?	Q33. Please describe how the technologies utilized with the medication administration caused an error.
R1	Yes		No	
R2		more clients with more meds each	No	the multiple med packaging has saved time. Not caused an error
R4			No	
R5	Yes	I feel like I am "nursing" the computer on wheels instead of the patient	Yes	If computerized stock drawer is filled with the wrong med to start with
R7	No		No	
R8	No		No	
R9	Yes	It has made med errors decrease Increases time of med delivery when system does not work correctly	Yes	home meds not barcoded and cannot be scanned with duplication given
R10	Yes	Improved medication administration	No	
R11	Yes	I may have to go in and take BP and pulse before pulling a medication with parameters because I now have to enter those values into the computer first, whereas before I would pull the medication and hold it aside in a different cup and determine whether or not to administer it after monitoring. In other ways, the computer system has improved workflow and allows me to complete the medication administration process faster.	No	
R14				
R15	Yes	takes longer, especially when there is a problem the barcode or COW recognizing an IV pump to associate a medication.	No	
R16	Yes	Process is much slower and time consuming Issues with computer speed, freezing, battery life on mobile units Bar codes don't always scan, are torn, or absent requiring need to find verifying nurse If computer system goes down unable to give meds for 30 min to 1 hr until printed MAR can be obtained because it is difficult to determine meds already given	No	
R17	Yes	I was not present prior to their existence to compare, but they help	No	
R19	Yes		Yes	
R21	No		No	

R22	Yes	Too many steps, too long a wait to get medications, sorting through medications to get out the ones needed, scanning and rescanning, drugs that don't scan, putting tags on meds just to scan them.	Yes	the meds are not available to administer on time, takes too long to sort through all the meds to find the ones you need, meds and equipment not in the same place, meds can be located in 5 different areas. these lead to meds not being given on time.
R23	Yes	Slowed down med pass	No	
R24	No		No	
R25	Yes	takes more time. Have to wait until computer/machine available as only so many available on unit	No	
R26	Yes	The scanning of medications and patient's arm bands, the 1-2 questions the computerized medication charting asks during the process can end up in going back and forth between the COW, the pt and the medication.	No	
R28	Yes	all of the medication checking and waiting until another nurse is available definitely interrupts the flow of my operations. it takes so much time!!!	Yes	sometimes the wrong drawers in the pixus open and because we get into so much of a routine we just pick up that medication. sometimes the scanners are down or scanning incorrectly.
R29	Yes	Workflow has become slower, albeit, safer	No	
R30	Yes		No	
R31	Yes	downtime	No	
R32	Yes	more complex with the computer technology	Yes	our facility just started a computer entry program and it is a learning curve for all
R33	Yes	When these systems are used, it initially slows down the process. This changes after adjustment to the technology.	No	
R34	Yes	Meds need to be verified by pharmacy before signing out in the computer	No	
R36	Yes	more complex, more steps	Yes	computer screen jumping off medication viewing
R37				
R38	No		No	
R39	No		No	
R40	Yes	Less time	No	
R41	No		No	
R42				n/a
R43	Yes	It takes longer giving medications using the MAK however, it is so much safer for both the patient and the nurse	No	
R44	No		No	

R45	No		No	
R47	Yes	it's actually moe efficient, and it's actually hard to make a med error	No	
R48	Yes	COMPUTERS OFTEN SLOW MAKING IT TAKE LONGER TO PASS MEDICATIONS AND CHART B/C HAVE TO WAIT	No	
R49	Yes	Sometimes the computers have trouble logging in and then you have to go find one that is working. At times the scanners on the computers do not work so meds cannot be scanned.	No	
R52				
R53	Yes	better	No	
R54	Yes	It takes time to program infusions, find pumps.	No	
R55	Yes	Administration of medications has taken longer. Not as many students able to administer medications	No	
R56	Yes	The necessity of taking the insulin vial into a patient's room for scanning means it is not available to other nurses. Computer downtime slows the process. Inaccurate/confusing orders entered at the pharmacy level require me to stop and confirm or get clarification.	Yes	The caution that the medication was over an hour late is EXACTLY like the one that for it is over an hour early resulting in the patient getting a medication before scheduled time.
R57	Yes	LESS CONTROL, CARRYING MED FROM MED ROOM TO PT	No	
R58	Yes	I do require students to follow all the recommended safety practices, ie. 7 medication checks and 3 checks of the meds themselves, two persons doing math. This does slow us down a bit, since I am practiced, I try to calculate the skill level of students passing meds. Often we are passing meds after the 30-60 minute time frame allowed, we always document in computer why they are late.	No	
R59	Yes	less chance of med error, slows charting	Yes	charting error
R60	Yes	Have to leave the cart to go to the Pyxis machine to obtain medications stored there as they are not in the same location	No	
R61	Yes	added time to retrieve the meds from the pyxis	No	
R62	Yes	Time for administration is recorded.	No	
R63				
R64		Nursing is disregarded as an annoyance.	No	
R65	Yes	have to wait turn to use 2 med dispense machines. contents are not same in either machine and sometimes have to go to both machines to obtain meds for one patient	Yes	Dispensed 1 pill instead of 2 for a dose as the nurse has to manually remove all pills involved in dose. More than one drug stored in drawer divided by separators, and pull wrong drug either from wrong bin in drawer or wrong med winds up in that drugs bin

R66	Yes	It has become more difficulty with the introduction of CPOE. The physicians have not been accepting of this change and have resisted to the of CPOE becoming a detriment to patient safety instead of an asset. The physicians are not writing order on the computer because it takes too much of their time. They either write the orders as they did prior to CPOE and expect the house officers to enter the medications or they do not write them at all, and the med nurse has to call the physician multiple times to get an order. The house officers are refusing to be the secretaries for the attendings and are now making themselves unavailable to enter the patient orders.	Yes	The pharmacy has on occasion, missed the correct dosage ordered by the physician or the physician has ordered the incorrect dosage, frequency or schedule and pharmacy and nursing has not picked up the error until after the fact.
R67	No		No	
R68	Yes	Orders are not always entered in the EMAR. Anesthesia gives a verbal order and the nurse must then enter the order into the EHR.	No	
R69			Yes	
R70	No		Yes	
R71	Yes	improves	No	
R72	No		No	
R73	No		Yes	Since I deal with pharmaceutical products that are usually oral or dermal, the technologies that interfere are minor (ie, improper application of a transdermal patch, improper dosing) although the error can have serious and even fatal consequences
R74	Yes	It has improved patient safety and availability of medications	Yes	t the beginning of CPOE and installation of the Pyxis there were errors but this has improved
R76	Yes			
R77	Yes	On most days, work flow has improved. When the technologies work correctly, the rights of medications are done with more ease and speed and help with accuracy. When they do not work, they consume more time cause frustration and may affect medication administration.	No	
R78	No			order entry. Physicians do not check what other physicians have ordered. Nurses also forget to sign off what they have given.
R79	No		No	
R80	Yes	All the checks has required some time to slow down and read the screens on the computer. However, I feel safer that all the checks are in place..	No	
R81	No		No	
R82	No		No	

R83	Yes	waiting for COW or access to Omnicell (Pyxis)	No	
R84	No		No	
R87	Yes	it slows workflow when there are computer related malfunctions, or if an order is not verified; it also slows workflow if another RN is entered into the same patient as you are giving meds to for another reason such as verifying an order.	No	
R88	No		No	
R89	Yes	Needing a two person verification.	Yes	The medication is not available or grayed out which makes it difficult to remove and administered.
R90	Yes	slower	Yes	orders are entered incorrectly and dispensed incorrectly; items are entered more than once
R91	Yes	Due to time stamping i can now only do meds with 2 students per day as if i do more we will not be in compliance with med administration for proper time of day. In other words, i can only do 2-3 in a one hour period. They are first time med administrators on a unit.	No	
R93	Yes		No	
R95	Yes	Helped	Yes	
R96				
R97	Yes	less staff	No	
R98	Yes	Since BCMA is new to the hospital and its employees and to the students, it takes longer from cart to bedside	No	
R99	Yes	Stopping what I'm doing to retrieve "narcs" which even includes Motrin and vitamins from the accudose	Yes	Doctors have changed orders before I have refreshed my EMAR and the order has been discontinued
R100	Yes		No	
R102	No		No	
R103	No		No	
R107	Yes	Recent study demonstrated that 13%-15% of barcodes did not scan. Change in med process based on this plus the reporting mechanism that must be completed. Medications in numerous places that must be collected to administer. Difficult to organize medication administration for patient. Frequent in and out to deliver meds.	Yes	Missed PRN meds because drop to the bottom of the field/screen and may not be visualized. Missed opportunity to aid patient. Unable to get STAT and/or emergency med out of Omnicell because either password was out of date or needed a second person to verify med and second person not readily available. Date/times for antibiotic administration provided by pharmacist and noted on MAR. Failed Core Measure due to selected timing.

R108	Yes	Generally speaking, barcode has made me feel more secure and if I encounter a problem, am grateful that there's a fall-back mechanism. Especially because a robot picks the meds and they are all together in the med drawer. CPOE is still in its infancy and while it may be good to not deciphering handwriting, errors are entered due to force function of computer. CPOE has not necessarily improved the accuracy of med ordering. Also, with CPOE if the doc is under the category of 'meds' versus 'order sets', he/she may not get the menu they think they are looking for...so, order something else with a comment. MIS thinks all is well because they 'oriented' the docs to CPOE (I believe it was a 1-2 hr class) and the CPOE includes everything (not just meds, but TEDs and BGM and labs, etc etc). If I have my computer up not on the status board, I don't necessarily know an order has been entered (let's say a STAT). I need to be constantly looking (and refreshing) the computer. I perform this function less often due to my position and it's time-consuming and annoying- I honestly don't know how the staff nurse gets through med administration without errors. It is time-consuming. And, nurses seem to more frequently be the answer to solve system or other department problems. It's a tough world out there for bedside nurses.	Yes	Wrong drug ordered; wrong dose ordered, etc. As per my previous paragraph, doctors are forced into choosing certain queries within an order.
R109	Yes	No unit clerk so I have to do EVERYTHING myself.	No	
R110	Yes	BCMA in it's current phase at our facility is a stand-alone adjunct to paper charting. The process of logging into a system using a handheld device and then concurrently documenting an administration on paper is time consuming and redundant. This process makes the med pass take more time than necessary and can be a distraction when the hardware doesn't perform as expected when trying to perform a task.	No	
R111	Yes	Medication administration takes much longer when a computer is needed.	No	I don't
R112	Yes	Force more steps to ensure the rights of medication are followed, but at the same time force more steps to ensure more interruptions are possible, and probable.	No	

Error Reporting (Q34 – Q40)

ID	Q34. I am usually sure what constitutes a medication error.	Q35. I am usually sure when a medication error should be reported using an incident report /electronic submission.	Q36. Some medication errors are not reported because of the reaction from management.	Q37. Some medication errors are not reported because of the reaction from coworkers.	Q38. Have you ever failed to report a medication error because you did not think the error was serious to warrant reporting?	Q39. Have you ever failed to report a medication error because you were afraid that you might be subject to disciplinary action or even lose your job?	Q40. Have you ever failed to report a medication error for any other reason and why?
R1	Yes	Yes	No	No	No	No	
R2		Yes	No	No	No	No	
R4	Yes	Yes	No	No	No	No	
R5	Yes	Yes	Yes	Yes	Yes	No	multivitamin was charted as given by the shift that just ended and med was still in a cup at the patient bedside
R7	Yes	Yes	No	No	No	No	
R8	Yes	Yes	No	No	No	No	
R9	No	Yes	Yes	Yes	Yes	No	
R10	Yes	Yes	Yes	Yes	Yes	Yes	I was afraid to report an error I found of a senior nurse, for fear of repercussion from that nurse/other nurses.
R11	Yes	Yes	No	No	No	No	
R14	Yes	Yes	Yes	No	No	No	
R15	Yes	Yes	Yes	Yes	Yes	No	The error was caught before administration and corrected. Also, have forgotten to report because too busy and thought I would get to it later.
R16	Yes	Yes	No	No	No	No	
R17	Yes	Yes	Yes	No	Yes	Yes	
R19	No	Yes	Yes	Yes	No	No	
R21	Yes	Yes	Yes	No	No	No	I have always reported errors however, I can understand why people don't report. The backlash associated with an error and the consequences therein.

R22	Yes		Yes	No	Yes	No	yes, usually due to time delays, too many reports in a day
R23	Yes	Yes	No	Yes	No	No	
R24	Yes	Yes	Yes	Yes	Yes	Yes	No
R25	Yes	Yes	No	No	No	No	never
R26	Yes	Yes	No	No	Yes	No	I may have done #35, cannot remember an incidence, but in 16 years, it must have happened. What constitutes a medication error? Given at the wrong time? What is the wrong time? Giving it other than what pharmacy staff put it in for? or giving it at a time for the patient that it would do the patient the most benefit? For example, isosorbide and levothyrozxine should be given before breakfast, so if I given them at 0600 and they are ordered for 1000, is that a med error?
R28	Yes	Yes	Yes	Yes	Yes	No	
R29	Yes	Yes	No	No	No	No	
R30	Yes		No	No	No	No	
R31	Yes	Yes	No	No	No	No	
R32	No	Yes	No	No	No	No	
R33	Yes	Yes	No	No	No	No	No.
R34	Yes	Yes	No	Yes	Yes	No	
R36	Yes	Yes	No	No	No	No	
R37	Yes	Yes	Yes	No	Yes	No	
R38	Yes	Yes	No	Yes	No	No	Never an actual error. A near miss in which the medication was never given buy discovered. Example- Ampicillin vial from pyxis found to be another drug before reconstitution returned to the proper bin in pyxis .
R39	Yes	Yes	No	No	No	No	
R40	Yes	Yes	Yes	Yes	Yes	Yes	
R41	Yes	Yes	Yes	No	No	No	
R42	Yes	Yes	No	No	No	No	no

R43	Yes	Yes	No	No	No	No	I have used the traditional med adm system prior to the introduction of the MAK, and never been hesitant to report an error. I think that the MAK has greatly reduced the possibility of error in med adm if used properly. Recently, I was shocked to learn that a travel nurse was taking drugs out of the MAK and placing them in med cups on the med cart then scanning the pts as she went along. This is not safe practice. Needless to say she is no longer working at our institution. The sad thing is there is always someone who tries to work around the system, even a safe one.
R44	Yes	Yes	No	No	No	No	No
R45	Yes	Yes	No	No	No	No	
R47	Yes	Yes	Yes	Yes	No	No	no
R48	Yes	Yes	No	No	No	No	
R49	Yes	Yes	No	No	No	No	N/A
R52	Yes	Yes	Yes	Yes	No	No	
R53	Yes	Yes	No	No	No		
R54	Yes	Yes	No	No	Yes	No	
R55	Yes	Yes	No	No	No	No	no
R56	Yes	Yes	No	No	No	Yes	No.
R57	Yes	Yes	No	No	No	No	
R58	Yes	Yes	Yes	Yes	No	No	Not in recent history, 30 years is a long time. I try to focus on safety and reporting with students, that experience can be useful in the "safety" of being a student. I had a near miss that I reported to the state, and of course the facility . . . it still makes me sick to think about it. Student was dropped from program but returned six months later and graduated successfully. This was in a PN program, I currently teach in a University based BSN program.
R59	Yes	Yes	No	No	No	No	
R60	Yes	Yes	No	No	No	No	
R61	Yes	Yes	Yes	Yes	No	No	no
R62	Yes	Yes	Yes	Yes	No	No	
R63	Yes	Yes	No	No	No	No	

R64	Yes	Yes	Yes	No	No	No	
R65	Yes	Yes	Yes	Yes	No	Yes	While a nursing student gave digoxin dose to patient with same last name as patient meant for dose. Fear of dismissal from program.
R66	Yes	Yes	No	Yes	Yes	No	
R67	Yes	Yes	No	No	No	No	No
R68	Yes	Yes	Yes	Yes	Yes	No	
R69	Yes	Yes	No	No	No	No	
R70	Yes	Yes	No	No	No	No	
R71	Yes	Yes	No	Yes	No	No	
R72	Yes	Yes	No	No	No	No	
R73	Yes	Yes	Yes	Yes	No	No	I had an experience in which I was unaware of the error until I discovered it later. No ill effects to the patient was observed and I did not report it.
R74	Yes	Yes	No	No	No	No	No
R76							
R77	Yes	Yes	Yes		No	No	No. At this point in my career I have been fortunate enough to not have a medication error.
R78	No	Yes	Yes	Yes	No	No	
R79	Yes	Yes	No		No	No	
R80	Yes	Yes	Yes	Yes	No	No	
R81	Yes	Yes	No		No	No	
R82	Yes	Yes	No		No	No	
R83	Yes	Yes	No		No	No	
R84	Yes	Yes	No		No	No	No
R87	Yes	Yes	Yes	Yes	No	No	
R88	Yes	Yes	No		Yes	No	
R89	Yes	Yes	No		Yes	Yes	No
R90	Yes	Yes	No		No	No	

R91	Yes	Yes	No		No	No	Typically, it is not a med error that is at issue, it is rate/number of meds in system. Typically, pt requests 2 pills for pain and upon entering room to administer, would now prefer only 1. Want to return med to system and it is only a tylenol. Forgetting to correct it in the system, but it is charted at the bedside that pt now received only one pill .
R93	Yes	Yes	Yes	Yes	No	No	
R95	Yes	Yes	Yes	Yes	Yes	Yes	
R96							
R97	Yes	Yes	Yes		No	No	time required to complete paperwork would be writing up med errors frequently.
R98	Yes	Yes	No		No	No	
R99	Yes	Yes	Yes	Yes	No	No	
R100	Yes	Yes	No		Yes	No	
R102	Yes	Yes	No		No	No	
R103	Yes	Yes	Yes	Yes	Yes	No	
R107	Yes	Yes	No		No	No	From experience in supervision and management, I have found that nurses face med "errors" constantly as part of the daily routine. When I've asked them to complete an event report because of late med, unscannable med, etc., they will do so, and will often be happy to because it provides a way to vent their frustration with the "system" that has been causing the ongoing problems. But I do find that they will do it because they see that I am supporting the report and them and that I expect the report. I am not so sure what happens when I do not know about the daily occurrences, frustrations, reactions, etc. Yes, I do know. It is not done on any kind of routine basis. Mostly done when some egregious error has taken place or they are angry or frustrated at some Doc, patient, or co-worker.
R108	Yes	Yes	Yes	Yes	No	No	No, I have not. And, I do not think my institution is particularly abusive. But I do think nurses fear retribution. Probably one of the most important areas for reporting that is under-reported is the 'almost' med error. Errors prevented by nursing or pharmacy, but it's too busy (and don't think of causing overtime) for nurses to take the time to fill out the form to report a potential error. But, that is where process changes can take place and is probably the important piece of med error reporting.

R109	Yes	Yes	No		No	No	No. I have had only one medication error in my career, thank God, and I reported it immediately.
R110	Yes	Yes	No	Yes	No	No	
R111	Yes	Yes	No	Yes			I am not sure I can answer an "ever" question as I can't recall my entire nursing career.
R112	Yes	Yes	Yes		No	No	No

APPENDIX E: DESCRIPTIVE DATA FROM SURVEY RESULTS

(N=92)

Survey Question	Responses		Themes
	N	%	
Q1. Gender			
Male	12	13%	
Female	79	85.9%	
Missing	1	1.1%	
Q2. What is your highest level of schooling or the highest degree you have received?			
Diploma	8	8.7%	
Associate	8	8.7%	
Bachelor	29	31.5%	
Master	38	41.3%	
Doctoral	9	9.8%	
Q3. How many years have you worked as a nurse?			
1 year	6	6.5%	
1-2 years	5	5.4%	
3-5 years	11	12.0%	
6-10 years	5	5.4%	
10-15 years	6	6.5%	
16-20 years	9	9.8%	
>21 years	50	54.3%	
Q4. What is the length of time you worked on present unit?			
<1year	16	17.4%	
1-2 years	21	22.8%	
3-5 years	21	22.8%	
6-10 years	15	16.3%	
>10 years	19	20.7%	
Q5. What is the bed size of your hospital?			
<100	16	17.4%	
100-300	33	35.9%	
301-500	19	20.7%	
501-700	14	15.2%	
>701	3	3.3%	
Missing	7	7.6%	
Q6. What is the location of your hospital?			
Urban	28	30.4%	
Suburban	41	44.6%	
Rural	16	17.4%	
Missing	7	7.6%	
Q7.What is your primary hosp. work setting?	10	10.9%	
Acute critical care	12	13%	
Medical	11	12.%	
Surgical	6	6.5%	
Telemetry	3	3.3%	
Emergency room	5	5.4%	
Stepdown	4	4.3%	
OB/NICU	1	1.1%	

Pediatrics	6	6.5%	
Pre/Post Op	10	10.9%	
Long term care	3	3.3%	
Education	8	8.7%	
Psych	3	3.3%	
Primary Care	1	1.1%	
School Nurse	8	8.7%	
Other	1	1.1%	
Missing			
Q8. Which shift do you typically work?			
Day	62	67.4%	
Evening	14	15.2%	
Night	13	14.1%	
Missing	3	3.3%	
Q9. Do you work a permanent shift?			
Yes	71	77.2%	
No	21	22.8%	
Q10. Do you rotate shifts?			
Yes	18	19.6%	
No	72	78.3%	
Missing	2	2.2%	
Q11. What type of shift do you typically work?			
4 hour	2	2.2%	
8 hour	55	59.8%	
10 hour	13	14.1%	
12 hour	22	23.9%	
Q12. How many days do you typically work in a row?			
2 days	20	21.7%	
3 days	20	21.7%	
4 days	13	14.1%	
5 days	33	35.9%	
Other	2	2.2%	
Missing	4	4.3%	
Q13. Do you work without breaks during your shift?			
Yes	49	53.3%	
No	42	45.7%	
Missing	1	1.1%	
Q14. Do you ever work through meal breaks?			
Yes	75	81.5%	
No	16	17.4%	
Missing	1	1.1%	
Q15. Do you follow the rights of medication administration each time you administer medications?			
Yes	83	90.2%	
No	9	9.8%	
Q16. If you do not follow the rights of medication administration, which steps do you utilize? (Select all that apply)			
Right patient			
Yes	10	10.9%	

No	82	89.1%	
Right time			
Yes	6	6.5%	
No	86	93.5%	
Right route			
Yes	8	8.7%	
No	84	91.3%	
Right drug			
Yes	8	8.7%	
No	84	91.3%	
Right dose			
Yes	8	8.7%	
No	84	91.3%	
Right assessment			
Yes	1	1.1%	
No	91	98.9%	
Right evaluation			
Yes	1	1.1%	
No	91	98.9%	
Q17. Do you utilize a standardized procedure during medication administration? (Such as an insulin checklist)	34	37.0%	
Yes	58	63.0%	
No			
Q17 (b). Comments	Double checks with high alert medications: 13 response; Barcoding process: 8 responses; Rights of medication administration: 4 responses		
Q18. Please describe the standardized procedures used with medication administration.	Rights of medication administration: 14 responses; Scanning: 14 responses: Double checks: 9 responses; 2 patient identifiers: 5 responses; Hand washing: 1 response; Hospital policy: 1 response		
Q19. What is the source of patient medication storage on your floor? (Select all that apply)			
Automated dispensing machine			
Yes	53	57.6%	
No	39	42.2%	
Medication cart			
Yes	38	41.3%	
No	54	58.7%	
Stock medication			
Yes	29	31.5%	
No	63	68.5%	
Refrigerator			
Yes	44	47.8%	
No	48	52.2%	
Q20. Is your medication cart kept in a closed, locked room?			
Yes	40	43.5%	
No	49	53.3%	
Missing	3	3.3%	

Q21. Please describe where is the medication cart located.	Nurses station: 31 responses; Medication preparation room: 30 responses; In the hallway: 16 responses In patient areas: 1 response; Didn't specify, varies client to client: 1 response; Not used: 1 response		
Q22. Are the supplies necessary for the medication administration located in the same place as the medications?			
Yes	71	77.2%	
No	20	21.7%	
Missing	1	1.1%	
Q23. Please describe the location of the supplies needed to administer medications.	Bedside: 4 responses; Across hall: 3 responses; Central area of unit: 3 responses; Medication room: 3 responses; Nurses station: 3 responses; Ends of hall- 2 responses; Kitchen: response; Varies client to client: 1 response		
Q24. Have you ever been interrupted during medication administration process?			
Yes	91	98.9%	
No	1	1.1%	
Q25. How many times during 1 patient med prep or administration?			
1 time (0)	14	15.2%	
2 times (1)	27	29.3%	
3 times (2)	21	22.8%	
4 times (3)	12	13.0%	
5 times (4)	1	1.1%	
6 times (5)	1	1.1%	
>6 times in one patient medication pass (6)	13	14.1%	
Missing	3	3.3%	
Q26. At what point in the medication administration process was the interruption? (Select all that apply):			Patient/patient care: 22 responses; Doctors questions: 15 responses; Phone calls: 14 responses; Family questions: 12 responses;
Verifying the medications			
Yes	52	56.5%	Nurses questions: 10 nurses;
No	40	43.5%	Unit staff/ lab staff: 10 responses;
At the medication cart			Alarms: 3 responses;
Yes	58	63%	Student nurse questions: 3 responses;
No	3	37.0%	Emergencies: 2 responses;
Pulling the medication			Report: 2 responses;
Yes	65	70.7%	Missing items: 1 response;
No	27	29.3%	Pages: 1 response;
Gathering supplies			SBAR: 1 response;
Yes	52	56.5%	Second signature on high alert medications: 1
No	40	43.5%	response;
On the way to the patient room			Witness narcotic waste: 1 response
Yes	58	63.0%	
No	34	37.0%	
When entering the patient room			
Yes	35	38.0%	
No	57	62.0%	

Prior to verification of the patient			
Yes	41	44.6%	
No	51	55.4%	
During the medication administration			
Yes	48	52.2%	
No	43	46.7%	
Missing	1	1.1%	
After the administration			
Yes	47	51.1%	
No	45	48.9%	
Prior to documentation			
Yes	44	47.8%	
No	48	52.2%	
Q27. Have you ever self-interrupted?			
Yes	57	62.0%	
No	34	37.0%	
Missing	1	1.1%	
Q28. How did you self-interrupt? (Select all that apply)			
Answer phone			
Yes	43	46.7%	
No	49	53.3%	
Texting			
Yes	3	3.3%	
No	89	96.7%	
Discussion of non medication administration	39	42.4%	
Yes	53	57.6%	
No			
Q29. Do you utilize any of the following technologies with medication administration? (Select all that apply)			Computer access: 1 response; Computer at bedside: 1 response; Still use paper MAR (medication administration record): 1 response; The computer on wheels does lock the medication drawers after 5 seconds: 1 response
BCMA (barcoding)			
Yes	38	41.3%	
No	54	58.7%	
CPOE (Computerized order entry)			
Yes	47	51.1%	
No	45	48.9%	
Automated dispensing machine (Pyxis)			
Yes			
No	67	72.8%	
Smart pumps (with electronic library built in)	25	27.2%	
Yes	46	50%	
No	46	50%	
Syringe pumps			
Yes	25	27.2%	
No	65	70.7%	
Computer on wheels			
Yes	55	59.8%	
No	37	40.2%	
Q30. Do technologies utilized with administration of medications affect your workflow?			
Yes	61	66.3%	

No Missing	21 10	22.8% 10.9%	
Q31. Please describe how the workflow has changed.	Increased delivery time: 22 responses; Computer issues: 7 responses; Safer: 7 responses; More complex: 5 responses; Decreased delivery time: 4 responses; Improved process: 4 responses; Inaccurate/confusing orders: 3 responses; Carrying medications to the patients room: 2 response; Decrease errors: 1 response; 2 person check: 1 response; 5 rights: 1 response; Increased patients, increased medications: 1 response; Improved workflow: 1 response; Less control: 1 response		
Q32. Has use of technology caused a medication error? Yes No Missing	 19 65 8	 20.7% 70.7% 8.7%	
Q33. Please describe how the technologies utilized with the medication administration caused an error.	Computer issues: 4 responses (medication dropping off screen, grayed out, eMAR (electronic medication administration record) not refreshed when order was changed); Error made by pharmacy and not picked up by nurse for incorrect dose: 4 responses; Medications late: 4 responses; Drawer filled with the wrong medication: 2 responses; Learning curve with computers: 2 responses; Medication and equipment not in the same place: 2 responses; Scanner issues: 2 responses; Dispensed one pill and not two, therefore manually have to remove the pills: 1 response; Charting error: 1 response; Improper application of medication: 1 response; Medication not signed out: 1 response; No person to do a second check for high alert medication: 1 response; Password outdated: 1 response (unable to get STAT medication out of locked cabinet); Pulled wrong medication from drawer, or wrong medication in the wrong drawer: 1 response; Saved time: 1 response; Wrong medication drawer opened: 1 response		
Q34. I am usually sure what constitutes a medication error. Yes No Missing	 85 4 3	 92.4% 4.3% 3.3%	
Q35. I am usually sure when a medication error should be reported using an incident report /electronic submission. Yes No	 88 4	 95.7% 4.3%	
Q36. Some medication errors are not reported because of the reaction from			

management. Yes No Missing	 32 59 1	 34.8% 64.1% 1.1%	
Q37. Some medication errors are not reported because of the reaction from coworkers. Yes No Missing	 30 60 2	 32.6% 65.2% 2.2%	
Q38. Have you ever failed to report a medication error because you did not think the error was serious to warrant reporting? Yes No Missing	 20 69 3	 21.7% 75.0% 3.3%	
Q39. Have you ever failed to report a medication error because you were afraid that you might be subject to disciplinary action or even lose your job? Yes No Missing	 8 80 4	 8.7% 87.0% 4.3%	
Q40. Have you ever failed to report a medication error for any other reason and why?	No, NA, none: 17 responses; Near miss: 4 responses; Fear of repercussion: 3 responses; Too busy: 3 responses; Pulled two pills, the patient only wanted one pill- not updating the charting in the system: 2 responses; Did not realize error until after the fact, no ill effects: 1 response; Fear of dismissal from nursing school: 1 response; Medication left at bedside for patient to take, patient forgot: 1 resp.; Rate and number of medications set up for a medication error: 1 resp.; Time to complete error reporting: 1 response; What constitutes a medication error?: 1 response; Workarounds- 1 response		

APPENDIX F: SUMMARY OF POST SURVEY INTERVIEWS

RQ1 - How do nurses perceive the factors that contribute to medication errors originating during the medication administration process?

Nurse 1
Process: Nice when it works, speeds up the process, the five rights all get met during the process with the use of the scanner and computer on wheels. Scan all of the patient medications, get a green check, then scan the patient get a green check and can proceed. If there is a problem with the medication, get a red X.
The problem arises with the scanner not working, it sometimes dies with no reason, can tap on it and it then works, or sometimes it doesn't. May be a problem with the patient ID band not scanning or the medication not available when it is due to be given to the patient.
These issues may cause an error but more so the technology prevents an error. It helps keep the nurse on track so they do not fall behind, keeps track of what needs to be done on the shift, allows the STAT medications to be given when they are needed.

Nurse 2
Process: that the medication administration process was 'wonderful'. This nurse stated the process involved a bar coding scanner and a computer on wheels. The process unfolded with the nurse scanning the medications at the bedside and then scanning the patient's identification wristband. If each was correct, the nurse sees a green check on the computer screen. If there is an error, a red X appears. The nurse was asked to further describe the error process that may unfold with a red X. The nurse shared an example of a medication order for a protonix (a medication that helps the stomach control acid buildup) that was ordered to be given intravenously (thorough a small catheter via a vein in the patients

Nurse 3
Process: In the pre op area, medication reconciliation is a critical task for the nurse. This is asking the patient to tell each medication and dose they are currently taking at home. Many of the patients bring in their bottles for the nurse to review. With many of the surgical cases, pre op antibiotics are given. All medication carts in the OR are the responsibility of Anesthesia, and the nurse is not responsible those carts. In the OR, the nurse will have medications in a locked cabinet on the OR wall, usually lidocaine is pulled the most. In the post op area there is a locked wall cabinet and narcotic boxes.
Depending on how busy, interruptions are related to the case issues, breaks are given around the cases but there are many days when breaks get consumed with cases

Nurse 4
Process: Bring the medication into the room with the computer cart and scanner, scan if OK, goes green, if a change in dose and pharmacy tried to strip out and update correct dose and there is an overlap in computer timing, goes red. If parameters for BP medication pop up, need to take BP first (sometimes need to find a working cuff) and then proceed to that medication administration. If holding a medication or no BP is posted, it will not let you advance until you complete that section. Verify the patient by scanning and two unique identifiers, then scan medications, then administer medications. If a medication requires charting, such as Heparin, you tap charted list and chart where you administered the medication or document what the BP is.

Nurse 5
Process: Was afraid the technology was going to slow down the process of administering medications but with enough 'caught' there was good buy in from the nurses.
Medications are in the patients' room. Pharmacy rounds every 30 minutes but still not getting medications up to the patients rooms in time for the medication to be given. This is tedious for the nurse.

Nurse 6
Process: Each nurse is given the computer for the shift and the computer on wheels alerts you that you have a medication within one hour but you only have 30 minutes before or after a medication scheduled time to administer a medication. Go to the med room, swipe in with the nurse ID badge and go to the Pyxis. Take out the medications to be administered for that time frame, gather the supplies from the medication room, and go to the computer on wheel place all the supplies together and proceed to the patient room. Scan the patient's bracelet once, verify with date of birth and asking the patient their name and then scan each medication, pressing OK after each medication. If you do not get an OK, can enter the medication manually if it is a medication issue.

Nurse 8
Process: Usually use a large outdoor area, such as a parking lot. Tents are rolled out with enough room for four large pickup trucks to come under as well as room for the volunteers. The clients do not leave their vehicle; the nurse climbs into the car and administers the vaccine. Always have paramedic and radio dispatch support on site for these vaccine clinics.

Nurse 9
Process: Review the list of medications and gather the medications supplies that may be needed. Take the computer on wheels and supplies, to the patient room. Move to the side of the room, go to the locked medication drawer in the patient room, remove the medications to be administered, review the medications to be administered, wash hands, scan and identify the patient with date of birth and name. Scan and give the medications, educate the patient if needed, check that the medication drawer is locked, leave the room and move onto the next patient.

RQ2- How can interactions between nurses and technology be improved to support the medication administration process?

Nurse 1
May cause errors but more so prevents errors, helps with not making an error during shift, one has to try very hard to commit an error using the technology given for the process
The system alerts with missing of any of the five rights
With the increase time to do this process and all of the other needs of the patient, difficult to get breaks or eat

Nurse 2
Workarounds with the system occur but only done when it is a benefit to the patient, such as a necessary medication is not in the patients drawer and it is necessary as the patient received too much narcotic and it is compromising their respiratory status
Missed updates on the eMar when the nursing computer is not refreshed during medication administration
Lots of interruptions when moving the computer cart from room to room
RN cannot walk a straight line without interruptions when going to the Pyxis to retrieve medications that nurse thought was in the patient drawer such as Colace or Tylenol. On the way back to the Pyxis the nurse is usually asked to stop and help other nurses. Increase in distractions. When medication has been obtained from Pyxis and finally get back down the hall to the patient room, need to go back and refocus, most times the computer has timed out and nurse will need to start the process from the beginning.
Has not had an error due to the technology
Rate of near misses has decreased since the days of paper documentation and medication administration.

Nurse 3
Reconciliation at the end of the shift with the narcotics utilized during the operative procedure is the biggest error. Getting the entire nurse anesthetist staff on the same page is hard. Cannot come back at the end of the day and say this is what I did not use or what was wasted, as all wastes need to be witnessed by a second RN. Need to follow policy.

Nurse 4
Had a situation where the medication required charting of the site where the Heparin was given. The procedure was followed but when the nurse went back in later for another medication administration for the same patient, and an error message appeared saying the site was not documented for the Heparin. The nurse spoke with the charge nurse, emailed the manager, manually went into the program and changed the time to the original time the medication was given and sent an email to the IT department. The nurse was not sure how to classify this issue.

Nurse 5
There is a policy where the medication room is a zone for no interruptions but don't really have this in process yet as workloads have doubled, and the patient to staff ratio has increased to eight patients for each nurse.
If a nurse goes too slow with the process, or gets called away to assist a fellow nurse, there is a problem that the nurse can not rescan since the system took it and this presents a problem for double checking and signing out the medication manually.
Keeping track of the overrides in the system, see more of this in the labor and delivery and intensive care units where the patients health changes quickly and becomes emergent

Nurse 6
Interruptions are often as the ICU unit has a culture of helping each other to keep the patients comfortable. With only one nursing assistant for the shift everyone pitches in to make the day work.
With the morning medications, every patient is usually getting medications, so there is usually many interruptions for all of the nurses working.
The most common errors are in the LASA, in that the medication was placed in the medication bucket and looked like the correct medication, but when the nurse pulls it, scans it is the wrong medication. Even though the medication was labeled for the correct patient. Another example was bar coding on the IV bag was correct but the medication within the bag was incorrect.
Most of the errors are due to pharmacy dropping off a wrong medication or may occur if the scanners are down.

Nurse 7
Unfortunately have seen nurses who have scanned the medications ahead of time, even for the full day. With the updated technology this workaround has become much more difficulty and do not see this occurring.
The medication process has become cumbersome with the interruptions with up to 25 patient to give out medications and pain medications per shift.
There has been issue when the nurse uses the technology bypassing the recommendations for usage. The example was giving regular Insulin, the bottle was scanned and the nurse drew up 13 cc instead of 1.3 cc. Now all Insulin as well as Heparin is double-checked.
Heparin labeling should be in different colors as this is confusing for nurses who work with both the baby and adult patients. They are different concentrations of medication but both have the same label coloring. Potassium has a different color code for each concentration of dose.

Nurse 8
Errors can occur with the wrong person getting the wrong vaccine. The mistakes can occur because the parent may have handed the child the wrong form and the nurse documented on the form. Really everyone in the car is getting the same vaccine, the same lot number, but it is the principle and policy of the matter.

Nurse 9
Have seen nurses pulling the medication for all of their patients all at one time. Put all of the medications in one bin, not in marked drawers and proceed to give their medications. Errors have occurred with the wrong medications in the patient drawers. ‘I know the patient and did not pick up the scanner’ one nurse was observed with a near miss.

RQ3 - How does hospital culture affect the reporting of medication administration errors, and what types of errors are not reported?

Nurse 1
Never had an error but aware of the incident reporting process
Would report an error that occurred or a system error that would occur. Did not look at a near miss when standing at the door of patient A with patient B medications. Stated was usually distracted, realized they needed to go to patient B room.

Nurse 2
Has not had an error utilizing technology, did have errors in the days of paper usage and medication administration
Did not consider battery issues or tripping hazards from computer plugs in patients rooms something that should be reported

Nurse 3
In the state electronic reporting system, it is not about pointing fingers but changing the system and improve the process moving forward, not to get anyone in trouble. With the reporting of errors there has been a small change in attitude with the staff, but many still feel it is a blame game

Nurse 4
Doesn't really know about this process, did have a wrong patient scan once the scan showed Lopressor 25 mg and should have scanned 50 mg, which is what the medication was labeled and verified as 50 mg. For bad scans, the report is sent to the manager and they go over the process

Nurse 5
Has used the system and feels it is very overwhelming to do the reporting. Some of the errors probably do not get reported because they are not caught on time.
Ancef was hanging and went back into the room at the end of the hour and realized the pump had never been turned on.
Nurse has caught big errors with the introduction of the technology when the providers would check the wrong box or line for an order.
Management has gotten strict that the floors need to self govern and utilize the reporting system to increase patient safety outcome and improve process

Nurse 6
For the near misses that have occurred for this nurse, a long lengthy computer form for both actual and near misses is completed.

Nurse 7
NA

Nurse 8
Meet with manager and review the process. Have not had an error to report.
Nurse 9
Fill out the electronic form for both errors and near misses. In addition when working with nursing students will complete a form to send to the school.

CURRICULUM VITAE

Mary Gallagher Gordon, MSN, RN, CNE

mag45@drexel.edu

EDUCATION

2006- present Enrolled in Doctoral program, College of Information, Science and Technology at Drexel University

2003 Drexel University, College of Nursing and Health Professions, Post Masters Nurse Educator Certification

1982 –1984 University of Pennsylvania; Master of Science in Nursing
1977 – 1981 Gwynedd Mercy College, Bachelors of Science in Nursing

GRANT ACTIVITY / RESEARCH

2011- Drexel Universtiy
Role: PhD study
PI: Susan Gasson, Co-I- Mary Gallagher Gordon
Status: IRB Study Approved

2011- Drexel University
Role: Co- Investigator
"Educating Professional Nurses for Tomorrow's Complex Clinical Environment & Emerging Demographics: Enhancing Safety & Inter-Professional Communication
PI: Mary Ellen Smith Glasgow Co-I: Kym Montgomery, Mary Gallagher Gordon, Jen Olszewski, Kate Morse, Linda Wilson
Status: IRB Study Approved

Drexel University
Role: Co-Investigator
"Standardized Patient Experience: Evaluation of Student Outcomes"
PI: Linda Wilson, CO-I: Patricia Dunphy Suplee, CO-I: Mary Gallagher Gordon, CO-I: Magdeleine Vasso
Status: IRB Study Approved

ACADEMIC APPOINTMENTS

2009- present Drexel University, Philadelphia, Pennsylvania
Director of Undergraduate Clinical Education
Senior Administrator of Compliance for the Nursing Program
2002- Present Drexel University, Philadelphia, Pennsylvania
Assistant Clinical Professor
2001-2002 Holy Family College, Philadelphia, Pennsylvania, Adjunct clinical faculty
1992 – 2002-Community College of Philadelphia, Philadelphia, Pennsylvania; Adjunct clinical

faculty
1994-2001- LaSalle University, Philadelphia, Pennsylvania; Adjunct clinical instructor
1993- Thomas Jefferson College of Allied Sciences, Philadelphia,
1986-1988- Montgomery County Community College, Blue Bell; Adjunct pediatric clinical instructor
1984-1985- Gwynedd Mercy College, Gwynedd Valley, Pennsylvania; Full time faculty

PUBLICATIONS

Posmontier, B., Montgomery**,** K., Smith Glasgow**,** ME., Morse, K., Gallagher Gordon, M., Montgomery, O., Farabaugh, D., Multak, N. *A novel transdisciplinary simulation educational experience: Introducing students to collaborative healthcare*. 8th International Nursing Conference in Seoul, Korea, Nursing Education: New Paradigm for Global Environment, October 27-28, 2011

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