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Healthcare error is a persistent challenge for clinicians, administrators, regulators, and policy makers. Researchers argue that the number of errors originally cited by Institute of Medicine's (IOM) landmark report, *To Err is Human: Building a Safer Health System* (1999) were grossly underestimated and that despite concerted efforts aimed to mitigate error in healthcare settings, error remains a persistent and difficult problem to combat. Given the pervasiveness of this phenomenon, informed research is needed to discover why errors persist; informing interventions expressly created to reduce the incidence of error.

Nurses are the largest provider of healthcare services in the United States (U.S. Bureau of Labor Statistics, 2013), and their surveillance across all healthcare settings is critical in efforts to improve patient safety by reducing errors. The purpose of this study was to examine the association of demographic and environmental factors on the prevalence of nursing errors resulting in patient harm among licensed nurses who violated the North Carolina Nursing Practice Act (NC NPA) between years 2011 and 2015. Exploration of nurse error through analysis of existing data from the Taxonomy of Error Root Cause Analysis and Practice Responsibility (TERCAP) database was important to identify patterns of error, risk factors, and systems issues that have contributed to practice breakdown.

This cross-sectional study was guided by the Organizational Accident Causation Model. The model explains how latent and active failures contribute to the work conditions facilitating unsafe acts to occur. Nurse demographics (age, gender, educational preparation, and nursing tenure), organizational factors (shift worked, work environment, and history of prior employer discipline) and commission of a medication error (active failure) were assessed for their association with error resulting in patient harm through Chi-square tests and logistic regression (N=544).

Findings revealed that error resulting in patient harm and commission of a medication error resulting in patient harm was significantly associated with the variables of age and work environment. Results also revealed that nurses ≥ 50 years of age were found to be significantly associated with commission of a medication error that resulting in patient harm. Gender and work environment were found to be significant predictors of error resulting in patient harm with male nurses have lower odds of committing error resulting in patient harm than female nurses. Nurses who worked in 'other' work environments (non-traditional work settings) had lower odds of committing error resulting in patient harm when compared with nurses working in the hospital setting. Nurses working in 'other' work environments also had lower odds of committing medication errors resulting in patient harm when compared with nurses who worked in hospital settings.

This study's examination of relationships among organizational work environment factors, nurse demographics, and error resulting in patient harm among nurses practicing in North Carolina has implications for nursing regulation and clinical

practice. Study findings provided nurses working in direct care roles information for consideration as they engage in their self-reflective activities to evaluate and enhance their personal practice while meeting continuing competence requirements of the state of North Carolina. Findings can serve as a catalyst for enhanced information sharing between nurse employers and the North Carolina Board of Nursing regarding remediation efforts for suspected violations of the Nursing Practice Act and nursing administrators can utilize findings to provide their staffs with focused education on contributing factors to nursing error while also evaluating work environments with a fuller appreciation of the needs of older nurses.

AN ANALYSIS OF NURSING ERROR AMONG LICENSED NURSES WORKING IN NORTH CAROLINA USING THE TAXONOMY OF ERROR ROOT CAUSE ANALYSIS AND PRACTICE RESPONSIBILITY DATABASE

by

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CHAPTER I

BACKGROUND AND SIGNIFICANCE

Introduction

Nurses, as the largest provider of healthcare services in the United States, are essential to efforts to enhance patient safety through error reduction. Nursing professionals are uniquely positioned to detect and prevent healthcare errors due in part to their education regarding preventive care, adherence to the nursing process and constant vigilance of patients navigating within the care continuum. Licensed nurses have not traditionally taken a lead role in initiating research around healthcare error or error prevention, however, in more recent years nursing researchers are tackling this phenomenon and proposing alternatives that enable healthcare providers to improve delivery systems and reduce error.

Continued attention to the subject of error in healthcare facilities may be due to the devastating impact healthcare error can have on patients, families and providers in the healthcare system. Nurses desire the care rendered to conform to the principles of non-maleficence and beneficence, yet error, particularly error resulting in harm at the hands of a nurse, is in direct contrast to the goal of care delivery. Therefore, errors resulting in patient harm should be investigated as offered in this study so that patient harm is reduced.

Of particular interest are errors resulting in patient harm committed by licensed nurses working in the state of North Carolina. While there is no comprehensive national database to capture nursing error from all employers of licensed nurses, the National Council of State Boards of Nursing (NCSBN) developed a taxonomy of error to capture errors that occur and are found to violate the laws and rules that govern nursing practice in varying states across the US. This database enables participating Boards of Nursing to proactively examine errors and errors resulting in patient harm. The North Carolina Board of Nursing, a contributing entity to the NCSBN taxonomy of error supports investigation of errors committed by licensed nurses working within the state so that the information can be used to improve internal processes in addressing violations of the Nursing Practice Act, educate nurses and the public about errors occurring within the state, and reduce future errors.

Background and Significance

Error as it relates to healthcare quality and delivery in the United States became of national concern in the late 20th century spawned by expert opinion showcased through a series of articles highlighting the prevalence of error in the United States. In 2000 the Institute for Medicine (IOM) issued a report titled *To Err is Human: Building a Safer Health System*, which argued that between 44,000 to 98,000 preventable medical errors occur annually in U.S. healthcare facilities (Kohn, Corrigan, & Donaldson, 2000). The report highlighted that preventable medical errors result in annual estimated costs of between $17 billion and $29 billion in hospitals nationwide. The paper also referenced the intangible consequences of error including loss of trust in the healthcare system,

diminished satisfaction by both patients and health professionals, physical and psychological discomfort, and lost worker productivity (Kohn, Corrigan, & Donaldson, 2000).

The IOM released a second report, *Crossing the Quality Chasm: A New Health System for the 21st Century* (2001), that emphasized that understanding how healthcare errors occur would help decrease recurrence of those errors. The report outlined ten guiding principles to redesign healthcare systems and reframe traditional thought processes regarding healthcare delivery and the role of organizations in the commission of error. The report suggested that applying evidence to health care delivery, using information technology, aligning payment policies with quality improvement, and preparing the workforce would enable the healthcare industry to embrace needed change to reduce medical error. The release of these two reports galvanized the modern patient safety movement in the United States (Agency for Healthcare Research and Quality, 2013) and spawned discussion surrounding how to lessen the prevalence of medical error in healthcare facilities in the United States.

Despite a developing interest in medical error, follow-up studies to the *To Err is Human* report argue that the number of healthcare errors was underestimated and despite continued efforts on the part of healthcare administrators, errors are still pervasive in healthcare facilities (Leape et al., 2009). Medication errors, a subset of medical error, are common through healthcare delivery systems. Aspden, Wolcott, Bootman, and Cronenwett (2006) reported that at least one medication error occurs every day for *every* hospitalized patient, implying that the error rate has not abated since the initial release of

the *To Err is Human* report. Andel, Davidow, Hollander and Moreno (2012) stated the costs associated with medical error are nearly $1 trillion annually when quality-adjusted life years are applied to those patients that die because of error, and Makaray and Daniel (2016) argued that medical error is the third leading cause of death in the United States.

Error Association with Patient Harm

Medical errors are a significant contributor to injury and death in the United States (Kohn, Corrigan, & Donaldson, 2000) and this association with patient harm may have been a catalyst to push patient safety efforts to the forefront of healthcare providers', administrators', and researchers' minds. Despite, however, an emphasis on patient harm as an untenable outcome of healthcare error, the literature finds that researchers are mixed when including an associated injury or harm to the patient as a component of medical error in their theoretical and operational definitions.

Sentinel studies including the Harvard Medical Practice Study and the Utah and Colorado Medical Practice Study included patient harm as a component of a quantifiable adverse event, influencing other researchers examining the topic (Leape, 1997; Wilson, Runciman, Gibberd, Harrison, Newby, & Hamilton, 1995; Gandhi et al., 2003; Thomsen, Winterstein, Søndergaard, Haugbølle & Melander; 2007; West et al., 2008). Hofer, Kerr, and Hayward (2000) argued that medical errors should be defined in terms of failed processes that are clearly linked to adverse outcomes, given that patient harm is an outcome that should be avoided.

James Reason, a prominent psychiatrist whose research focused on human error, stated there is no need to specify that harm has occurred, a sentiment supported by other

patient safety researchers (Taxis & Barber, 2003; Anoosheh, Faghihzadeh, & Vaismoradi, 2008; Habermann, Foraita, & Cramer, 2013). Additionally, near miss events, defined as "unanticipated incidents in which an error was made but no harm occurred" (Tanaka et al., 2012, p.785), also provide insight into root causes of healthcare errors. According to the National Safety Council (NSC) (2013), near miss incidents often precede healthcare error events but may be overlooked, as there was no harm. The NSC states that most healthcare errors were preceded by warnings or near miss incidents, therefore, recognizing and reporting near miss incidents can enhance an organization's safety culture and potentially decrease incidence of healthcare error. There are varying opinions on whether patient harm is a necessary component of error investigation, however, given the nurse's desire to avoid patient harm, errors resulting in patient harm were examined as part of this study.

Types of Healthcare Error

Some of the more frequently cited nursing errors include medication errors and communication failures, specifically hand-off errors (Pham et al., 2012). Exploration of these types of errors reveals nurses are intimately involved in processes that can prevent or reduce incidence of these types of errors. Therefore, it is proposed that research exploring factors contributing to these errors would be necessary to develop tailored interventions for licensed nurses in their efforts to improve patient safety.

Medication errors. Medication errors are one of the most common types of healthcare errors (Bates, Boyle, Vander Vliet, Schneider & Leape, 1995; Aspden, Wolcott, Bootman, & Cronenwett, 2006; Agency for Healthcare Research and Quality

[AHRQ], 2015). According to the Agency for Healthcare Research and Quality [AHRQ](2015), medication error is an error (of commission or omission) at any step along the pathway that begins when a clinician prescribes a medication and ends when the patient actually receives the medication. Berdot, Gillaizeau, Caruba, Prognon, Durieux, and Sabatier (2013) stated medication administration errors are frequent in hospital settings and Hughes and Blegen (2008) argued that hospitalized patients suffer preventable injury or even death because of adverse drug events associated with errors made during the prescribing, dispensing, and administering of medications to patients.

Role of nurses in occurrence of medication errors. While licensed nurses practicing in North Carolina, exclusive of some advanced practice registered nurses, are not permitted to prescribe medications to treat illness, nurses may be responsible for medication administration to patients in variety of healthcare settings. Medication errors may include wrong dose; wrong drug delivered or prescribed; known allergy; wrong time or route; missed dose; or dosing error (Pham, et al., 2012). These types of errors may be under the purview of licensed nurses, who may contribute to the error incident. West et al. (2008) stated that errors involving the incorrect administration, dosage, or timing of the correct drug contributed to errors that were more likely to be associated with clinical harm to patients. In line with the IOM report, *The Future of Nursing: Leading Change, Advancing Health* (2010), these studies highlight that nurse surveillance is key to reducing healthcare error, especially medication administration errors.

Purpose

Because the incidence of medical error has not drastically declined, continued research is needed to discover why and how to combat the persistent trend. According to the 2008 National Sample Survey of Registered Nurses, sponsored by the U.S. Department of Health and Human Services, an estimated 3.1 million Registered Nurses (RNs) were licensed in the United States, and 84.8% of them were employed in nursing positions (U.S. Department of Health and Human Services, Health Resources, and Services Administration [HRSA], 2010). Nurses are the largest provider of healthcare services in the United States (U.S. Bureau of Labor Statistics, 2016a) and as such provide the most direct and continuous care to patients. Licensed nurses are therefore in a key position to detect and intervene to prevent healthcare errors.

Multiple studies have examined the incidence of healthcare error in hospitals and other healthcare settings. Some have focused on specific units or types of registered nurse tasks associated with healthcare error (Taxis & Barber, 2003; Ozkran, Cocaman, Ozturk & Seren, 2011). Several nursing peer-reviewed journal articles have focused on identifying meaningful interventions to reduce error in acute care settings and nursing student performance (Chard, 2010; Drach-Zahavy & Pud, 2010; Kalisch, Landstrom & Williams, 2009). Research efforts have also investigated registered nurses' perceptions of error (Armitage, 2009; Crigger & Meek, 2007; Pugh, 2009) as well as organizational factors contributing to healthcare error including nurse staffing, workload, and staffing mix (Aiken, Clarke, Cheung, Sloane & Silber, 2003; Kane, Shamliyan, Mueller, Duvai, & Wilt, 2007; McHugh, Kelly, Smith, Wu, Vanak & Aiken, 2013; Stimpfel & Aiken,

2013; Tourangeau, Cranley, & Jeffs, 2006). There are, however, few published studies focused on identifying the root causes of healthcare error where the practice of the licensed nurse involved in the healthcare error was also found to be a violation of that state Nursing Practice Act. There are none to date specifically examining nurses practicing in North Carolina.

The goal of this research was to explore data contained in the taxonomy of error to better assess associations between determinants of nursing error by licensed nurses practicing in North Carolina. Specifically, the purpose was to examine the association of demographic and environmental factors on the prevalence of patient harm among licensed nurses who committed violations of the North Carolina Nursing Practice Act from years 2011 to 2015. Exploration of healthcare error through secondary data analysis of the Taxonomy of Error Root Cause Analysis and Practice - Responsibility (TERCAP) database is important to identify patterns of error, risk factors, and systems issues that contribute to practice breakdown.

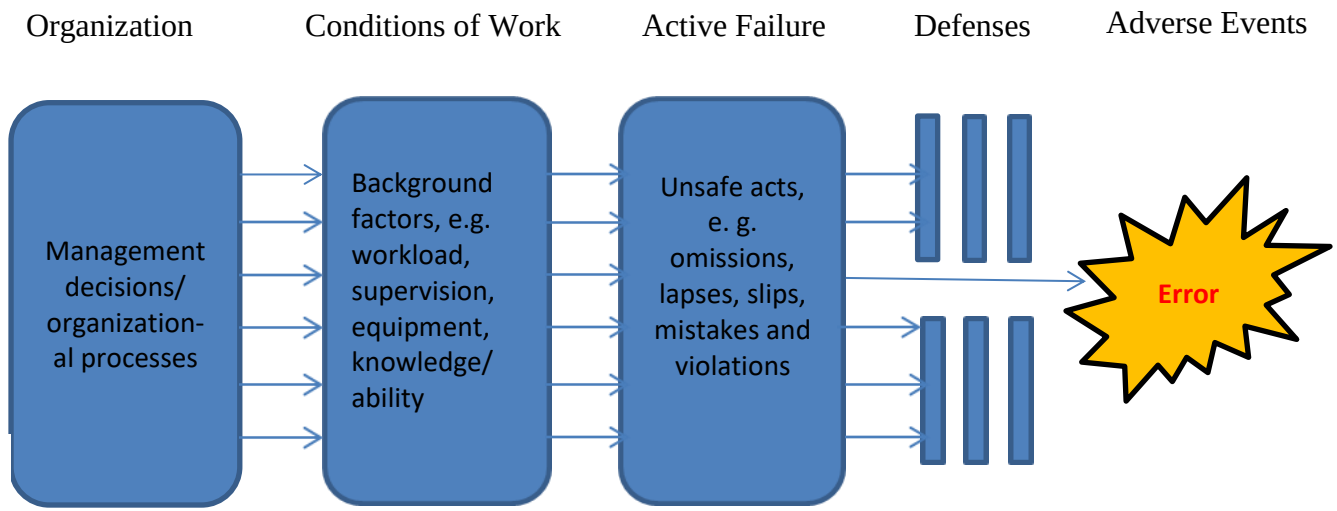
Conceptual Framework

Human Error Theory/Organizational Accident Causation Model

Despite an origin in aviation, human error theory has become the dominant framework referenced by healthcare researchers in the study of healthcare error (Liu, Manias, & Gerdtz, 2010). Reason (2000) proposed two alternatives (person versus systems approach) for the management of error. The person approach attributes error solely to the individual believed to have committed the mistake; while the system approach gives consideration to the environment in which an individual was operating

that may have significantly influenced the errant behavior. As a proponent of the latter approach, Reason (1990; 2000) developed the Organizational Accident Causation Model (also termed the Swiss cheese model or OAM), highlighting how defenses, barriers, and safeguards put into place to mitigate error may be penetrated by an accident trajectory despite the best of intentions of the individual and system designers (see Figure 1). Reason (2000) argued that a comprehensive approach to error management is necessary to recognize influences from individual and environmental factors on human behavior and resulting outcomes.

Figure 1. Organizational Accident Causation Model (based on Reason, 1990)



Errors are typically defined as the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim (Kohn, Corrigan & Donaldson, 2000), a definition inspired by Reason's work. Reason's full definition of error has transcended disciplines particularly those in the social and applied sciences, where human interaction is the essence of study within those fields. Reason (1990) states,

> Error will be taken as a generic term to encompass all those occasions in which a planned sequence of mental or physical activities fails to achieve its intended outcome, and when these failures cannot be attributed to the intervention of some chance agency (p. 9).

The OAM is an explanatory model used to examine the events that lead to an adverse outcome. The contributors of nurse error for consideration include the culture of the organization, the circumstances under which the nurse was working, and ultimately the conduct of the nurse involved. Recognizing that humans are fallible; healthcare administrators and clinicians develop defensive layers to prevent error from occurring. Ideally, these defensive layers remain intact; however, inherent in the development process is the potential for failure or weakness in the system. The Swiss Cheese Model is so named because of the idea that each defensive barrier equates to a slice of Swiss cheese and the holes in each slice are analogous to the defense weaknesses. As the slices are stacked (defenses) in line, it becomes conceivable that an error may permeate through one defensive barrier only to be averted because another defensive barrier held firm when

the weaknesses were located in a different place. Unfortunately, when the weaknesses of each defensive barrier align, an error trajectory is created leading to an error (Duke University Medical Center, 2014).

How the Organizational Accident Causation Model Relates to Nurse Error

The licensed nurse is a professional educated in the protection, promotion, and optimization of health and abilities, prevention of illness and injury, alleviation of suffering through the diagnosis and treatment of human response, and advocacy in the care of individuals, families, communities, and populations (American Nurses Association, 2014). The administration of nursing services is an integral part of the healthcare experience. Nurses are primed to be at the forefront of developments in patient care initiatives, particularly as it relates to patient safety by virtue of being a provider of healthcare services and a line of defense against medical error (Faye, Rivera-Rodriguez, Karsh, Hundt, Baker, & Carayon, 2010). Unfortunately, this assignment also uniquely positions nurses to engage in error and suffer the consequences of blame that are often associated with the commission of error. The nurse's role provides an opportunity to examine the active and latent failures associated with their actions possibly resulting in patient harm. Exploration of relationships between nurse characteristics and environmental factors (both of which are considered latent factors), commission of a medication error (active factor) and the likelihood for patient harm among nurses practicing in North Carolina provided information on areas to focus remedial education efforts, gave rise to the development of interventions geared to prevent and mitigate

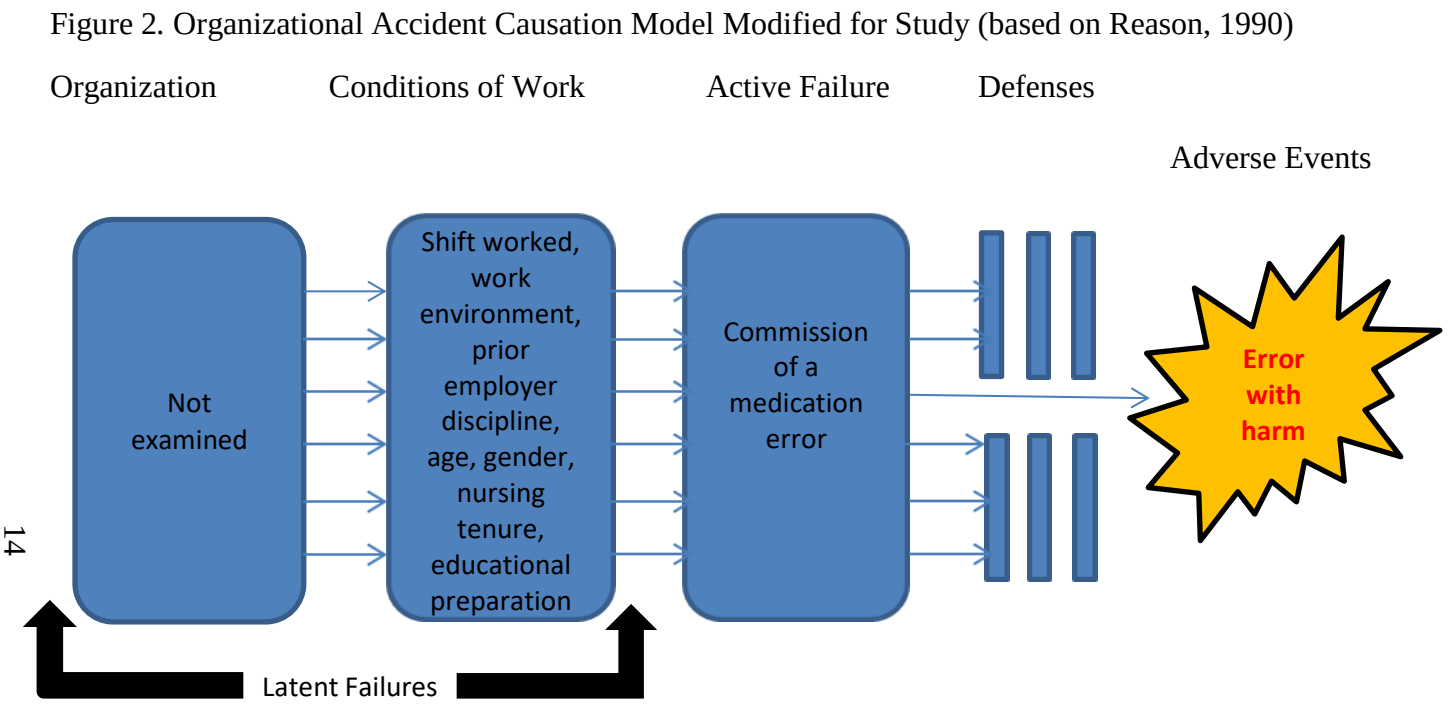
nursing error, and informed the North Carolina nursing community about nurse error in hopes that individual nurses will reflect on their own daily practice routines and make any necessary adjustments to lessen their risk of committing error.

Variables Under Examination

The OAM suggests that latent and active factors contribute to nursing error. Reason argued that identifying and examining those contributing factors may help individuals working within the system (i.e., nurses) develop tools or interventions to mitigate errors that occur. While there are numerous latent and active factors that influence error, this study examined several latent factors, as identified in the literature and explicated in Chapter 2, which contribute to errors resulting in patient harm.

Nursing demographics (i.e. age, gender, educational preparation, prior employer discipline, and nursing tenure) have all been found to have some impact on the work performance of the licensed nurse and thereby the errors that they commit. Likewise, the length of the shift worked and the work environment (i.e. employment setting such as hospital, long-term care, outpatient settings) have also been shown to influence errors resulting in patient harm. The influence of medication administration errors (active failures) has briefly been discussed as an important factor to consider when examining error that results in patient harm. These identified variables particularly in tandem have the potential to greatly influence the care delivered by nurses within the state of North Carolina. Figure 2 provides a schematic highlighting how the identified variables under examination are captured by the OAM and their impact on error resulting in patient harm.

Figure 2. Organizational Accident Causation Model Modified for Study (based on Reason, 1990)



Definitions

The following concepts are defined to explicate the purpose of this study.

Human Fallibility

An underlying premise in human error theory is that humans are fallible and are prone to cause error (Reason, 1990; 2000). Psychological antecedents of unsafe acts attributable to an individual, "such as distraction, momentary inattention, and forgetting, are difficult to control because they are entirely natural human reactions to work environments" (Chang, 2007, p. 48). According to Gray, Sabnani, and Kirschenbaum (1993), Reason argued that errors arise out of normally adaptive psychological processes; therefore, errors are to be expected and considered normal human processing and behavior.

Unsafe Acts/Active Failures

Active failures are "unsafe acts or omissions committed by those whose actions have an immediate adverse consequence" (Vincent, Taylor-Adams, & Stanhope, 1998, p. 1155). Often, these acts are committed by individuals in direct contact with the patient, e.g. the actualizer of the process such as the nurse administering a medication or the surgeon holding the scalpel (Duke University Medical Center, 2014). Although there is no specific taxonomy for active failures, these occurrences have often been classified as errors and violations (Vincent, Taylor-Adams, & Stanhope, 1998).

Error: Error will be taken as a generic term to encompass all those occasions in which a planned sequence of mental or physical activities fails to achieve its intended

outcome, and when these failures cannot be attributed to the intervention of some chance agency (Reason, 1990, p. 9).

Violation: "Violations are deviations from safe operating practices, procedures, standards, or rules" (Vincent, Taylor-Adams, & Stanhope, 1998, p. 1155). Violations can either increase the probability of a subsequent error, or they can increase the likelihood that the error will have a bad outcome. According to Vincent, Taylor-Adams and Stanhope (1998) violations are the product of a social regulated environment, whereas errors are often attributed to a fault of the mind (such as inattention or forgetfulness).

Latent Failures

Latent failures are those acts that "provide the conditions in which unsafe acts occur" (Vincent, Taylor-Adams, & Stanhope, 1998, p. 1155). Latent failures are often unrecognized until a healthcare error occurs because the decisions reaffirming those conditions are typically not made by front line clinicians at the bedside.

Defenses

Defenses are barriers or safeguards put into place to protect potential victims and assets from local hazards (Reason, 2000) or they are utilized to recover from treatment errors (Vincent, Taylor-Adams, & Stanhope, 1998). Defensive barriers are often effective, but there are always weaknesses because their design and execution were done by humans. Reason (2000) argued that some defenses are engineered (i.e. alarms and automatic shutdowns), others rely on the vigilance of providers such as nurses, anesthetists, or unit secretaries, and some defenses depend on procedures and administrative controls such as policies or practice guidelines.

Study Definitions

1. Nursing error is defined broadly as the disruption or absence of any of the aspects of good practice including near misses. The term nursing error will be used interchangeably with practice breakdown.
2. Age is the chronological length of life expressed in years. For this study age is recorded as a whole number representing the nurse's lifespan in years since birth to the date of the error rounded down as was recorded in the TERCAP database.
3. Gender refers to the socially constructed characteristics of women and men – such as norms, roles, and relationships of and between groups of women and men. The concept of gender includes five important elements: relational, hierarchical, historical, contextual and institutional (World Health Organization, 2016). In the TERCAP dataset, gender is recorded as only male, female, or unknown.
4. Nursing tenure is the chronological length of licensure for the licensed nurse expressed in years. For this study nursing tenure is recorded as a whole number representing the elapsed time between the initial year of licensure and the date of the error incident as was recorded in the TERCAP database.
5. Work environment refers to the place of employment of the licensed nurse at the time of the error incident. Work environment is categorized according to the TERCAP protocol (NCSBN, 2011) as the following: Ambulatory Care, Home Care, Physician / Provider Office or Clinic, Assisted Living, Behavioral Health, Hospital, Long Term Care, Unknown, Critical Access Hospital, Office - based Surgery, and other.

6. Educational preparation refers to the educational pathway for the licensed nurse resulting in a graduation from an approved nursing education program and conferment of a degree or certificate in nursing. For this study, educational preparation was denoted as a certificate in licensed practical nursing, associate degree in nursing (licensed practical nursing), diploma in registered nursing, associate degree in nursing (registered nursing), baccalaureate degree in nursing (registered nursing), masters (nursing), doctorate (nursing), baccalaureate (non-nursing), advanced degree (non-nursing); other or unknown.
7. Medication error refers to a breakdown in the standard for safe medication administration where the licensed nurse administers the right dose of the right medication via the right route to the right patient at the right time for the right reason (NCSBN, 2011).
8. Harm is defined as actual temporary or permanent impairment of the physical, emotional, or psychological functions or structure of the body and / or pain that requires intervention (NCSBN, 2011). For purposes of the study, harm is affirmed as either being present (yes), not present (no), or unknown.
9. Licensure type refers to level of licensure the licensed nurse held at the time of the error incident. For purposes of this study, licensure status refers to a licensed practical nurse (LPN) or a licensed registered nurse (RN).
10. Shift worked refers to work comprising recurring periods in which different groups of workers do the same jobs in rotation. For the purposes of this study the shifts are categorized by the length of time typically worked by licensed nurses.

Those include eight (8), ten (10), and twelve (12) hour shifts, on-call coverage (without specification to length of time required of the licensed nurse to serve in an on-call capacity) other and unknown.

Research Questions

The research questions included the following:

1. RQ1: To what extent are the variables of age, gender, educational preparation, nursing tenure, work environment, shift worked, and patient error type (specifically medication error) related to the report of patient harm?
2. RQ2: Is there a combination of the variables of age, gender, educational preparation, nursing tenure, work environment, shift worked, and patient error type (specifically medication error) that are predictive of patient harm?
3. RQ3: Is there a difference in age, gender, educational preparation, nursing tenure, shift worked, and work environment in those nurses who committed a medication error resulting in patient harm and those that committed a medication error resulting in no patient harm?

Guided by the OAM, the research questions include both active and latent aspects of nursing care that are likely to contribute to errors resulting in patient harm. The independent variables of age, gender, educational preparation, nursing tenure, work environment, shift worked, and patient error type (specifically medication error) are examined to better determine what impact they have on error resulting in patient harm so that nurses can appropriately intervene to reduce error resulting in harm. Such interventions are derived through scholarly investigation to give insight into how, and to

what extent, some of the variables may be manipulated to result in fewer errors resulting in patient harm. It is expected that findings will be used to develop best practice guidelines as it relates to the preparation of future nurses and the continued education of currently licensed nurses.

Chapter Summary

This research study used a secondary analysis of data from case entries entered into the TERCAP database to examine the association of demographic and environmental factors on the prevalence of patient harm among licensed nurses who committed violations of the North Carolina Nursing Practice Act from years 2011 to 2015. New data will be obtained by an analysis of existing information contained in the TERCAP database. The Organizational Accident Causation Model will be utilized to guide the study given the model is aptly able to denote latent and active failures and their associations of nursing error to patient harm. This study is important because it explores the contributing factors to nursing error and resulting patient harm, thereby providing the foundational information needed to develop best practice guidelines surrounding nursing error prevention.

CHAPTER II

LITERATURE REVIEW

Introduction

The theoretical literature and relevant research focused on nursing error (alternatively termed practice breakdown) and system breakdown are presented in this chapter. The concept of error is explored and the continued evolution of taxonomies of error and classification modalities is also highlighted. This chapter demonstrates why the Taxonomy of Error Root Cause and Practice Responsibility (TERCAP) database is the premier repository to address the proposed research questions by providing a review of the historical development of the tool, the psychometric properties of the tool, and explicating the applicability of tool use in nursing regulation.

To better understand how nursing error has traditionally been addressed by the regulatory body for nurses, this chapter discusses the concept of Just Culture and the influence of this philosophy within the NCBON. Additionally, the relationships between individual nurse characteristics of age, educational preparation, and gender, environmental characteristics of work environment, shift worked, and finally the commission of a medication error and their associations with nurse error resulting in patient harm are examined as well.

To gain an understanding of the phenomenon of interest, much of the literature review was conducted by searching the Cumulative Index to Nursing and Allied Health

Literature (CINAHL), PubMed, and Proquest Digital Dissertation. Additionally, publications from the IOM (also known as the National Academy of Medicine), Agency for Healthcare Research & Quality (AHRQ), state and national regulatory bodies, and public administration publications were reviewed. Key words used in the search included practice breakdown, medical error, nurse/ nursing error, error classification, and patient safety. After accessing journal publications, reference lists were reviewed to access more articles relating to contributing factors of error.

The Concept of Error

Humans are fallible; therefore, error is present in every activity undertaken by human beings. As such, error has been defined as it relates to a particular field of study. For example, in linguistics, error signifies a deviation from normal or accepted sentence structure, grammar, punctuation, etc. (Ellis, 1994). In mathematical statistics, error can refer to an erroneous determination as to the truth of a tested hypothesis as in Type I and Type II errors (Banerjee, Chitnis, Jadhav, Bhawalkar & Chaudhur, 2009). In law, error often refers to mistakes made by a lower court in applying the law in a particular legal case where the error may or may not have influenced the ultimate verdict of the case (*Lehman & Phelps, 2005).* In each of the noted disciplines, error is generally defined as a discrepancy between the expected norm and the actual outcome and it is within this context that medical and nursing error is most aligned.

Medical errors are typically defined as the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim (Kohn, Corrigan, & Donaldson, 2000). This definition was spawned by the original work of James Reason, a

psychology professor, in the 1990s. Reason's full definition of error has transcended disciplines particularly those of the social and applied sciences, where human interaction is the essence of study within those fields. Unfortunately, there is no one unifying definition of error in the nursing literature, however, nursing literature often defaults to a version of Reason's definition of error. Reason's work helped refocus healthcare administrators towards the environmental circumstances impacting error rather than strictly focusing on the individual practitioner that may have been involved in the error. Medical errors have been deemed a significant contributor of injury and death in the United States (Kohn, Corrigan, & Donaldson, 2000), however, error, in a broader sense, can encompass a myriad of "mistakes" through intentional or unintentional acts, miscalculations, or failure on the part of the individual to complete a prescribed activity.

The National Council of State Boards of Nursing (NCSBN) in developing their taxonomy of error, elected to forgo use of the term "error" as the phenomenon of interest. Rather developers of the tool chose to use the term practice breakdown, which was thought to more accurately capture the intricate nuances inherent in the nursing profession. The tool developers wanted to ensure that a nurse's diagnostic abilities necessary for detecting illness and appropriately intervening, did not overshadow the nurse's need to recognize and enact patient advocacy, dignity and respect, and understand the human experience of disease (Benner et al., 2006).

The concept of error transcends all human activity and disciplines define error according to the needs of that particular field of study. Some clinicians may narrowly define the concept of error to include only those unanticipated events occurring in the

medication administration process. The emphasis on medication error in the acute care setting is relevant given that the majority of nursing care is provided in hospitals. There remains, however, a great need to more clearly define error in nursing practice and better understanding the reasons behind practice breakdown so that effective interventions are developed to mitigate error.

Prevalence of Error Resulting in Patient Harm

There are many adverse outcomes of error documented in the literature, and some of them can be summarized into three main categories. Error results in a) patient death and b) injury (AHRQ, 2001; Kohn, Corrigan, & Donaldson, 2000; Neale, Woloshynowych & Vincent, 2001). Errors also c) increase costs for healthcare organizations and the healthcare system as a whole (AHRQ, 2001; Neale, Woloshynowych & Vincent, 2001). While escalating healthcare, costs should not be minimized because of the impact on a significant portion of healthcare consumers, the focus of this review is on the outcome of patient harm which includes death and injury to patients.

An examination of several landmark studies provides a historical review of patient safety by revealing that medical error was (and remains) a significant contributor to patient injury and harm (Kohn, Corrigan & Donaldson, 2000). Based on an extrapolation of all hospital admissions in the United States in 1997, the *To Err is Human Report* argued that nearly 100,000 patient deaths and 1 million injuries occurred in US facilities on an annual basis (Kohn, Corrigan & Donaldson, 2000). The IOM's 2001 report, *Crossing the Quality Chasm* continued to highlight the pervasiveness of harm

resulting from medical error. This report highlighted a study which found that only 55% of patients in a random sample of adults received recommended care, with little difference found between care recommended for prevention of acute or chronic conditions and actual care rendered to address acute or chronic conditions. Likewise, the report revealed 18,000 Americans die each year from heart attacks because they did not receive preventive medications, although they were eligible for them. At the time the 2001 report was published, health-care errors were deemed the seventh leading cause of death in the US (IOM, 2001). These findings suggest that not only was mortality associated with error in US healthcare facilities, but substandard care (perhaps through care omission) results in mortality and morbidity.

Five years after the first IOM report was published, Encinosa & Hellinger (2005) found in a study conducted to estimate the cost of errors in surgeries that patients who experienced an adverse event were 3% more likely to die in 90 days than those that did not experience an adverse event. While these findings may be indicative of the increasingly complex medical and surgical environment or the increasing morbidity of an aging population undergoing surgery, a study of ten (10) North Carolina hospitals revealed that harm resulting from medical care was common, with no evidence to suggest that the rate of harm decreased substantially over a 6-year period (Landrigan, Parry, Bones, Hackbarth, Goldmann, & Sharek, 2010). A study by James (2013) found that about 200,000 to 400,000 preventable patient deaths occur annually in U.S. hospitals based on estimates from years 2008 to 2011. James argued that serious harm seems to be 10 – 20 times more common than lethal harm. These findings are suggestive that patient

harm has not abated since the IOM's *To Err is Human* report was released and that there has been little impact on the prevalence of error in US healthcare facilities over the last 30 years (when the Harvard Medical Study was conducted).

The breadth of medical error is such that policy initiatives have been instituted to establish a "regulatory framework" for effective solutions (Thomas, 2007, p. 2). At the national level, Patient Safety Organizations (PSOs) were established by the Patient Safety and Quality Improvement Act of 2005 to collect confidential information about health care errors in order to analyze common factors that contribute to errors. Additionally, in 2010, President Obama signed into law the Patient Protection and Affordable Care Act (commonly known as the ACA) which includes as one of nine titles a mandate *improving the quality and efficiency of healthcare*. Beginning in 2013, the ACA linked Medicare payments to quality performance on common high-cost conditions such as cardiac, surgical and pneumonia care (Democratic Policy and Communications Center, 2010).

These regulatory frameworks may be necessary to drive needed improvements in the healthcare industry to reduce patient harm resulting from medical error. However, the national attention focused on medical error should also extend to the state level through regulatory entities that are charged with upholding public protection. The following section discusses how the North Carolina Board of Nursing (NCBON) has addressed error among licensed nurses.

The North Carolina Board of Nursing and Nursing Error

The continued focus on medical error and the impact on American consumers of healthcare may reinforce the legislatively mandated charge of public protection among

occupational health licensing boards. Boards of Nursing (BONs) were initiated to provide standards to the nursing profession because of the inherent risk of harm posed by practicing clinicians and their impact to the welfare of citizens of a state (Russell, 2012). As part of their legislated charge, BONs promulgate laws and rules governing nursing practice (American Nurses Association, 2013). These regulations explain the Board's authority to establish the minimum standards for entry into the nursing profession, approval of nursing educational programs, and provide for the enforcement of the rules set forth by the BON (Lewis & Horne, 2016). Some of those regulations guide nursing practice in accordance with established standards of care, which should help prevent nursing error. However, if nursing practice is in violation of nursing regulation(s), the errant behavior may lead to practice breakdown or nurse error.

Just Culture Philosophy at the North Carolina Board of Nursing

Formal reports are made to BONs to investigate and remedy practice breakdown, however, assessing contributing factors to and the root causes of nurse error is challenging without a defined frame of reference. According to Lewis and Horne (2016), members of the NCBON elected to embrace the Just Culture philosophy, a risk management model pioneered by Outcomes Engenuity, LLC (formerly Outcomes Engineering, Inc.). The model enhances patient safety by recognizing and modifying system flaws and by holding individuals accountable for reckless behavior or repeated behavior that poses increased risk to patients. Khatri, Brown, and Hicks (2009) asserted that measured steps are needed for organizations to move from a blame culture to a Just Culture, given medical errors and poor quality of care result from this punitive culture.

As such, the NCBON has taken steps to integrate a Just Culture perspective into Board processes when reviewing practice events or errors and when identifying appropriate resolutions that promote practice enhancement and patient safety. Doing so has resulted in benefits reaching key stakeholders including patients, employers, and licensees, recognizing that effective public protection depends upon the ability to learn from mistakes regardless of patient outcomes (Burhans, Chastain, & George, 2012).

The North Carolina Board of Nursing and Error Intervention

Given the NCBON's mandate to protect the public, Board members and staff engage in activities to enforce the laws and rules promulgated regarding nursing practice including those rules explicitly outlining the activities that might warrant disciplinary action against a licensed nurse (See Appendix C – G.S. 90-0.2018). Board members have delegated authority to Board staff to review and make decisions about many violations of the North Carolina Nursing Practice Act (NC NPA). This delegated authority has enabled Board staff to develop several tools and programs that align with the Just Culture Philosophy which enable the Board to intervene when errors occurs. In 2004, the NCBON created the Practitioner Remediation Enhancement Program (PREP) as a pilot project to better understand if Board intervention through non-disciplinary means could enhance nursing practice, empower the involved licensed nurse, improve retention rates of licensed nurses that engage in error activities, and reduce recidivism among licensed nurses being reported to the NCBON. The program was designed based on the belief that

> safe nursing care is promoted through collaboration with other organizations within the ever-changing healthcare environment; humans are fallible and errors are to be expected, even within the best systems; nurses who have identified needs related to increasing knowledge, skills or abilities have the potential to successfully upgrade competency and enhance performance; and nurses should have an opportunity to upgrade knowledge and skills in a constructive, non-punitive manner (North Carolina Board of Nursing Practitioner Remediation Enhancement Program, para. 1).

PREP has been successful, due in part to the commitment on the part of the NCBON to proactively engage nurses in remediation activities such as mentoring, educational coursework including continuing education, and increased supervisory oversight. These activities provide the tools and resources needed to prevent recurrence of a similar or more egregious error in the nurse's future practice.

When errors do occur, the NCBON addresses them using several tools designed to assist employers, Board staff, and Board members in their decision making regarding the potential for harm and what should be the most appropriate outcome. The complaint evaluation tool (CET) was developed "to guide employers in using Just Culture principles when reviewing practice errors and to clarify the criteria for reporting nurses to the [NC]BON" (Burhans, Chastain, & George, p. 43). The tool mirrors the Just Culture Algorithm developed by David Marx of Outcomes Engineering, who introduced the Just Culture philosophy to error management. Akin to the Organizational Accident Causation Model introduced by Reason, the Just Culture philosophy recognizes that humans engage in error; they also engage in risky behaviors that often lead to errors and that risk for error is inherent in society (Outcome Engineering, 2007). The CET categorizes events as human, at-risk behavior, or reckless behavior on the part of the licensed nurse involved in

the error incident. The employer is able to better ascertain how the decision making and subsequent action of the nurse may have been influenced by organizational systems, the licensed nurse themselves, and defenses in place at the time to mitigate error. The tool helps the employer consider multiple factors that may have influenced the error incident and are therefore important to evaluate when considering the need for the employer to make a formal complaint regarding the incident to the NCBON.

If a formal report is made to the NCBON, Board staff investigators and Board members can reference sanctioning guidelines developed using the Just Culture philosophy. The sanctioning guidelines help to ensure decision makers have objective criteria on which to evaluate investigated cases and render consistent decisions when errors constitute violations of the NC NPA (Lewis & Horne, 2016). Specifically, the guidelines take into account the risk-taking behavior and decision making of the licensed nurse when considering appropriate sanctions for those errors that have been fully investigated and determined to constitute a violation of the NC NPA. The guidelines were designed to align conduct constituting more egregious actions and intentional behaviors with more stringent sanctions whereas actions that were mistakes or minor lapses in judgment on the part of the licensee may result in a less stringent sanctions. The Just Culture philosophy supports remediation for mistakes and minor lapses in judgement. Intentional acts and repetitive behaviors that have been remediated warrant disciplinary action towards the licensed nurse.

Consistent with the learning culture set forth in the Just Culture philosophy, the NCBON is also involved with state efforts to address common concerns regarding

healthcare and patient safety. The NCBON has partnered with the North Carolina affiliate of American Association of Retired Persons (AARP), the North Carolina Foundation for Nursing and other organizations in the Future of Nursing Action Coalition. This campaign is taking active steps to respond to the IOM's *Future of Nursing: Leading Change, Advancing Health* report. Thomas (2007) suggested that coalitions, formed between the health care industry, professional associations, and patient advocacy groups are working to promote strategies to reduce error rates and improve patient safety. Central to the *Future of Nursing* Report was a call for nurses to practice to the full extent of their education and training, achieve higher levels of education and training through an improved education system that promotes seamless academic progression, become full partners in redesigning health care in the United States and engage in better data collection to assist in effective workforce planning and policy efforts (Institute of Medicine [IOM], 2010). Each of the initiatives is recommended under the auspices that enhancements in the largest segment of the healthcare workforce will translate to enhanced quality care, improved patient outcomes, and public protection.

The NCBON was an early participant in a study sponsored by NCSBN, a not-for-profit organization that provides education and research to promote evidence-based regulatory excellence to identify the root causes influencing a nurse at the time of a practice breakdown. Taxonomy of Error, Root Cause Analysis, and Practice-Responsibility (TERCAP) is a national nursing adverse event database designed to collect the practice breakdown data from BONs to identify the root causes of nursing practice breakdown from system and individual perspectives (National Council of State

Boards of Nursing [NCSBN], 2013). NCSBN's taxonomy of error is one of several categorizations of error developed to bring consensus to this phenomenon; however, as further explored in the following sections, TERCAP is the most appropriate repository for study of nurse error.

Prominent Taxonomies of Healthcare Error in the US

Taxonomies facilitate measurement of the concept of interest by promoting standardization in language (Taib, McIntosh, Caponeechia, & Baysari, 2011) and by providing "clarity, specificity, and differentiation" (Thomas, 2007, p. 19). There are many criteria appropriate for developing classification systems of medical error making efforts to glean viable information difficult (Chang, Schyve, Croteau, O'Leary, & Loeb, 2005). According to Taib, McIntosh, Caponeechia and Baysari (2011), it is vitally important that taxonomies of error are comprehensive in their attempts to capture a wide range of contributing factors to error because incomplete taxonomies result in a limited understanding of error, recommendations, and resulting interventions that are derived from the taxonomy.

The 2003 IOM report, *Patient Safety: Achieving a New Standard of Care* suggests that standardization and better data management on patient safety events, including medical errors are needed to inform the development and implementation of effective strategies aimed at reducing preventable errors and resulting harm. A review of the literature, however, found that there are several taxonomies of medical error, each with unique delineations that make it difficult to engage in comparative analysis. For example, Taib, McIntosh, Caponeechia and Baysari (2011) conducted a review of

twenty-six published taxonomies of healthcare or medical error noting that most of the identified taxonomies were developed for a specific domain (i.e. general practice, primary care, or pediatrics).

One of the earliest taxonomies of error is the Advanced Incident Monitoring System (AIMS™). Spawned by a study suggesting the need to classify and study anesthesia incidents, AIMS™ was developed by the Australian Patient Safety Foundation [APSF] (2016) "to collect and analyze detailed information about healthcare incidents using a classification based on our understanding of iatrogenic harm and the things that can go wrong in healthcare" (About Us section, para. 3). Eventually, the AIMS™ anesthesia taxonomy was expanded to include other specialty areas. In 1996 widespread implementation of the system was undertaken in South Australia (Runciman, 2002). According to APSF (2016), growing international interest in AIMS prompted the organization's involvement in the development of an international Classification for Patient Safety, a project sponsored by the World Health Organization.

In 1995, U.S. Pharmacopoeia and several other like-minded organizations formed the National Coordinating Council for Medication Errors Reporting and Prevention (NCC MERP). The council released a medication error taxonomy in 1999. According to Gallagher and Nadzam (2015), this taxonomy provides a standard language and structure of medication error-related data for use in developing databases to analyze medication errors. In response to the need to have a forum to analyze medication errors based on the error taxonomy created by NCC MERP, U.S. Pharmacopoeia released MEDMARX, the nation's first anonymous, confidential, internet-based, voluntary medication error

reporting program in August 1998 (Santell, Hicks, McMeeken, & Cousins, 2003). Data from MEDMARX contributes to knowledge about the causes and prevention of medication errors. It is the largest adverse drug event repository with more than 2 million medication errors (Schiff et al., 2015). In 2008, U.S. Pharmacopoeia transferred all rights, ownership, and management of the MEDMARX reporting program to Quantros which has since incorporated the capabilities into its safety and risk management (SRM) suite of solutions. Researchers are able to gain access to the repository and individual organizations continue to reap internal benefits by analyzing and acting on information provided to the repository.

While the Quantros SRM software would provide needed information regarding the medication administration process, its narrow focus would not be sufficient to fully recognize the broader scope of nursing care delivery or the errors that may result from that care. Medication administration is a task often inherent in nursing, however, nursing practice encompasses far more than the task of medication administration. According to the North Carolina Nursing Practice Act (2009), "Nursing is the dynamic discipline which includes the assessing, caring, counseling, teaching, referring and implementing of prescribed treatment in the maintenance of health, prevention and management of illness, injury, disability or the achievement of a dignified death" (Chapter 90 Article 9A § 90-171.20). Therefore, the Quantros SRM software, while important for the study of medication errors, was not intended to serve as a taxonomy for the examination of errors occurring within the nursing profession.

In response to growing concerns over nursing error, NCSBN took proactive steps to ensure that the nursing profession remained accountable to consumers of healthcare by investing resources into the development and maintenance of Taxonomy of Error Root Cause Analysis and Practice-Responsibility (TERCAP).

Instrument: Taxonomy of Error Root Cause Analysis and Practice Responsibility Database

The TERCAP tool's conception began in 1999 when the NCSBN convened an expert panel to examine nursing practice breakdown. The Practice Breakdown Advisory Panel (PBAP) argued that a dichotomous view of nursing error (specifically referencing a system versus individual blaming approach) was insufficient to assess root causes of error or determine initial steps to remediate error (Benner, Sheets, Uris, Malloch, Schwed, & Jamison, 2002; Benner et al., 2006). The PBAP incorporated the concept of 'practice responsibility' into discussions regarding nursing error. According to Benner, Sheets, Uris, Malloch, Schwed and Jamison (2002), practice responsibility refers to "the socially embedded knowledge, notions of good, and skill lodged in a healthcare team of local practitioners" (p. 510). The Practice Breakdown Research Advisory Panel (PBPAP) for NCSBN then conducted an analysis of twenty-one case studies from nine BONs and developed the first iteration of the TERCAP tool. The TERCAP tool was developed to measure practice breakdown, which is defined as "the disruption or absence of any of the aspects of good practice" (NCSBN, 2010, p. 16). The identified standards of good nursing practice include prevention, intervention, safe medication administration, attentiveness/ surveillance, clinical reasoning, documentation, interpretation of provider

orders, and professional responsibility/ patient advocacy. The developers believed these categories were essential to the delivery of effective nursing care based on established standards (Benner et al., 2006; NCSBN, 2010). The online version of the TERCAP tool was initiated in 2007, with ten sections encompassing sixty items for data collection regarding practice breakdown across jurisdictions (NCSBN, 2010). A further refined version of the online instrument was released in April 2011 and remains in current use. The number of items was reduced to from sixty to forty-five (mandatory response) items with the remaining items optional to data collectors.

Theoretical Framework for the TERCAP Tool

The NCSBN practice breakdown advisory panel suggested that two theoretical frameworks influenced the development of the tool. The PBAP believed that Dr. James Reason's Organizational Accident Causation model succinctly captured the significance of poor system design and multiple opportunities for error to occur within complex, high risk industry such as healthcare. Reason also believed that focus or blame of the individual involved in the error limited one's view of the factors that contributed to the end error (Reason, 2000), a belief also held by tool developers.

Charles Vincent's framework for root cause analysis was the primary guiding basis for 2007 TERCAP tool (NCSBN, 2010). Vincent's framework was influenced by Reason's OAM as noted by the emphasis on recognizing system influences on error commission (Vincent, Taylor-Adams, Stanhope, 1998). Vincent's framework stated adverse events often originate in a variety of systemic features operating at different levels—the task, the team, the work environment, and the organization. This framework

was used as a guide for the investigation of incidents occurring within healthcare entities to generate ways of assessing risk, and to focus research on the causes and prevention of adverse outcomes. The TERCAP tool encompasses five factors that are thought to contribute to adverse events: work environment, team, individual staff member, task, and the patient (Vincent, Taylor-Adams, Stanhope, 1998).

Inclusion and Exclusion Criteria of the TERCAP Database

According to the NCSBN TERCAP Resource Manual (2012), cases meeting the following criteria were included in the original NCSBN study for aggregate data analysis:

1. The case involves a nurse who was involved in the error.
2. The case involves one or more identifiable patients. The TERCAP protocol (2011) advises that the investigator entering data should only enter information on one patient per practice breakdown event.
3. The case is one in which the board substantiates that a practice breakdown occurred and the board dismisses the case with or without disciplinary action.
4. The case allows for all or almost all of the data collection instrument fields to be completed.

Exclusion criteria for the original study included those cases in which the nurse enters an alternative program where there is no investigation or there is a determination that there was no practice breakdown (NCSBN, 2012).

Given all case entries met the above stated criteria; the target population of this study was based only on North Carolina relevant data. The cases under study were the NC BON's investigative case files for nursing practice error resulting in a violation of the

North Carolina Nursing Practice Act (NC NPA). Each case was evaluated for entry into the TERCAP database after the NCBON had confirmed jurisdictional authority for the alleged practice breakdown, completed a thorough investigation which may include gathering information necessary for completion of the TERCAP tool, evaluated the available evidence for burden of proof, substantiated a violation(s) of the NC NPA, recommended a sanction of resolution to the involved licensed nurse, and effectively adjudicated and reached case resolution with the reported licensee.

The North Carolina Board of Nursing through internal policy elected to only submit cases to the TERCAP database that resulted in sanctions of Non-Disciplinary Consent Order, or Published Consent Order to include Voluntary Surrender of licensure (Appendix A). Licensed nurses participating in an alternative to discipline program related to substance use disorder were excluded from case entry, regardless of whether the case involved practice breakdown. Additionally, licensed nurses participating in a non-disciplinary remediation program titled the Practitioner Remediation Enhancement Program were excluded from case submission to the TERCAP database.

Reliability of the TERCAP Database

According to Polit and Beck (2012), reliability is the consistency with which a tool measures the targeted attribute over several or repeated measurements. Although no specific reference was made to temporal stability through test-retest reliability, the PBAP did engage in steps to ascertain the reliability of the tool. NCSBN (2010) argued that the research design to develop the 2007 TERCAP tool included a qualitative descriptive case study analysis over a period of six years and four reviews of cases. It was through

repeated case review that the PBAP was able to identify the ten major sections that informed the factors of the 2007 TERCAP tool. NCSBN (2010) stated, the PBAP "reviewed the cases and used repeated examinations to establish the instrument's validity reliability and other essential qualities" (p. 20).

Developers also assessed coder inter-rater reliability, which refers to the consistency of performance among different raters or judges in assigning scores to the same objects or responses (Waltz, Strickland, & Lenz, 2010). Inter-rater reliability was the primary focus for the PBAP in the development of the 2007 TERCAP tool. This test of equivalence was of upmost importance to the PBAP because "the TERCAP instrument requires the investigator to make a judgment about the patient's care and the nurse's behavior based on interviews and a review of records" (NCSBN, 2010, p 22). The equivalence of the tool may be satisfactory, however, an assessment of parallel forms was not provided, nor was internal consistency (Cronbach's Alpha) established by or disseminated by developers.

Although the developers did not provide specific information regarding test-retest reliability of the TERCAP, Thomas (2007) assessed test-retest reliability by asking direct care providers to complete the modified 2007 TERCAP database on two separate occasions. Thomas (2007) found that the degree of test-retest agreement primarily ranged between 0.60 – 1.00, however, two items (Prevention [0.50] and Interpretation of Authorized Providers Orders [0.50]) fell outside of this range. Thomas (2007) performed additional analysis of these two items using Spearman's rho correlational analysis which revealed that Interpretation of Authorized Providers' Order continued to be outside the

acceptable range. Thomas (2007) argued that the factor name may have been confusing to participants since the original name was Interpretation of Doctors' Orders. This name was felt to be more clearly defined in the expectations of participating nurses.

Validity of the TERCAP Database

Validity of an instrument refers to "the degree to which an instrument measures what it is supposed to measure" (Polit & Beck, 2012, p. 336). Validity and reliability are interrelated therefore they are not mutually exclusive of each other. Validity is assessed through consensus building until the tool has inferred validity (Polit & Beck, 2012).

According to NCSBN (2010) the TERCAP tool was revised after an expert panel analyzed 109 cases from multiple jurisdictions. Members of the expert panel served as subject matter experts and ascertained recurring themes, analysis of root causes, clinician and team contributions to error and components of practice responsibility through case analysis. Face validity was established by using the PBAP as the expert panel.

Content validity refers to the degree to which an instrument has an appropriate sample of items for the construct being measured and adequately covers the construct domain (Polit & Beck, 2012). The PBAP spent a significant amount of time examining the construct of practice breakdown so the resulting tool could capture the full domain of this phenomenon. As noted previously, regulators and practice experts contributed to these discussions to ensure the conceptualization process was robust and thorough (NCSBN, 2010). It is also important to note that the PBAP compared the taxonomy of nursing error to an equivalent taxonomy of medical errors made by physicians during the

deliberative process. The TERCAP tool contains many of the concepts denoted in the medical error taxonomy and adds others that are more specific to the role of nurses in healthcare delivery (NCSBN, 2010).

Construct validity ascertains what the instrument is truly measuring (Polit & Beck, 2012). A form of factor analysis was not used in the development of the TERCAP instrument, however, the standards of practice previously mentioned were identified through an initial case analysis and based on that information, the PBAP trended case elements and recurring themes in practitioner behavior, nurse characteristics, work environment, and organization/ management factors to develop more specific causative factors under the major categories. In an unpublished Master's thesis studying nursing vigilance by Emrich (2004) (as cited in Benner et al., 2006), the TERCAP tool was able to differentiate between behaviors indicative of negligence on the part of a licensed nurse, versus those behaviors demonstrated by a prudent nurse engaged in standards of safe nursing practice. Given one of the eight standards of practice is *attentiveness/ surveillance*, this study may provide limited support to the TERCAP tool's construct validity. Criterion-related validity was not formally assessed by the developers of the TERCAP tool, however, Zhong and Thomas (2012) performed a study analyzing the association between employment history and practice error using national data from the TERCAP database and could ascertain positive associations raising the possibility the instrument may have some predictive validity.

Usefulness of the TERCAP Database in Nursing Regulation

The TERCAP database is unique because it captures data from BONs regarding authenticated nursing error. The database is comprehensive in its efforts to identify a varied number of factors that influence nursing error. The database also allowed this researcher to ascertain the impact those factors might have had on the severity of harm to the involved patient. Much care was taken to ensure that experts in nursing regulation provided input to ensure the tool adequately measured nursing error consistently (Benner et al., 2006; NCSBN, 2010). Significant efforts were also made to ensure that data collectors would interpret questions similarly and provide consistency in the information based on the questions posed in the instrument. These strides have made the TERCAP tool a good resource for nurse regulators striving to determine causes of practice breakdown, focus remediation efforts and inform targeted interventions to prevent error recurrence.

The TERCAP database uses "uniform processes across states to examine different patterns of errors and to distinguish practice breakdown from misconduct and willful negligence" (NCSBN, 2010, p. 20). While North Carolina specific data had not been separately analyzed, state specific data had been analyzed as part of a national examination of error by NCSBN. The study examined whether the independent variables of shift worked (8 hour, 10 hour, 12+ hour, on-call), type of patient treatment error (specifically medication error) and the work environment (hospital, long-term care or other agencies) are associated with the dependent variable of patient harm. These three

variables were chosen as pertinent factors to examine consistent with the literature on nursing error which revealed that work environment factors are associated with error and may be associated with poor patient outcomes.

Association of Select Environmental Factors and Patient Harm (Adverse Events)

According to the OAM, active and latent factors contribute to adverse events. Adverse events were defined as "an injury that was caused by medical management (rather than the underlying disease) and that prolonged the hospitalization, produced a disability at the time of discharge, or both" (Brennan et al., 1991, 370). Latent factors include those organizational influences which are outside the control of the direct care provider. Organizational influences may include decisions regarding the shifts available for nurses to work and the type of work environment in which the licensed nurse is employed. It is also important to note that the type of error that occurred may also influence an outcome of patient harm.

Shift Work

Healthcare delivery occurs on a constant basis and as the largest provider of healthcare in the US; nurses render a substantial portion of that care. According to Trinkoff et al. (2011), nurses in the United States often work extended hours (outside of the traditional 9am – 5pm workday) to provide continuous care to patients. Traditional nursing shifts were broken down into three, 8-hour periods of time; however, more recently healthcare agencies have embraced longer 12 to 13 hour shifts to reduce hand-offs and labor expenses, while trying to improve staff satisfaction by allowing staff to work fewer shifts (Griffiths et al., 2014). Unfortunately, the healthcare industry's need

for efficiency and convenience has resulted in extended duration work shifts and shift work which have adverse effects on patient outcomes and increase health care errors and patient injuries (Lockley et al., 2007). While some studies show that extended work shifts result in increased fatigue for nurses and performance deficits (Geiger-Brown et al., 2012; Iskra-Golec, Folkard, Marek, & Noworel, 1996), Rogers, Hwang, Scott, Aiken and Dinges (2004) found that both errors and near errors are more likely to occur when hospital staff nurses work twelve or more hours at a stretch.

The impact that work shifts have on patient harm is also noteworthy. Trinkoff et al. (2011) found that work schedule was significantly related to mortality when staffing levels and hospital characteristics were controlled. These researchers also found that pneumonia deaths were significantly more likely in hospitals where nurses reported schedules with long work hours and lack of time away from work. Stimpfel and Aiken (2013) argued that nurses who worked shifts of ≥ 12 hours were significantly more likely to report poor quality of care and poor patient safety when compared with nurses working 8- to 9-hour shifts. Bae and Fabry (2014) found in their review of literature on nurse work hours, overtime and patient outcomes, that six of the eighteen studies reviewed found that when shift length was longer (i.e., working 12 hours), adverse patient outcomes (hypoglycemic events, errors or near errors, and pneumonia death), perceived adverse events, and patient dissatisfaction increased. Similarly, Clendon and Gibbons (2015) found that the risk of making an error appears higher among nurses working 12

hours or longer on a single shift in acute care hospitals. These same researchers stated that facilities operating 12 hour shifts should "review this scheduling practice due to the potential negative impact on patient outcomes" (p. 1231).

Similar research findings are noted to extend beyond US borders and specific adult populations. Stimpfel, Lake, Barton, Gorman, and Aiken (2013) found that nurses in the pediatric setting working ≥ 13 hours reported worse job outcomes, lower quality, and lower safety for their patients when compared with nurses working 8-hour shifts. Griffiths et al. (2014) completed a cross-sectional survey of 31,627 registered nurses in general medical/surgical units across 12 European countries. The authors found that nurses working ≥ 12 hours were more likely to report poor or failing patient safety, poor/ fair quality of care and more care activities left undone.

The potential impact of the length of shifts worked by licensed nurses and adverse impacts on patient harm is an important aspect of healthcare delivery and warrants further study, particularly because the use of 12 hour shifts is prevalent in the United States (Stone et al., 2006; Trinkoff et al., 2011). Some researchers have suggested that the available evidence provides little assurance that continued use of 12 hour shifts by nurse employers is appropriate because there are conflicting findings detailing the benefits or unacceptable risks to patients and staff alike (Estabrooks et al., 2009; Harris, Sims, Parr & Davies, 2015). The proposed research study will add to the knowledge base on the association (or lack thereof) between shift worked and error resulting in patient harm by licensed nurses. Study findings will inform administrators of nursing services as they deliberate their staffing decisions.

Work Environment

According to Siegler, Mirafzali and Foust (2003), hospitals have become places where healthcare providers order and administer continuous "monitoring, high-tech investigations or treatments, and therapies that would be too complex to provide elsewhere" (p. 80). As such, hospitals are often repositories for medical innovation and disaster. With this acknowledgment, many studies examining medical error have been conducted in the acute care/ hospital setting (Siegler, Mirafzali & Foust, 2003), including those highlighted in the landmark IOM reports. Interestingly, Sears, O'Brien-Pallas, Stevens, and Murphy (2013) found that even within the hospital setting, medical/surgical units report more errors than critical care environments. The study authors argued that there was a 2.9% increase in the number of pediatric medication administration errors for every one bed increase on a unit suggesting that the more patients housed on a particular unit, the more likely an error will occur. Such implications have potentially far-reaching effects for healthcare providers within and external to the hospital setting.

Licensed nurses, employers, regulators, and administrators must remain cognizant that healthcare errors are prevalent in all healthcare settings. According to Gandhi et al. (2003), and Thomsen, Winterstein, Søndergaard, Haugbølle, and Melander (2007), adverse drug events, generally defined as a medication error resulting in harm, are common in ambulatory care with many being preventable and resulting in hospitalization. Taché, Sönnichsen and Ashcroft (2011) found the median adverse drug event rate in

ambulatory care to range from 3.3% to 9.62% depending on study design (retrospective versus prospective). They also found significant differences in the rate of adverse drug events between different age groups of people.

Abu Salem (2006) found in his cross-sectional survey of home health care nurses that the largest number of perceived care errors in home health care was related to medication errors and this type of healthcare error was the most prevalent type of error occurring in this practice setting as well. This finding is in contrast to the findings of Smucker, Reagan, Elder, and Gerrety (2014) who argue in their qualitative exploratory study of home hospice care personnel that the most commonly reported incidents resulting in patient harm involved patient falls and inadequate control of symptoms, not medication errors.

Patients in U.S. nursing homes also experience healthcare error. Crespin et al. (2010) found that 37% of medication errors were repeated one or more times in nursing home settings, with wrong dosage and wrong administration as the most frequent causes. These authors found that while the absolute harm rates were small, repeat errors were twice as likely to be harmful to patients compared to non-repeated ones. Common to each of these studies is that they highlight the pervasive problem of healthcare error in U.S. healthcare settings, despite continued research and government reports' recommendations for corrective action.

Type of Healthcare Error

Some of the more frequently cited healthcare errors include medication errors, hospital-acquired infections, falls, and hand-off errors (Pham et al., 2012). Exploration

of these healthcare errors reveal nurses are intimately involved in processes that can prevent or reduce incidence of these types of errors. Of particular focus to this research study are medication errors; exploring factors contributing to these errors is necessary to develop tailored interventions for licensed nurses in their efforts to improve patient safety.

Medication errors. Medication errors account for a large portion of error that occurs within the US healthcare delivery system (IOM, 2007). In 2001, the Agency for Healthcare Research and Quality (AHRQ) stated adverse drug events result in more than 770,000 injuries and deaths each year and cost up to $5.6 million per hospital, depending on size. Adverse events are defined by the U.S. Health and Human Services, U.S. Food and Drug Administration (FDA) as "any undesirable experience associated with the use of a medical product in a patient" (U.S. Health and Human Services, U.S. Food and Drug Administration [FDA], 2014). AHRQ also found that patients who experienced adverse drug events (ADEs) were hospitalized an average of 8 – 12 days longer than patients who did not suffer ADEs (AHRQ, 2001). The IOM released a report titled, *Preventing Medication Errors* (2007) which stated that on average each hospitalized patient in the US experiences one medication error per day. More recent data shows that medication errors that result in patient harm account for approximately 700,000 emergency room visits, and 100,000 hospitalizations annually in the US (AHRQ, 2015). According to the IOM (2007), medication errors result in more than 7000 patient deaths costing an estimated 3.5 billion dollars annually, however, Choi et al. (2015) argued that these

figures remain underestimated because researchers have not traditionally included the costs of medication errors associated with less severe patient outcomes or potential errors.

Part of the nurse's role in providing aid to a patient is to initiate and deliver nursing care according to an established plan, which includes implementing nursing interventions and medical orders consistent with 21 NCAC 36 .0221(c) and within an environment conducive to client safety (North Carolina Nursing Practice Act, 2009). One such intervention may be the task of administering medications and treatments to the patient. Nurses have the knowledge, skill, and ability to administer medications and yet errors still occur. Rather than focus on the incidence of medication errors, nursing researchers have traditionally focused on trying to determine factors influencing medical error, especially as it relates to medication administration errors.

Kalisch, Langstrom and Williams (2009) found that assessments and interventions such as medication administration were noted to be the most significant activities that were missed by nursing staff in the acute care setting. Sheu, Wei, Chen, Yu, and Tang (2009) found that medication administration errors may be caused in part by both system and personal factors including the use of less experienced nurses, working day-shifts and working on medical-surgical units. Ozkan, Cocaman, Ozturk, and Seren (2011), found in their study of medication administration errors on a pediatric unit that the most common errors were wrong time and wrong dose. Researchers found that a majority of the factors contributing to violations were related to system factors rather than individual factors (Smits et al., 2010) specifically suggesting that workload contributes to all types of

medication errors, however, interruptions are a significant contributing factor to errors (Cramer, Phlabein, & Habermann, 2013; Murphy & While, 2012; Ozkan, Cocaman, Ozturk & Seren (2011); Unver, Tastan, & Akbayrak, 2012).

Medication errors in North Carolina. The state of North Carolina has no mandatory adverse event reporting programs under regulatory control. North Carolina has only a voluntary medical error reporting program for nursing homes that is administered by the State's Quality Improvement Organization (QIO), Carolinas Center for Medical Excellence. Therefore, there is no comprehensive state-wide system available to track medication errors. Individual healthcare entities may have internal mechanisms to identify, track and trend medication errors, however, without a coordinated system; efforts to reduce medication errors are decentralized and may be less effective.

Hansen and colleagues (2006) performed a retrospective review of state reports submitted to the QIO by 384 North Carolina nursing homes. During a 9-month period in the year 2004, just over 9, 200 medication errors were reported. Of those reported, the medication errors disproportionately included central nervous system agents (16%) and analgesics (11%). Findings also revealed that medications considered potentially inappropriate in the elderly were frequently involved in the reported errors. These research findings are particularly important given nursing homes in the state of North Carolina employ a large number of licensed practical nurses who are often charged with medication administration in these facilities.

Association of Nurse Demographic Factors and Patient Harm

The emphasis on workplace contributors to error may be due to increasing literature stating medical error is often attributed to inadequate workplace systems rather than individual competence (Dennison, 2007; Hughes & Ortiz, 2005; Kohn, Corrigan & Donaldson, 2000; Leape et al., 2009; Painter, Dudjak, Kidwell, Simmons & Kidwell, 2011; Reason, 2000) This finding is consistent with the beliefs of healthcare leaders who also suggest that heavy workloads and the complexities found within healthcare delivery systems contribute to error (Kane, Shamliyan, Mueller, Duvai & Wilt, 2007). Patient safety efforts continue to highlight the need for a multi-leveled approach to error reduction, however, one cannot ignore that despite continued national attention on the subject of error reduction, decreasing the incidence of medical error has been challenging. Therefore, it is important for the nursing community to remain acutely aware of the impact that trending nursing workforce characteristics potentially have on the overall effectiveness of nursing care quality and patient safety in addition to the work environment and type of healthcare error involved in an error incident.

Nurse Age

According to the 2008 U.S. nursing workforce survey, the average age of a registered nurse (RN) was reported to be 47 years and close to half of RNs were 50 years of age or older (U.S. Department of Health and Human Services, Health Resources and Services Administration, 2010). Hart (2007) suggested that the aging workforce may be attributed in part to Americans living longer, healthier lives, lack of foresight and active

preparation in anticipation for retirement, and unforeseen default on pensions. Many baby boomers' self-identity is tied to their occupation, therefore to engage in life without a work purpose may be disconcerting for some (Hart, 2007).

Raines (2010) stated that for some accelerated educational program participants, the nursing profession became an attractive profession after they engaged in self-reflection. These transition students are often entering the nursing profession later in life which also contributes to the aging nursing workforce (Auerbach, Buerhaus, & Staiger, 2011). Employers and managers of older nurses need to be aware of the unique needs of this population specifically with regards to their work environments and assignment selection in order to support an aging workforce in their continued careers.

Hill (2011) argued that the myths around subpar performance on the part of aging nurses are unfounded despite the negative connotations associated with aging. Hill (2010) suggested that older adults can maintain a high level of mental cognition through continued work interactions and a commitment to learning. Older adults also self-reported having better mental well-being than their younger registered nurse counterparts (Letvak, Ruhm, & Gupta, 2013). Despite these findings, the literature also suggests that health problems may increase as people age (Keller & Burns, 2010) and older workers experience changes in visual acuity, hearing loss and muscle strength loss which places them at increased risk for workplace injury (McMahan & Sturz, 2006; Phillips & Miltner, 2015). The physical changes that occur in aging may impact care delivery by older nurses, thereby raising concerns about nursing care quality and resulting patient outcomes. Letvak, Ruhm, and Gupta (2013) found in their cross-sectional study of

hospital employed registered nurses in North Carolina that there were no significant differences between older registered nurses (defined as greater than 50 years of age) and younger nurses across several variables including rate of medication errors, quality of care, and physical wellbeing. The study did find, however, that older nurses reported higher health related productivity loss, lower worker productivity, and a higher rate of patient falls. Fragar and Depczynski (2011) found in a qualitative study of older allied health workers (aged 50 years and over), that workers reported having difficulty in reading labels, hearing patients and colleagues, manual handling, medication administration and other tasks associated with working in healthcare.

Findings from these studies suggest that nursing leaders and healthcare administrators should continuously strive to develop and adopt work environment enhancements like flexible scheduling options, ergonomically enhanced patient care environments, and as noted previously, skillful assignment selection. Doing so may mitigate adverse effects on patient care quality such as delays in responsiveness by nurses to patient needs, mis-communication in an increasingly collaborative care delivery environment, the inability of nurses to meet the physical demands of the provider role, and increased incidence of medication administration errors.

The profession is very supportive of older nurses continuing their careers. Yet as the licensed nurse ages, it is important for all nurses to better understand the implications of this phenomenon within the workforce so the profession is prepared to take active steps to support older nurses in their efforts to provide the highest quality of care to patients.

Nurse Gender

Nursing is a female dominated profession and that gender specificity may perpetuate gender specific stereotypes (Kelly, Fealy, & Watson, 2012), including in their educational preparation as licensed nurses. Barriers to male matriculation in nursing education programs include social isolation (MacWilliams, Schmidt &. Bleich, 2013), failure to acknowledge and discuss gender differences in expressions of care, particularly with physical touch used by men vs. women (Whiteside & Butcher, 2015); sexism (Meadus & Twomey, 2011), suppression of the contributions men have made to the field of nursing (Evans, 2016), and media portrayals of male nurses as socially or sexually deviant (Stanley, 2012; Weaver, Ferguson, Wilbourn & Salamonson, 2014). These stereotypes and educational barriers have made it difficult to recruit and retain men in nursing (MacWilliams, Schmidt & Bleich, 2013) and may be a contributing factor towards incivility within the profession which may increase the likelihood of medical errors, adverse events and compromise patient safety and quality of care (Rosenstein & O'Daniel, 2006).

According to Cleary, Hunt, and Horsfall (2010), studies have determined that many health care workplaces possess negative environments that foster disrespectful attitudes, inappropriate behaviors, and bullying. These behaviors are found to create psychological and behavioral costs such as stress and anxiety that can impact job performance (Wright & Khatri, 2015). Vessey, Demarco, Gaffney, and Budin (2009) noted bullying to be associated with diminished quality of care and revealed that bullying occurs more on medical/surgical units than other hospital units.

Einarsen, Hoel, and Notelaers (2009) identified three categories of bullying: work-related, person-related, and physical intimidation. Work-related bullying may include behaviors such as being given unreasonable deadlines, assigning tasks below a person's competency level, or withholding information that affects performance. Person-related bullying may consist of behaviors such as being ignored or excluded, spreading gossips and rumors, or hints and signals from others to quit one's job. Physically intimidating behaviors may include invasion of personal space, shoving and blocking the way, threat of violence, physical abuse, or actual abuse. Wright and Khatri (2015) found that male nurses experienced higher work-related bullying than female nurses. Findings from this study also suggested that work-related bullying showed an indirect relationship with medical errors through a mediating effect of psychological/behavioral responses (Wright & Khatri, 2015). A review of these findings raise question of whether male nurses, in comparison to female nurses, are the subject of work-related bullying which may adversely impact the quality of care rendered to patients and ultimately lead to errors. These direct associations are not found in the current literature hence the need for continued exploration of the topic through this study.

While male nurses have been the subject of stereotypes and work-related bullying, they have also have been shown to be overrepresented in patient safety identification systems examining adverse events for nurses. NCSBN (2015) revealed that a report gleaned from an examination of the national TERCAP data revealed that male nurses and licensed practical nurses (LPNs) or vocational nurses (VNs) are overrepresented in the group of nurses who committed practice breakdown. This finding is consistent with

previous NCSBN studies (Zhong & Kenward, 2009; Zhong, Kenward, Sheets, Doherty, & Gross, 2009), which also show a disproportionally high percentage of male nurses and LPN/VNs having committed a practice breakdown. Similarly, Kenward (2008) found in his review of discipline data of licensed nurses from years 1996 to 2006, that among RNs; male nurses represented 18% of the disciplined population which was substantially higher than the 6% of the national population males accounted for among RNs in the National Sample Survey of Registered Nurses available at the time. At the state level, males have also been overrepresented in programs offered through the NCBON to either remediate practice deficiencies or misconduct through one of the drug monitoring programs (K. Privette, personal communication, January 21, 2016; P. Trantham, personal communication, April 2, 2016). While these findings do not offer a direct correlation between gender status and patient harm, further research is warranted to determine whether associations exist between gender, commission of error and patient harm.

Educational Preparation

There are differing educational pathways to earn a degree in nursing the US. For LPNs, there are two primary paths, either through a vocational/ certificate program or by earning a diploma in practical nursing. The length can vary but programs typically last 1 year (North Carolina Board of Nursing, 2016a). There are three traditional ways to become formally educated as a registered nurse in the U.S. Those three pathways towards licensure include matriculation in an associate's degree program (typically lasting two years), which are offered through community colleges, a diploma program (often lasting three years) offered through a hospital-based educational program, and a

bachelors' degree (typically lasting at least four years) which is offered through a traditional university setting. Each educational program, while varying in length, is designed to prepare the student to take and successfully pass the National Council Licensure Examination – Registered Nurse (NCLEX - RN®) or Practical Nurse (NCLEX – PN®), developed and maintained by NCSBN. The NCLEX® is designed to screen candidates to determine if they are minimally competent to enter the practice of nursing (American Association of Colleges of Nursing [AACN], 2014). Once the NCLEX® is successfully passed, graduates can apply to a Board of Nursing or comparable regulatory authority for licensure to practice either as a licensed practical/ vocational nurse or a registered nurse and carry the designation, "LPN/ LVN" or "RN" as applicable.

According to the IOM report titled, *The Future of Nursing: Leading Change, Advancing Health* (2010), evidence to support definitive transition to a single minimal degree for entry to practice is inconclusive. Specifically, the report cited there is limited research specifically linking RN education level with improved patient safety, a sentiment previously argued by Ridley (2008). Fueling the debate are conflicting research findings in the literature. Blegen, Vaughn, and Goode (2001) argued that acute care hospital units with more baccalaureate prepared nurses had no significant impact on the incidence of medication errors or other nurse sensitive indicators like patient falls. Sales et al., (2008) found that RN education was not significantly associated with mortality. However, a growing body of research argues that increasing the number of baccalaureate prepared registered nurses in hospital settings results in decreased patient mortality (Aiken, Clarke, Cheung, Sloane & Silber, 2003; Kane, Shamliyan, Mueller,

Duvai, & Witt, 2007; McHugh et al., 2013; Yakusheva, Lindrooth, & Weiss, 2014). Some studies have also been replicated in other countries giving additional support for arguments that employing licensed nurses educated at the baccalaureate level results in better patient outcomes (Aiken et al., 2014; Cho et al., 2014; Estabrooks, Midodzi, Cummings, Ricker, & Giovannetti, 2005; Tourangeau, Cranley & Jeffs, 2006).

Despite some inconsistency in the literature, the IOM recommended increasing the proportion of nurses with a baccalaureate degree to 80% by year 2020 and employers may be leading efforts for this recommendation to become a reality. According to the 2013 American Association of Colleges of Nursing's (AACN) survey of deans of nursing schools, an increasing number of employers are either showing preferential hiring practices for baccalaureate prepared nurses or are simply requiring the minimal degree of newly hired registered nurses to be at the baccalaureate level. AACN stated this is a trend that has persisted for at least three years (2013). Several state led initiatives have been considered that would require registered nurses wishing to practice in any of those states be educated at the baccalaureate level. These "BSN in 10" campaigns would require those nurses not holding a baccalaureate degree upon initial licensure within a state, to obtain a baccalaureate degree within ten years of initial licensure (Haverkamp & Ball, 2013).

While there are efforts to increase the number of baccalaureate prepared nurses working in the U.S., Fulcher and Mullin (2011), publishers of a policy brief for the American Association of Community Colleges, argued the majority of the newly graduated registered nurses in the U.S. are educated through associate degree pre-

licensure programs. Their report stated associate degree nursing educational programs provide the nation its greatest number of minority registered nurses and educate the majority of registered nurses in rural settings. According to the report titled, *The U.S. Nursing Workforce: Trends in Supply and Education*, published by the U.S. Health Resources and Services Administration [HRSA] (2013), among first-time test takers, nearly 60% were not baccalaureate prepared and non-baccalaureate degree candidates taking the NCLEX-RN® exam experienced nearly 97% growth between the years 2001 to 2011. The report also stated that of all NCLEX-RN® takers during the same time period, the number of baccalaureate prepared RN candidates more than doubled and there was an estimated 86% increase in the annual number of RN to BSN graduates between years 2007 and 2011.

The dialogue regarding the impact of educational preparation of licensed nurses will continue as pressures mount to increase the number of licensed nurses to meet future care demands amid growing concerns regarding quality of nursing care. Administrators, regulators, and politicians must weigh these delicate topics in order to ensure patients receive the highest quality of care by educated clinicians.

Nursing Tenure (Years of Nursing Experience)

This chapter has explored how age may influence the performance of a nurse; however, one should not presume that a nurse's age coincides with the nurse's professional experience as a licensed nurse. Nursing is an attractive profession to many individuals looking to embark on a second or third career and these students may be older, more established, and bring different work experiences and motivators with them

as they pursue a career in nursing (Moore, Kelly, Schmidt, Miller, & Reynolds, 2011; Wujcik, 2010). Researchers contend that nurses' years of experience contribute to nursing quality (Aiken, Havens & Sloane, 2009; Dunton, Gajewski, Klaus, & Pierson, 2007; Hill, 2010). This position has been supported by Blegen, Vaughn, and Goode (2001) and Tang, Sheu, Yu, Wei, and Chen (2007) who have suggested that more experienced registered nurses make fewer medication errors. Dunton, Gajewski, Klaus, and Pierson (2007) reported that in addition to RN hours and skill mix, nursing years of experience is an important factor promoting the quality of safe and effective hospital care. Specifically, the researchers found that having a higher percentage of *experienced* RNs on the unit was related to lower fall rates and lower hospital acquired pressure ulcer rates. More recently, Hickey, Gauvreau, Curley, and Connor (2013) found that the odds of death among pediatric patients with congenital heart defects increased as the percentage of "pediatric critical care unit nurses with two years' clinical experience or less increased, yet the odds of death decreased as the institutional percentage of critical care nurses with eleven years' clinical experience or more increased" (p. 637).

Intuitively, one might believe that nurses become better in their respective roles with more experience, thereby decreasing the number of adverse outcomes to patients. Benner's landmark work, *From Novice to Expert: Excellence and Power in Clinical Nursing Practice (1984)* suggested that nurses develop and hone their skills over time by gaining a fuller understanding of their patients and their patients' clinical processes through a solid education and a myriad of experiences. This experiential knowledge enables the nurse to function at a higher level where he or she is able to more quickly and

aptly assess, evaluate, and render appropriate interventions. Given these enhanced abilities, one might presume that operating as an expert nurse with years of experience would decrease one's propensity to engage in errant behavior because the knowledge and know-how necessary to gain expertise guides the nurse towards the most efficacious behavior (Hill, 2010). While there is broad consensus around this model, Kenward (2008), found that discipline issued against a licensed nurse by U.S. Boards of Nursing for nursing misconduct (inclusive of both practice and drug related misconduct) occurred less frequently among nurses with one year or less of experience, while 39% of disciplined nurses had been licensed between ten and twenty-four years. Kenward (2008) also found that approximately 3% of the disciplinary sanctions issued during the decade long review involved some type of medication error. Despite these findings, nursing experience and expertise is not to be diminished, given the literature shows the positive impact experience can have on patient outcomes; rather, these findings highlight the continued need for additional research to further explore the relationships between years of nursing experience, error incidence, and patient outcomes.

Conclusion

This chapter highlighted the need for nursing leaders to remain mindful of all influential factors of nurse error. While the trend among quality professionals has been to focus on identifying and remediating latent error through system reorganization, the nursing profession should not completely lose sight of the trends in the nursing workforce that also influence patient safety. The challenge for the profession is to not only remain abreast of the current challenges and opportunities for the nursing workforce but to take

steps to actively embrace viable initiatives to address nursing care delivery of the future. The factors discussed in this chapter give but only a glimpse of the complexity inherent in healthcare delivery by nurses. Employers, managers, public policy makers, regulators, and licensees should all be attuned to the changing healthcare environment and the impact on the health care industry including but not limited to the work environment, quality of care rendered, and clinical expertise at the bedside. As the leading provider of healthcare services in the U.S., it is incumbent upon the nursing profession to lead the dialogue around these very pertinent topics as we strive to enhance patient care quality.

CHAPTER III

METHODOLOGY

Introduction

This chapter describes the methodology used to evaluate the associations among demographic factors (age, gender, nursing tenure and educational preparation), environmental factors (commission of a medication error, shift worked, and work environment) and first reported error incidents resulting in patient harm. This chapter explicates the research design, the sample, protection of human subjects, and the data analysis plan.

Datasource

The TERCAP Database is an online repository available to state BONs for the collection and analysis of factors contributing to practice breakdown. This database was appropriate for use for this study because it captured individual, healthcare team, patient and system contributors to practice breakdown. As such, the TERCAP tool aligns well with the major constructs of the Organization Accident Causation Model (OAM) developed by Dr. James Reason.

The TERCAP database is unique in that it was specifically designed to classify nursing error by identifying categories of practice breakdown in accordance with broadly accepted nursing standards (Benner et al., 2006) (Table 1). By defining those eight types of practice breakdown, the TERCAP tool can help standardize nursing practice and

disciplinary processes of state based nursing regulation leading to improved communications and effectiveness of state BONs.

Table 1. Practice Breakdown Categories Defined in the TERCAP Tool

Prevention	Intervention
Attentiveness/ Surveillance	Clinical Reasoning
Medication Administration	Documentation
Interpretation of Authorized Providers' Orders	Professional Responsibility/ Patient Advocacy

Out of the eight practice breakdown categories, medication administration was examined as one of several independent variables in the study. While the details of medication administration error were not examined, the presence of a medication error was analyzed as it relates to patient harm. The data collected in the TERCAP tool comes from multiple data entry personnel who are employees of the investigative staff of North Carolina Board of Nursing. Each investigator undergoes training on the requirements for data entry into TERCAP, part of which is offered through NCSBN. The BON investigator entering the case details into the database chose one of the practice breakdown categories as being the primary cause of the error event. Recognizing the potential variability inherent in having multiple individuals perform data entry, inter-rater reliability was the primary focus for the PBAP in the development of the 2007 TERCAP database. The overall kappa statistic for the TERCAP instrument was 0.75. The PBAP stated that this value represented excellent agreement between data collectors (NCSBN,

2010) however, based on Polit & Beck (2012) this kappa statistic may be more indicative of fair to good agreement between the data collectors.

Design

The study was associational and used cross-sectional design. Cross-sectional designs are often used to determine associations and correlations between variables and may be used to make comparisons between groups (Hulley, Cummings, Browner, Grady, & Newman, 2013). The sample selected was analyzed in aggregate and as appropriate the sample was examined for differences between groups. Because the purpose of the study was not to establish cause and effect between variables, this design was considered appropriate for the objectives of this study which were to explore relationships between nurse demographic factors, environmental factors, and error resulting in patient harm.

Sample

The sample for the study included 544 cases meeting the inclusion/exclusion criteria as outlined in Chapter 2 for error events occurring within North Carolina. This constituted a repository census of all cases pertaining to RN and LPN investigations by the NC BON during the April 1, 2011 to July 31, 2015 time period. The entire set of cases comprised the sample used in the analysis for this study.

Power and Sample Size Considerations

The study had one dependent binary variable (patient harm) and several independent variables (age, gender, educational preparation, nursing tenure, shift worked, work environment, and commission of a medication error). Logistic regression analyses were used to determine if the demographic and environmental factors (gender, age,

nursing tenure, educational preparation, shift worked, commission of a medication error and work environment) were more likely to result in patient harm (dependent variable). For the logistic regression to model any versus no patient harm as the dependent variable, with a significance level of $\alpha = 0.05$ and power of 80%, the minimum number of required events is between 5 and 9 (i.e., event = any harm caused to patient) (Vittinghoff & McCulloch, 2006). With a 25% prevalence of any harm (determined by preliminary analyses of TERCAP data), the required total sample size was 360 cases (assuming 9 events per independent variable) with complete data. As noted above, the total sample included 544 cases thus the study had sufficient sample size and power.

Data Measures

As noted in Chapters 1 and 2, the three primary variables of study, included the shift worked by the licensed nurse, the work environment type, and commission of a medication error. While nurse demographic variables in and of themselves may influence practice breakdown and resulting error, they may account for a relatively small portion of that influence (Lewis, 2015). Therefore, this study focused on those environmental factors (while acknowledging the influence of nurse demographics) that have previously been shown to impact nurse error.

The TERCAP database captured the work environment a licensed nurse was employed in at the time of the practice breakdown incident and the shift he/she was working at the time. The TERCAP database also captured information about the types of error committed by licensed nurses including commission of documentation and medication errors (Table 2). These three factors were analyzed (along with nurse

demographics) to determine their association with the presence of patient harm. Work environments and nursing services are highly diverse; therefore, the researcher condensed the pool of alternatives for the independent variable work environment. In 2015, the majority of RNs worked in an acute care/ hospital setting (U.S. Labor Statistics, 2016a) and the majority of LPNs worked in the long-term care environment (U.S. Labor Statistics, 2016b), therefore these two categories were necessary for review. Table 2 outlines how the remaining work environment options, were recoded into one category labeled "other" (i.e. outpatient – based surgery, home care, assisted living, school nursing). Likewise, the variables of shift worked and educational preparation were also recoded to reflect the trends described in the literature (Table 2).

The dependent variable of patient harm was a categorical variable with four distinct categories of measurable harm delineated with in the TERCAP Database (Table 3). Despite some controversy over whether patient harm is a necessary component of medical error, the presence of any patient harm (regardless of the severity) for this study was categorized as affirmation of patient harm, hence recoding the variable as dichotomous (Table 2).

Table 2. Variables, Response Codes, Recoding of Variables for Study Analysis

Variable	Response Codes as measured in TERCAP	Variable Level	Recoding of Variables for Study Analysis
(Nurse)Age	Years – Based on birthdate	Continuous	Calculated based on birthdate and date of incident
Nurse Tenure	Years – Based on year of licensure	Continuous	Calculated based on earliest year of licensure and year of incident
Gender	Male/ Female/ Unknown	Categorical	Female = 1 Male = 0
Commission of a medication error	Medication Error Yes/ No/ unknown	Categorical	Medication Error Yes = 1 No = 0 Unknown = 999
Educational Preparation	Practical/Vocational – LPN Associate Degree - LPN Associate Degree - RN Diploma – RN Baccalaureate, Nursing Masters, Nursing Doctorate, Nursing Bachelors, non-Nursing Advanced Degree, non-Nursing Other nursing Degree Held by Nurse (Unknown)	Categorical	For Licensed Practical Nurses: Practical/Vocational Program and Associate Degree LPN Programs = 1 Diploma RN Programs = 2 Associate Degree RN Programs = 3 Baccalaureate Degree/ Master's Degree/ Doctorate/ Advanced degree, non-Nursing, Other Degree Held by Nurse = 4 Unknown = 999
Shift Worked	8 hour, 10 hour, 12 hour, on-call, unknown, other	Categorical	Recoded as: 8 hour = 1 10 hour and 12 hour shifts = 2 Other (inclusive of on-call, unknown and other categories) = 3

Variable	Response Codes as measured in TERCAP	Variable Level	Recoding of Variables for Study Analysis
Prior employer Discipline	Presence of Prior Employer Discipline Yes/ No/ unknown	Categorical	Presence of Prior Employer Discipline: Yes = 1 No = 0 Unknown = 999
Work Environment	Ambulatory Care Home Care Physician / Provider Office or Clinic Assisted Living Behavioral Health Hospital Long Term Care Unknown Critical Access Hospital Office - based Surgery Other	Categorical	Recoded into three groups: Hospital = 0 Long Term Care = 1 Others is inclusive of all categories excluding hospital and long-term care = 2
Patient Harm (Dependent Variable)	No Harm Harm Significant Harm Patient Death	Categorical	Recoded as a binomial variable Patient Harm - inclusive of Harm, Significant Harm, and Patient Death No Harm – inclusive of no harm No Harm = 0 Patient Harm = 1

Table 3. Severity of Harm Defined in the TERCAP Database

Possible TERCAP Responses	Operational Definitions for TERCAP
No Harm	An error occurred but with no harm to the patient
Harm	An error occurred which caused a minor negative change in the patient's condition
Significant Harm	Significant harm involves serious physical or psychological injury. Serious injury specifically includes loss of function or limb
Patient Death	An error occurred that may have contributed to or resulted in patient death

Protection of Human Subjects

This cross-sectional study was approved by the University of North Carolina Institutional Review Board (IRB) to ensure investigator compliance with Belmont principles (U.S. Department of Health and Human Services, Department of Health, Education, and Welfare, 1979). Licensed nurses associated with practice breakdown events had minimal risks associated with secondary data analysis given the data were collected retrospectively and only after each case was adjudicated by the North Carolina Board of Nursing. The TERCAP database itself is an online storage system owned and operated by the NCSBN. NCSBN maintains security integrity for the database, which includes strict unique log-in and password protected access to enter and manipulate data as well as encryption software once data are entered and submitted to the database.

Data Analysis

All analyses were performed with Statistical Package for the Social Sciences (SPSS), Version 24.0 for Windows (International Business Machines Corporation, 2015).

The characteristics of the sample of licensed nurses working in North Carolina who have violated the NC NPA by engaging in nurse error are described using descriptive statistics. The continuous variables of age (years) and nursing tenure (years) were described using means of central tendency including means, medians (as appropriate), percentages, standard deviations and 95% Confidence Intervals. Descriptive statistics with frequencies and proportions were calculated for the categorical variables of education preparation, shift worked, work environment, commission of a medication error, prior employer discipline and the dependent variable of patient harm. Multiple logistic regression was used for the study given there were multiple predictor variables being assessed and the outcome variable was binary (patient harm versus no patient harm). Pallant (2013) stated it is important to have a sufficient sample size with logistic regression models, to assess for outliers, and to assess for multicollinearity (high inter-correlations among predictor variables). Goodness-of-fit of the logistic regression models was assessed using the Hosmer-Lemeshow Test and influential observations were assessed by reviewing scatterplots, boxplots, D*f*Betas and Cook's distance values as applicable. Multicollinearity was assessed using variance inflation factors.

Bivariate correlations were assessed between the continuous variables of nursing tenure and age using Mann-Whitney U test. The Kruskal-Wallis test was used to assess the correlation between the variables shift worked and age. These bivariate statistical analyses were conducted to ascertain if results follow the strength and direction of predictions from the literature. It was expected that there would be a statistically significant correlation between clinician age and nursing tenure in spite of the increasing

number of second career students seeking entry into the nursing profession (Raines, 2011). Likewise it was expected that there would be a statistically significant correlation between increasing clinician age and length of shift worked given the physical demands of direct patient care. A significance level of 0.05 was established for all analyses.

Data Analysis for Research Questions

RQ1: To what extent are the variables of age, gender, educational preparation, nursing tenure, work environment, shift worked, and commission of a medication error related to the report of patient harm?

Each independent variable was assessed for an association with the outcome variable of patient harm. For the continuous variables of age and nursing tenure this association was assessed using the Mann Whitney U test and Kruskal-Wallis test, respectively. Associations between the independent variables of gender, commission of a medication error, educational preparation, work environment, shift worked and presence of error resulting in patient harm were assessed using Chi-Square tests with a significance level of 0.05.

RQ2: Is there a combination of the variables of age, gender, educational preparation, nursing tenure, work environment, shift worked and commission of a medication error that are predictive of patient harm?

A logistic regression model was run for the entire group of variables to ascertain what factors, if any in combination were predictive of error resulting in patient harm. The variables of educational preparation, work environment, and shift

worked were recoded into binomial variables. (Table 2) The significance level was established at 0.05.

RQ3: Is there a difference in age, gender, educational preparation, nursing tenure, shift worked work environment and presence of prior employer/ board discipline in those nurses who committed a medication error resulting in patient harm and those that committed a medication error resulting in no patient harm?

A binary logistic regression model was executed to evaluate this question. A new variable was created just examining those cases involving a medication error. The model assessed differences in those errors that resulted in patient harm and those medication errors that did not result in patient harm. This statistical analysis enabled this researcher to distinguish differences between the two groups and when appropriate run additional Chi-Square analyses. The significance level was set at 0.05.

Missing Data

The data were checked for missing information and corrected if erroneous prior to further analysis. Continuous variables were checked for outliers and normality in univariate analysis using boxplots, and Kolmogorov-Smirnov tests. Boxplots and scatterplots were used to assess outliers and missing values. Patterns of missing data were examined and when the missing data was found to be randomly dispersed and accounted for <5% of the sample size, no additional missing data adjustment was warranted (Tabachnick & Fidell, 2007). The variable, nursing tenure, had > 5% of the data missing (n = 38, 9.3%), therefore additional analysis was warranted to include assessing the

randomness of the data. When an outlier was detected within this same variable, analysis was run with and without the outlier. The results did not change with and without the outlier therefore the outlier was retained in all subsequent analyses.

Chapter Summary

In summary, this chapter has provided information regarding, the TERCAP database developed by the NCSBN to assess nurse practice breakdown, established the pertinent research questions proposed by the research study and presented the statistical analyses required to ascertain answers to the proposed questions. A descriptive, correlational, cross-sectional study was conducted to explore contributing factors resulting in patient harm. A census repository of 544 cases, representing error incidents committed by LPNs and RNs within the state of North Carolina comprised the study sample. The Organizational Accident Causation Model was the guiding framework for the study with variables identified akin to each of the model's conceptual categories. The statistical analyses used in the study included descriptive statistics, Chi-square test, Mann-Whitney U tests, Kruskal-Wallis tests and multivariate logistic regression modeling.

CHAPTER IV

RESULTS

This chapter provides an overview of the results of the study. The data are presented in five sections: the first section provides information on the findings from preliminary data analysis, a description of the sample follows and the remaining sections, guided by Reason's Organization Accident Causation Model, present data regarding each research question in the study. When necessary case findings will be referred to using female pronouns given the majority of the data collected were on female nurses.

Preliminary Data Analysis

All statistical analyses were performed using SPSS Version 24.0 (International Business Machines Corporation, 2015). The research questions were derived from data assessed by the 45 mandatory instrument questions thereby ensuring that most of the data would be present, however, analysis of frequencies revealed missing data for the variables of age, nursing tenure, educational preparation, gender and prior employer discipline. Analyses revealed that missing data were randomly dispersed and did not account for more than 5% of the total sample, therefore, no additional analysis or intervention was required. Review of the nursing tenure variable revealed that more than 5% of the sample had missing data randomly dispersed (n= 38 missing; 9.3% missing), a limitation of the study.

Descriptive statistics were calculated for continuous level data with mean, medians, standard deviation (*SD*), 95% confidence intervals, kurtosis and skewness. The continuous variables of nursing tenure and age have negative kurtosis values, suggestive that there may be too many cases in the extremes and there may be an under estimate of variance, however, according to Tabachnick & Fidell (2013), this finding should not "make a substantive difference in the analysis" with reasonably large samples (p. 80). Outliers were assessed by observing boxplots, and assessing for points of influence. One outlier was noted when evaluating nursing tenure. This outlier was deemed to be a valid observation and additional analyses were run with and without the outlier to determine the extent of influence. The findings were not impacted by inclusion or omission of the outlier, therefore the outlier was retained in subsequent analyses and non-parametric tests were performed as appropriate. Bivariate correlations were also assessed by scatterplots to check for linearity of the relationships and for normality by boxplots and Kolmogorov-Smirnov (K-S) tests. The variables of age and nursing tenure failed to meet the assumptions of normality as the K-S test revealed $p < 0.01$ for both variables.

Sample Demographics

Females comprised 87.1% of the entire sample. The mean age of licensed nurses in the sample was 45.61 years (*SD* ± 11.59) and the majority of the nurses represented in the sample were RNs (61.9%), spoke English as their primary language (98.0%) and received their nursing education in the United States (99.4%). The mean years licensed as a nurse regardless of licensure level was 14.48 (*SD* ± 10.95). Review of the educational preparation of the sample revealed the majority of licensed nurses (43.0%) were educated

at the associate degree level (consistent with RN licensure), with those being educated in practical/ vocational nursing accounting for 39.1% (Table 4).

Table 4. Sample Demographic Statistics and Frequencies

Variable (n)	*N* or Mean ± *SD*	Percentage (%)
Gender (n = 543)		
Female	473	87.1
Male	70	12.9
Age (n = 528)	45.61 ± 11.59 (Range 22 – 79)	
RN		
LPN (n = 205)	45.42 ± 12.19 (Range 22 – 75)	
Licensure Type (n = 544)		
RN	337	61.9
LPN	207	38.1
Primary Language is English (n = 544)		
Yes	533	98.0
No	6	1.1
Unknown	5	0.9
Country of Nursing Education (n = 544)		
US	541	99.4
Outside the US	2	0.4
Unknown	1	0.2
Nursing Tenure (n = 506)	14.48 ± 10.95 (Range 0 – 48)	
RN		
LPN (n = 197)	14.24 ± 11.83 (Range 0 – 48)	
Educational Preparation (n = 542)		
LPN – Practical/Vocational Degree	212	39.1
RN – Diploma Degree	24	4.4
RN – Associates Degree	234	43.0
RN – Baccalaureate, Masters, Doctorate, Advanced degree, non-Nursing, Other	72	13.2

Note: *SD* = standard deviation. Due to rounding and missing data, totals may not reflect 100%

Table 5 reveals the majority of the sample worked more than eight hours per shift, typically working twelve hour shifts (38.8%). The 10 hour and 12 hour shifts were combined as were the on-call, unknown and other shifts. Most of the nurses had received

no employer discipline (62.1%) prior to the error incident and the vast majority had not received Board discipline (92.5%) prior to the error incident. Nearly one third of the sample (32.5%) committed a medication error as the error incident being reported.

Table 5. Sample Work Environment Statistics and Frequencies

Variable (n)	***N***	**Percentage (%)**
Shift Worked (n = 544)		
8 hour	260	47.8
10 hour	18	3.3
12 hour	211	38.8
On-call	10	1.8
Unknown	38	7.0
Other	7	1.3
Shift Worked (n = 544)		
8 hour	260	47.8
10 hour or 12 hour	229	42.1
Other	55	10.1
Prior Employer Discipline (n = 544)		
Yes	204	37.5
No	338	62.1
Unknown	2	0.4
Prior Board Discipline (n = 544)		
Yes	41	7.5
No	503	92.5
Commission of a Medication Error (n=543)		
Yes	367	67.6
No	176	32.4

Note: Due to rounding and missing data, totals may not reflect 100%

The majority of licensed nurses in this sample worked in the "other" category setting (37.1%). The "other" work setting included multiple employment settings however there were comparable numbers of licensed nurses working in the hospital and long-term care settings as shown in Table 6.

Table 6. Work Environment 'Other' Category Breakdown (N = 544)

Variable	*N*	Percentage (%)
Work Environment		
Hospital	164	30.1
Long-term Care	178	32.7
Other	202	37.2
Total	544	100.0
Work Environment Other Category Breakdown		
Ambulatory Care	8	1.5
Assisted Living	7	1.3
Behavioral Health	16	2.9
Critical Access Hospital	3	0.6
Home Care	131	24.1
Office- Based Surgery	1	0.2
Physician/ Provider Office or Clinic	30	5.5
Other – not specified	2	0.4
Unknown	4	0.7
Total	202	37.2

Note: Due to rounding and missing data, totals may not reflect 100%

The results are indicative that over half of the sample (54.2%) had worked two years or less in their respective units at the time the error incident. Notably, approximately 30% of the sample had only worked on their respective units between one and eleven months at the time of the error incident. This is in contrast to those nurses who had worked more than five years on their respective unit (24.4%) at the time of the error incident which also accounted for a large proportion of the sample, but not the largest proportion of the sample. These findings are presented in Table 7.

Table 7. Time Nurse was Employed on Their Respective Unit at the Time of the Error Incident (N = 544)

Variable	*N*	Percentage (%)
Length of employment on the Unit at the time of the error incident		
Less than one month	22	4.0
One month – Eleven months	168	30.9
One – Two years	127	23.3
Three to Five years	90	16.5
More than five years	131	24.1
Unknown	6	1.1

Note: Due to rounding, totals may not reflect 100%

As a result of the error incident, employers must decide how to intervene with the involved licensed nurse. According to Table 8, the vast majority of employers (68.6%) chose to terminate the nurse's employment after the error incident while only 15.6% of employers chose to retain the licensed nurse after the error incident. The results revealed that 83.8% of the licensed nurses either resigned from employment or were terminated from employment post error incident.

Table 8. Employment Status of the Licensed Nurse Post Error Incident (N = 544)

Variable	N	Percentage (%)
Employer Retained Nurse	85	15.6
Nurse resigned	41	7.5
Nurse resigned in lieu of termination	42	7.7
Nurse terminated	373	68.6

Note: Due to rounding percentages may not equal 100%

Review of the descriptive statistics related to the presence of patient harm revealed that one quarter (25.7%) of all errors analyzed in this study resulted in some type of patient harm (n = 140). The majority of cases resulting in some type of harm were of a relatively minor nature (15.4%). The breakdown highlighting the severity of patient harm caused by error is presented in Table 9.

Table 9. Cases Resulting in Patient Harm (N = 544)

Variable	*N*	Percentage (%)
Error resulting in Patient Harm		
Yes	140	25.7
No	404	74.3
Total	544	100.0
Positive Error resulting in Patient Harm Breakdown		
Error resulting in some patient harm	84	15.4
Error resulting in significant patient harm	21	3.9
Error resulting in patient death	35	6.4
Total	140	25.7

Note: Due to rounding, totals may not reflect 100%

Bivariate correlations for age and nursing tenure were assessed using Spearman's Rho Correlation. There was a statistically significant positive association between the nurse's age and nursing tenure ($r_s(504) = 0.722$, $p < 0.01$). This finding would indicate that as the nurse's age increases so does the nurse's experience in the nursing profession. Correlation between the nurse's age and shift worked was assessed using the Kruskal-Wallis test. The variable shift worked was recoded into three categories (Table 2 – Chapter 3). Findings revealed an overall significant difference on the age of the nurse, ($\chi 2$ (n=528) = 9.30, $p = 0.010$). To explore this finding further, Mann-Whitney U tests were performed to assess the correlation between those nurses working 8 hour shifts and those nurses working either working 10 or 12 hour shifts. There was a statistically significant difference (Z= -2.697, $p = 0.007$) in the median ages of those nurses who worked 8 hour shifts (*Md* = 46.50 years) and those who worked 10 or 12 hours shifts (*Md* = 45.00 years).

Research Question #1

To what extent are the variables of age, gender, educational preparation, nursing tenure, work environment, shift worked, and commission of a medication error related to the report of patient harm?

According to the Organizational Accident Causation Model, the variables of age, gender, educational preparation, and nursing tenure constitute latent variables making up the organizational demographic work environment influencers of adverse outcomes which are defined as error resulting in patient harm in this study. The variables of nursing tenure and age failed to meet the assumptions of normality based on K-S test values where the *p*-values were assessed at < 0.01 for both variables. Therefore, Mann-Whitney U tests were performed to assess whether the variables of age and nursing tenure each had an association with error resulting in patient harm (noted as either present or not present). As noted in Table 10, findings revealed no significant association to the presence of patient harm for nursing tenure, however, the Mann Whitney U Test revealed a significant difference in the age of nurses who committed an error resulting in no patient harm (*Md* = 45.00 years, n = 388) and nurses who committed an error resulting in patient harm (*Md* = 48.50, n = 140).

Table 10. Association of Nursing Tenure and Age on the Report of Error Resulting in Patient Harm

Variable	Committed an Error resulting in No Patient Harm Median (Range)	Committed an Error Resulting in Patient Harm Median (Range)	Mann Whitney U *p*-value (Z)
Nursing Tenure (n = 506)	11.0 (0 - 48)	15.0 (0 - 46)	0.147 (-1.451)
Age (n = 528)	45.0 (23 - 79)	48.5 (22 - 72)	0.042* (-2.031)

Note: Due to rounding and missing data, totals may not reflect 100%
*Mann-Whitney U test significant at $p < 0.05$

The remaining organizational work environment variables of gender, educational preparation, shift worked, commission of a medication error, and prior employer discipline were assessed for an association with error resulting in patient harm, either with Chi-square or Fisher's Exact tests. There were no significant differences noted among the independent environmental variables of shift worked, commission of a medication error, positive history of prior employer discipline, or educational preparation. However, a Chi-square test for independence indicated there was a significant association between gender and presence of patient harm, $\chi^2(1, n = 543, p=0.008)$ with female nurses having a higher percentage of errors resulting in patient harm than male nurses. Additionally, there was a statistically significant association between the variable of work environment and error resulting in patient harm, $\chi^2(1, n = 544, p <0.01)$. Specifically, of those nurses who committed error resulting in patient harm (n = 140), there was a significantly higher percentage of that error occurring in hospital

and long-term care settings compared to other settings. Results from the Chi-square analyses are presented in Table 11.

An additional Chi-square test was performed to assess whether there was a significant difference between the two work environment categories, hospital and long-term care. The 'other' category of work environment was omitted, and a 2x2 Fisher's exact test was conducted. Results from the Fisher's Exact test revealed that there was no significant difference in the presence of patient harm between the work environments of hospital and long-term care settings ($p = 0.246$).

Table 11. Organizational Factors by Error Resulting in Patient Harm

Variable	**Committed an Error resulting in No Patient Harm N(%)**	**Committed an Error Resulting in Patient Harm N(%)**	**Chi-square *p* value**
Gender (n = 543)			0.008*
Female	342 (84.9)	131 (93.6)	
Male	61 (15.1)	9 (6.4)	
Total	403 (100.0)	140 (100.0)	
Educational Preparation (n=542)			0.529
LPN – Practical/ Vocational Degree	118 (29.4)	54 (38.6)	
RN – Diploma Degree	18 (4.5)	8 (5.7)	
RN – Associates Degree	208 (51.7)	64 (45.7)	
RN – Baccalaureate, Masters, Doctorate, Advanced degree, non-Nursing, Other	58 (14.4)	14 (10.0)	
Total	402 (100.0)	140 (100.0)	

Variable	Committed an Error resulting in No Patient Harm N(%)	Committed an Error Resulting in Patient Harm N(%)	Chi-square *p* value
Licensure Type			
LPN – Practical/ Vocational Degree	118 (29.4)	54 (38.6)	0.476
RN – Diploma, Associates, Baccalaureate, Masters, Doctorate, Advanced Degree, Other	284 (70.6)	86 (61.4)	
Total	402(100.0)	140 (100.0)	
Work Environment (n = 544)			0.000*
Hospital	117 (29.0)	47 (33.6)	
Long Term Care	116 (28.7)	62 (44.3)	
Other	171 (42.3)	31 (22.1)	
Total	404 (100.0)	140 (100.0)	
Shift Worked (n = 544)			
8 hour	194 (48.0)	66 (47.1)	0.886
10 or 12 hour	168 (41.6)	61 (43.6)	
All others	42 (10.4)	13 (9.3)	
Total	404 (100.0)	140 (100.0)	
Prior Employer Discipline (n =542)			0.951
No	251 (62.4)	87 (62.1)	
Yes	151 (37.6)	53 (37.9)	
Total	402 (100.0)	140 (100.0)	
Commission of a Medication Error (n = 543)			0.165
No	124 (30.8)	52 (37.1)	
Yes	279 (69.2)	88 (62.9)	
Total	403 (100.0)	140 (100.0)	

Note: Percentages may not equal 100% due to rounding and missing values.
Note: Chi-square analyses were run separately for variables with error resulting in patient harm.
*Chi-square significant at $p < 0.05$

Research Question #2

Is there a combination of the variables of age, gender, educational preparation, nursing tenure, work environment, shift worked history of prior employer discipline and commission of a medication error that are predictive of patient harm?

Binary logistic regression was performed to assess the impact of a number of factors on the likelihood that a report of error resulting in patient harm occurred. The model contained eight independent variables (age, gender, nursing tenure, education preparation, shift worked, work environment, commission of a medication error, and history of prior employer discipline). Goodness of fit was assessed using the Hosmer and Lemeshow Test ($p = 0.040$), indicating poor model fit, however the Omnibus Tests of Model Coefficients which provides an overall indication of how well the model performs over and above the results obtained with none of the predictors entered into the model was significant ($p = 0.001$). The Hosmer-Lemeshow test's significant findings could be due to the large sample size of the model which according to Marcin and Romano (2007) is a limitation in using this goodness of fit test.

Multicollinearity was assessed and all variance inflation factors were all less than 10, an indication that multicollinearity was not present (Tabachnick & Fidell, 2013). The full model containing all predictors was statistically significant, $\chi^2(12\ N = 542) = 34.787$, $p = 0.001$, indicating that the model was able to distinguish between errors that resulted in patient harm and errors that did not result in patient harm. The model as a whole explained between 6.7% (Cox and Snell R square) and 9.7% (Nagelkerke R squared) of the variance in error resulting in patient harm, and correctly classified 72.3% of cases.

As shown in Table 12, only two of the independent variables made a unique statistically significant contribution to the model (work environment and gender). These results indicated that the odds of a male nurse committing an error resulting in patient harm were 63.6% lower when compared with female nurses, adjusting for all other factors in the model (OR = 0.364; 95% CI=[0.169, 0.784]), a statistically significant finding (p=0.010). The model revealed that the odds of a nurse committing an error resulting in patient harm while working in 'other' work environments were 58.9% lower when compared to nurses working in the hospital setting, adjusting for all other factors in the model (OR = 0.411; 95% CI=[0.221, 0.765]). This effect was also statistically significant (p=0.005).

Table 12. Multivariable Logistic Regression for Error Resulting in Patient Harm (N = 542)

Variable	B	S.E.	Wald	df	OR	95% CI for OR	*p*-value
Age	0.016	0.013	1.487	1	1.016	[0.990, 1.042]	0.223
Gender							
Female [RC]	-	-	-	-	-	-	-
Male	-1.009	0.391	6.666	1	0.364	[0.169, 0.784]	0.010*
Nursing Tenure	0.001	0.014	0.011	1	1.001	[0.975, 1.029]	0.915
Educational Program							
LPN – Practical/ Vocational Degree	0.351	0.388	0.817	1	1.420	[0.664, 3.040]	0.366
RN – Diploma Degree	0.794	0.600	1.750	1	2.213	[0.682, 7.179]	0.186
RN – Associates Degree	0.288	0.347	0.686	1	1.333	[0.675, 2.634]	0.408
RN – Baccalaureate, Masters, Doctorate, Advanced degree, non-Nursing, Other [RC]	-	-	-	-	-	-	-
Shift Worked							
8 hour [RC]	-	-	-	-	-	-	-
10 or 12 hour	0.152	0.266	0.328	1	1.165	[0.691, 1.962]	0.567
All others	0.110	0.379	0.084	1	1.116	[0.531, 2.344]	0.772
Work Environment							
Hospital [RC]	-	-	-	-	-	-	-
Long Term Care	0.202	0.329	0.378	1	1.224	[0.643, 2.331]	0.539
Other	-0.889	0.317	7.870	1	0.411	[0.221, 0.765]	0.005*
Commission of Medication Error							
No [RC]	-	-	-	-	-	-	-
Yes	0.016	0.226	0.005	1	1.016	[0.652, 1.583]	0.943

Variable	B	S.E.	Wald	df	OR	95% CI for OR	*p*-value
History of Prior Employer Discipline							
No [RC]	-	-	-	-	-	-	-
Yes	0.132	0.220	0.360	1	1.141	[0.742, 1.755]	0.548

[RC] = Reference Category; CI = Confidence Interval; OR = Odds Ratio; *Significant at $p < 0.05$

Research Question #3

Is there a difference in age, gender, educational preparation, nursing tenure, shift worked, presence of prior employer discipline and work environment in those nurses who committed a medication error resulting in patient harm and those nurses that committed a medication error resulting in no patient harm?

Binary logistic regression was performed to assess the impact of the stated factors on the likelihood that a report of a medication error resulting in patient harm occurred. A new dichotomous dependent variable was created to assess this research question (medication error with patient harm vs. medication error without patient harm) where N = 335. The model contained seven independent variables (age, gender, nursing tenure, education preparation, shift worked, work environment and history of prior employer discipline). Goodness of fit was assessed using the Hosmer and Lemeshow Test ($p = 0.561$), indicating acceptable model fit (Polit & Beck, 2012). The Omnibus Tests of Model Coefficients was also significant ($p < 0.001$) indicating overall good model fit (Pallant, 2013).

Multicollinearity was assessed and all variance inflation factors were all less than 10, an indication that multicollinearity was not present (Tabachnick & Fidell, 2013). The

model containing all predictors was statistically significant, χ^2(11 N = 335) =37.963, $p <$ 0.001, indicating that the model was able to distinguish between medication errors that resulted in patient harm and medication errors that did not result in patient harm. The model as a whole explained between 10.7% (Cox and Snell R square) and 15.8% (Nagelkerke R squared) of the variance of medication errors resulting in patient harm and correctly classified 74.9% of cases.

Table 13 shows that the independent variables of work environment and gender were statistically significant contributors to this model. The results revealed that the odds of a male nurse committing a medication error resulting in patient harm were 62.9% lower when compared with female nurses, adjusting for all other factors in the model (OR = 0.371; 95% CI=[0.150, 0.918]). This was a statistically significant finding (p = 0.032). Additionally, the odds of a licensed nurse committing a medication error resulting in patient harm while working in 'other' work environments were 63.6% lower when compared to licensed nurses working in the hospital setting, adjusting for all other factors in the model (OR = 0.364; 95% CI=[0.168, 0.791]). This effect was also statistically significant (p = 0.011).

Table 13. Multivariable Logistic Regression for Medication Error Resulting in Patient Harm (N = 335)

Variable	B	S.E.	Wald	df	OR	95% CI for OR	*p*-value
Age	0.023	0.017	1.745	1	1.023	[0.989, 1.058]	0.186
Gender							
Female [RC]	-	-	-	-	-	-	-
Male	-0.991	0.462	4.605	1	0.371	[0.150, 0.918]	0.032*
Nursing Tenure	0.007	0.019	0.133	1	1.007	[0.971, 1.044]	0.715
Educational Preparation							
LPN – Practical/ Vocational Degree	0.386	0.492	0.616	1	1.471	[0.561, 3.858]	0.433
RN – Diploma Degree	0.639	0.774	0.682	1	1.894	[0.416, 8.629]	0.409
RN – Associates Degree	-0.061	0.439	0.019	1	0.941	[0.398, 2.225]	0.890
RN – Baccalaureate, Masters, Doctorate, Advanced degree, non-Nursing, Other [RC]	-	-	-	-	-	-	-
Shift Worked							
8 hour [RC]	-	-	-	-	-	-	-
10 or 12 hour	0.458	0.346	1.744	1	1.580	[0.801, 3.116]	0.187
All others	0.050	0.498	0.010	1	1.051	[0.396, 2.791]	0.921
Work Environment							
Hospital [RC]	-	-	-	-	-	-	-
Long Term Care	0.463	0.431	1.156	1	1.589	[0.683, 3.694]	0.282
Other	-1.010	0.396	6.511	1	0.364	[0.168, 0.791]	0.011*

Variable	B	S.E.	Wald	df	OR	95% CI for OR	*p*-value
Prior Employer Discipline							
No [RC]	-	-	-	-	-	-	-
Yes	-0.150	0.285	0.279	1	0.861	[0.493, 1.503]	0.861

[RC] = Reference Category; CI = Confidence Interval; OR = Odds Ratio; *Significant at $p < 0.05$

To assess whether differences existed in the latent independent factors of gender, educational preparation, work environment, shift worked, and a positive history of prior employer discipline between those licensed nurses that committed a medication error resulting in patient harm and those licensed nurses that committed a medication that did not result in patient harm, Chi-square or Fisher's Exact tests were performed.

There were no significant differences noted among the independent variables of shift worked, positive history of prior employer discipline, or educational preparation. However, a Chi-square test for independence indicated there was a significant association between the variable of work environment and commission of a medication error resulting in patient harm, $\chi^2(1, n = 366, p < 0.001)$. Specifically, of those licensed nurses who committed a medication error resulting in patient harm (n = 88), there was a significantly higher percentage of that error occurring in hospital and long-term care settings compared to other settings. It is notable that while not statistically significant, there may be an association between gender and commission of a medication resulting in patient harm, $\chi^2(1, n = 366, p=0.053)$ with female nurses having a higher percentage of medication errors resulting in patient harm than male nurses. Results from the Chi-square analyses are presented in Table 14.

Table 14. Organizational Factors by Medication Error Resulting in Patient Harm

Variable	Committed a Medication error resulting in No patient harm N(%)	Committed a Medication error resulting in patient harm N(%)	Chi-square *p*-value
Gender (n = 365)			0.053
Female	232 (74.1)	45 (86.5)	
Male	81 (25.9)	7 (13.5)	
Total	313 (100.0)	52 (100.0)	
Educational Preparation (n=366)			0.376
LPN – Practical/ Vocational Degree	95 (34.2)	38 (43.2)	
RN – Diploma Degree	9 (3.2)	4 (4.5)	
RN – Associates Degree	132 (47.5)	36 (40.9)	
RN – Baccalaureate, Masters, Doctorate, Advanced degree, non-Nursing, Other	42 (15.1)	10 (11.4)	
Total	278 (100.0)	88 (100.0)	
Work Environment (n = 366)			0.000*
Hospital	72 (25.9)	27 (30.7)	
Long Term Care	63 (22.7)	39 (44.3)	
Other	143 (51.4)	22 (25.0)	
Total	278 (100.0)	88 (100.0)	
Shift Worked (n = 366)			0.481
8 hour	137 (49.3)	43 (48.9)	
10 or 12 hour	107 (38.5)	38 (43.2)	
All others	34 (12.2)	7 (8.0)	
Total	278 (100.0)	88 (100.0)	

Variable	Committed a Medication error resulting in No patient harm N(%)	Committed a Medication error resulting in patient harm N(%)	Chi-square *p*-value
Prior Employer Discipline (n =365)			0.296
No	193 (69.7)	56 (63.6)	
Yes	84 (30.3)	32 (36.4)	
Total	277 (100.0)	88 (100.0)	

Note: Percentages may not equal 100% due to rounding and missing values.
Note: Chi-square analyses were run separately for variables with error resulting in patient harm.
*Chi-square significant at $p < 0.05$

Mann-Whitney U tests were performed to assess whether the variables of age and nursing tenure each had an association with commission of a medication error resulting in patient harm. Table 15 shows that the findings revealed no significant association to the commission of a medication error resulting in patient harm for nursing tenure, however, the Mann-Whitney U Test revealed a significant difference in the age of nurses who committed a medication error resulting in no patient harm (*Md* = 44.00 years, n = 266) and nurses who committed a medication error resulting in patient harm (*Md* = 47.50 years, n = 88). Results indicate that those nurses who committed a medication error resulting in patient harm had a statistically significantly higher median age than nurses who committed a medication error that did not result in patient harm.

Table 15. Association of Nursing Tenure and Age on Report of a Medication Error Resulting in Patient Harm

Variable	Committed a Medication Error resulting in No Patient Harm Median (Range)	Committed a Medication Error Resulting in Patient Harm Median (Range)	Mann Whitney U *p*-value (Z)
Nursing Tenure (n = 337)	11.0 (0 - 48)	16.0 (1 - 46)	0.136 (-1.489)
Age (n = 354)	44.0 (24 - 75)	47.5 (23 - 72)	0.039* (-2.059)

Note: Due to rounding and missing data, totals may not reflect 100%
*Mann-Whitney U test significant at $p < 0.05$

Recognizing that age was significantly associated with both error resulting in patient harm as well as commission of a medication error resulting in patient harm, additional Chi-square tests were performed to assess associations between older nurses, defined as 50 years of age and older and those nurses less than 50 years of age, with the variables of error resulting in patient harm and commission of a medication error resulting in patient harm. Results indicated there was no significant association between nurses aged 50 years and older and commission of a medication error resulting in patient harm (p=0.124). However, a significant association was revealed between nurses age 50 years and older and error resulting in patient harm (p= 0.034). Results are presented in Table 16.

Table 16. Association of Age (< 50 and ≥ 50 years) with Error and Medication Error Resulting in Harm

Variable	**Age <50 N(%)**	**Age ≥ 50 N(%)**	**Chi-square *p*-value**
Committed a Medication Error resulting in **No** Patient Harm (n = 227)	177 (78.0)	89 (70.0)	
Committed a Medication Error Resulting in Patient Harm (n = 127)	50 (22.0)	38 (30.0)	0.124
Committed an Error Resulting in **No** Patient Harm (n = 319)	245 (76.8)	141 (68.1)	
Committed an Error Resulting in Patient Harm (n = 207)	74 (23.2)	66 (31.9)	0.034* [a] FET

Note: Percentages may not equal 100% due to rounding and missing values.
Note: Chi-square analyses were run separately for variables with error resulting in patient harm.
*Chi-square significant at $p < 0.05$
[a] = FET – Fisher's Exact Test

To further explore the variable of age and the impact age may have on error resulting in patient harm, a binary logistic regression model was performed. The regression model included one independent variable (50 years of age and older versus those nurses less than 50 years of age) and the dependent variable of error resulting in patient harm where N = 526. The model was statistically significant, χ^2(1 N = 526) =4.796, p = 0.029. This model explained between only 0.9% (Cox and Snell R square) and 1.3% (Nagelkerke R squared) of the variance of errors resulting in patient harm and correctly classified 73.4% of cases.

Findings from the logistic regression model show that the independent variable of age ≥ 50 or < 50 years was a significant predictor of error resulting in patient harm. The odds ratio of 0.645 for age ≥ 50 or < 50 years was less than 1, indicating that the odds of a licensed nurse less than 50 years of age committing error resulting in patient harm were 35.5% lower when compared with nurses ≥ 50 years of age (OR = 0.645; 95% CI=[0.436, 0.954]). This was a statistically significant finding (p = 0.028).

Chapter Summary

A sample of 544 cases was examined in this study revealing that the mean age of the licensed nurses of the sample was 45 years. The majority of the sample were female, US educated, English speaking, registered nurses educated through associates degree programs. The majority of the sampled nurses worked 10 or 12 hour shifts in a variety of work settings but primarily in 'other' settings such as homecare and ambulatory care settings. Error groups were determined by the presence of patient harm or the presence of a medication with patient harm. Differences in continuous latent variables (age and

nursing tenure) and the outcome variables of error resulting in patient harm or commission of a medication error resulting in patient harm were assessed through Mann-Whitney U tests. Chi-square tests were performed to determine differences in independent variables by presence of patient harm or commission of a medication error resulting in patient harm.

Error resulting in patient harm and commission of a medication error resulting in patient harm were significantly associated with the variables of age and work environment. Specifically, working in the hospital setting and increasing age were found to be significantly associated with error resulting in patient harm and commission of a medication error resulting in patient harm. Gender and work environment were found to be significant predictors of error resulting in patient harm with male nurses have lower odds of committing error resulting in patient harm than female nurses. Nurses who had worked in 'other' settings had lower odds of committing error resulting in patient harm when compared with nurses working in the hospital setting. Additionally, nurses who had worked in 'other' work environments had lower odds of committing a medication error resulting in patient harm when compared with those nurses who worked in the hospital setting. Bivariate analyses revealed that age and nursing tenure were correlated. There was also an association between the age of the licensed nurse and the shift the nurse worked. There was a statistically significant difference in the median ages of nurses who worked 8 hour shifts and nurses who worked 10 or 12 hours shifts. Additional Chi-square analysis revealed that nurses ≥ 50 years of age were found to be significantly associated

with commission of a medication error that results in patient harm and a logistic regression model revealed that nurses ≥ 50 years of age had higher odds of committing error that resulted in patient harm.

CHAPTER V

DISCUSSION

This chapter consists of six sections. The first section presents a synopsis of the study, including the purpose, research questions, methodology and summation of findings. The subsequent sections review study findings for each research questions, discusses the limitations of the findings and conclusions. The final section offers recommendations for nursing practice, regulation and research. Limitations for generalizability of findings are also considered.

Study Synopsis

The purpose of this descriptive, correlational study was to examine demographic and environmental factors of licensed nurses who had committed an error resulting in a violation of the North Carolina Nursing Practice Act to determine the impact on error resulting in patient harm. The Organizational Accident Causation Model (OAM) was utilized as the framework to guide the study and examine the phenomenon of interest, error resulting in patient harm. The Taxonomy of Error Root Cause Analysis and Practice-Responsibility (TERCAP) database held information on nursing error committed by licensed nurses practicing within North Carolina which identified factors contributing to the errors including individual demographics (age, gender, educational preparation, and nursing tenure) and environmental factors including shift worked, work environment, and commission of a medication error.

Three research questions were examined as part of this study. The questions are as follows:

RQ1: To what extent are the variables of age, gender, educational preparation, nursing tenure, work environment, shift worked and patient error type (specifically medication error) related to the report of patient harm?

RQ2: Is there a combination of the variables of age, gender, educational preparation, nursing tenure, work environment, shift worked and patient error type (specifically medication error) that are predictive of patient harm?

RQ3: Is there a difference in age, gender, educational preparation, nursing tenure, shift worked, and work environment in those nurses who committed a medication error resulting in patient harm and those that committed a medication error resulting in no patient harm?

A repository census of all cases (N = 544) entered into the TERCAP database between April 1, 2011 to July 31, 2015 were examined as part of the study. Data analyses included parametric and non-parametric statistics, logistic regression analysis and ANOVA. Missing data were assessed and when found to be randomly dispersed and accounted for less than 5% of the entire sample, no additional intervention was required. When missing data were found to account for more than 5% of the sample, additional analyses were performed to determine the extent of the influence. There was no correlation between any of the independent variables and commission of a medication error or a documentation error. There was a statistically significant relationship between the age of the licensed nurse and the nursing tenure of the licensed nurse. This would be

expected given many students enter into collegiate nursing education programs during their college aged years and are anticipated to continue working in their chosen career, thus extending their nursing tenure as a licensed nurse along with their respective ages. While more second-career students are earning degrees in nursing and are becoming licensed to practice either as an LPN or RN, these non-traditional students still represent the minority of individuals seeking a career into the nursing profession (American Association of Colleges of Nursing [AACN], 2014).

Additional bivariate correlational analysis also revealed a statistically significant relationship between age of the nurse and the shift worked (8 hours, 10 or 12 hours, and other). ANOVA was used to assess this relationship further. Findings revealed there was a significant difference in age for those licensed nurses who worked 8 hour shifts (M=46.78 years) and those who worked 10 or 12 hour shifts (M=43.79 years), p=0.014. While causality is not assumed, this finding is suggestive that older nurses may seek nursing positions that do not require extended shift work.

Sample Descriptives

The sample of licensed nurses in this study was comparable with respect to several demographic variables including being educated in the U.S., English speaking as their primary language, and licensure as an RN, as reported in prior research studies on nursing error conducted in the US (Kalish, Tschannen, & Lee, 2012; Kalisch, Tschannen, Lee & Friese, 2014; Zhong & Thomas, 2012).

Sample demographics revealed the licensed nurses captured in the TERCAP database most often had limited experience working on in their respective units. The results revealed that approximately 30% of the sample had only worked on their respective units between one and eleven months at the time of the error incident. This finding suggests that the licensed nurses had limited experience in their respective work environments at the time of the error incident. Irrespective of the nurse's tenure at the time of the error incident, inexperience in a role may be akin to the novice or advanced beginner stages of Benner's Novice to Expert Theory (1984). In such circumstances, the nurse is unable to use discretionary judgment and the nurse may demonstrate only marginal acceptable performance as competence has not yet been achieved (Benner, 1984).

The study results also revealed that out of 544 cases, nearly 70% of licensed nurses were terminated from employment after the error incident occurred while 15.6% were retained by the employer. Unfortunately, this finding is consistent with the traditional "blame and shame" model of discipline often associated with healthcare error (Hughes, 2008; Reeder, 2001). This punitive culture leaves clinicians in fear of retribution and discourages them to report or talk about the error incident (Berlinger, 2008). This "code of silence" persists despite recognition that information from errors can improve future patient outcomes (Hughes, 2008). Hershey (2015) suggests that a safety culture empowers staff to report errors and fosters an environment of trust. National healthcare accreditors like the Joint Commission have recognized the need to shift the culture of healthcare organizations to a culture of safety, like Just Culture where

errors are more likely to be recognized as having origin in systems related processes than being solely attributable to the nurse caring for the patient (Elsevier, 2011; The Joint Commission Center for Transforming Healthcare, 2014).

Organizational Factors

A discussion of the study findings follows including a review of the sample demographics which comprise the organizational variables with respect to error resulting in patient harm as noted in Reason's Organizational Accident Causation Model (age, gender, educational preparation, and nursing tenure).

Age

The age of the licensed nurses in this study averaged 45.61 years which is consistent with age of nurses reported in the 2015 National Workforce Survey of Registered Nurses. This report highlighted that the average age of a registered nurse in the US was 44.6 years and the average age of a licensed practical nurse was 47.8 years (Budden, Moulton, Harper, Brunell, & Smiley, 2016). These mean age values represent a decrease in the average age of the licensed nurse when compared with the 2013 Nursing Workforce Survey which reported the average age for the registered nurse was 50 years of age (Budden, Zhong, Moulton, & Cimiotti, 2013).

Bivariate correlations revealed a statistically significant association between the age of the licensed nurse and nursing tenure as previously addressed. While there were no statistically significant associations between the age of the licensed nurse and commission of a medication error, this study revealed a statistically significant association between the age of the licensed nurse and the presence of patient harm

resulting from an error incident. As noted in previous studies, the presence of harm has been noted to be a factor in the assessment of quantifiable medical error (Gandhi et al., 2003; Hofer, Kerr, & Hayward, 2000; Leape, 1997; Thomsen, Winterstein, Søndergaard, Haugbølle & Melander; 2007; West et al., 2008; Wilson, Runciman, Gibberd, Harrison, Newby, & Hamilton, 1995). Given the nurse's duty for nonmaleficence, an act that resulted in any patient harm (as explicated in Chapter 3) was deemed a positive finding.

This study revealed that 25.7% of the error incidents resulted in some type of patient harm. This finding is in line with the retrospective study conducted by the U.S. Office of the Inspector General (2012) which found that an estimated 27% of Medicare beneficiaries hospitalized in October 2008 experienced harm from medical care classified as either serious adverse events or temporary harm events. Present study findings also showed that the majority of error incidents resulting in patient harm constituted negligible events where the error occurred caused a minor negative change in the patient's condition. It is worth noting that error incidents resulting in patient death constituted a higher proportion of the total number of patient harm error incidents than error incidents resulting in significant harm, which involved serious physical or psychological injury including loss of function or limb. While there are no published studies using TERCAP data to examine patient harm in North Carolina, this study's findings suggest that error incidents resulting in patient harm tend to fall in the extremes of the patient harm spectrum (i.e. either minor harm or patient death). This is consistent with findings from

the Texas Board of Nursing pilot study conducted using the TERCAP instrument as the vehicle for a standardized error classification system for use by facility nursing peer review committees (Thomas, Tietze, Benton, & Benbow, 2014).

This study's findings revealed that age is a predictor of both error resulting in patient harm and medication error resulting in patient harm. More specifically, the findings revealed that nurses aged less than 50 years had lower odds of committing error resulting in patient harm than their colleagues aged 50 years and older. There are gaps in the literature with respect to the older nurse and commission of error resulting in patient harm, however according to established research, work productivity does not decline with advancing age barring physical illness (Letvak, 2002; Letvak, Ruhm & Gupta, 2013). This study's findings may be more indicative of the need for greater focus on the needs of older nurses practicing in direct patient care roles rather than a slight on the aging nursing workforce in direct care roles. The phenomenon of an aging nursing workforce has been observed across several countries and researchers argue that nurse managers should evaluate the assignments of older nurses to determine how to most effectively utilize their expertise giving due attention to the physician and mental demands of highly complex patient care assignments (Letvak, Ruhm, & Gupta, 2013; North, Leung, & Lee, 2014; Story, Cheater, Ford & Leese, 2009).

Gender

The nursing profession has been and continues to be predominately female (Meadus & Twomey, 2011). Sample demographics from this study support this assertion noting that 87.1% of the sampled nurses were females. According to the Health

Resources and Services Administration (2013), 9.1% of the nursing workforce was made up of males. According to the U.S. Census Bureau, in 2013, men comprised 9.6% of all RNs (Census Bureau's Industry and Occupation Statistics, 2013). While this study sample comprised nurses that held either a North Carolina license or a multistate compact license, according to the North Carolina Board of Nursing, men comprise approximately 8.0% of actively licensed nurses holding a North Carolina license (North Carolina Board of Nursing [NCBON], 2016b). This finding is notable because male nurses comprised 12.9% of the sample, a larger percentage than noted in either the state or national data.

The percentage of male nurses is noteworthy because this study found that gender was statistically associated with errors resulting in patient harm. This finding suggests that there is a statistically significant difference in the distribution of female nurses committing error resulting in patient harm and male licensed nurses committing errors resulting in patient harm. Findings from this study indicate male nurses have lower odds of committing error that results in patient harm. While there is a gap in the literature specifically comparing nursing error incidence by gender, it is important to place this finding in context of the literature which finds that male nurses are overrepresented in patient safety identification systems examining adverse events for nurses (Evangelista & Sims-Giddens, 2008; Kenward, 2008; NCSBN, 2015; Zhong & Kenward, 2009; Zhong, Kenward, Sheets, Doherty, & Gross, 2009). The sample for this study was comprised of nearly 13% males, far more than the state specific or national proportions, a finding that male nurses were overrepresented in this study, consistent with other studies examining error incidents.

Female gender was determined to be a significant predictor of error resulting in patient harm and medication error resulting in patient harm. This study found that male nurses were over represented in this sample of TERCAP data, however, male over representation did not equate to the commission of more error that harms patients. A plausible alternative explanation for male over representation is that male nurses may be targeted because of their minority status in the nursing profession and therefore they may be more susceptible to scrutiny of their nursing practice (MacWilliams, Schmidt, & Bleich, 2013). Rather, the findings from this study suggest that the odds of errors committed by male nurses resulting in harm are lower when compared to female nurses, adjusting for all other factors in the model. This finding is clinically significant because it suggests that less harm is attributed to interventions rendered by male nurses when compared to female nurses. There is a gap in the literature specifically analyzing nursing error rates by gender, however, an older study conducted on discipline rates of Kentucky nurses found that male nurses committed violations at a rate 3 times that of females (Chappell et al., 1999). More recently, Evangelista and Sims-Giddens (2008) found in their study of gender differences in the discipline of Missouri nurses that females committed eight infractions not committed by male nurses and outnumbered males by a ratio of 2:1 for 3 of the 28 infractions studied. These findings are more consistent with the findings of the present study.

Researchers have suggested that the nursing profession needs to make greater strides in attracting males to the profession, particularly when faced with a nursing shortage (National League for Nursing, 2008; Barrett-Landau & Henle, 2014) in part to

combat the nursing shortage, increase diversity and expand nursing beyond a single sex profession. This study's findings suggest that male nurses may offer insight into error mitigation not previously recognized and warrant further exploration.

Nursing Tenure

Nursing tenure, defined as the years consecutively licensed as a nurse, was not statistically associated with patient harm or commission of a medication error. The sample revealed that average number of years licensed for both LPNs and RNs was 14.48 years. This finding is consistent with Zhong and Thomas (2012) who found the average number of years licensed by a nurse in a TERCAP study was 14.3 years. This variable was not found to be predictive of error resulting in patient harm. According to Hill (2010), experiential (practice) knowledge is necessary for the licensed nurse to engage in safer levels of practice. Hill (2010) states "experiential knowledge is characterized by skillful execution of nursing procedures as well as the ability to perform complex, multidisciplinary assessments and to recognize early signs of deterioration in the condition of a patient" (Abstract, Paragraph 1). As such the experiential knowledge gained through length of time in active nursing practice enhances the nurse's practice, enabling her to provide a higher quality of care. This sentiment is shared with researchers who have argued that having more experienced nurses enhances patient safety (Aiken, Havens, & Sloane, 2009; Dunton, Gajewski, Klaus & Pierson, 2007; Hill, 2010).

Findings from this study were not supportive of the general ideas that novice nurses commit more errors resulting in harm to patients (Berkow & Virkstis, 2008; Kenward & Zhong, 2006; Saintsing, Gibson, & Pennington, 2011). Nor were the findings suggestive that more tenured nurses commit fewer errors resulting in harm. Rather, the study found no association between nursing tenure and commission of error resulting in patient harm prompting the need for further inquiry into these variables.

Burritt and Steckel (2009) argued that the increasing complexities found in patient care and the changes in patient acuity require the skills developed and honed by expert nurses who have advanced clinical judgment and reasoning abilities. These authors also stated that this expert knowledge is only achieved through time (approximately 5 years) and the experiences gained through exposure in the practice environment. This study found that a large proportion (30%) of licensed nurses had less than one year's experience in their units prior to the error incident. This finding supports the notion that the "clinical abilities gap" as identified by Burritt and Steckel (2009), is present in a large number of error incidents resulting in patient harm.

It is noted, however, the present study's findings also revealed that 24% of errors were committed by nurses with at least five years of experience on their respective units at the time of the error incidents. According to Burritt and Steckel (2009) and Benner (1984), nurses with more years of experience should be better equipped to implement the nursing process and intervene with advanced skills that result in fewer error incidents. According to Reid and Catchpole (2011), healthcare professionals that believe the goal of patient safety endeavors should focus on reducing preventable error instead of

eliminating error altogether may perpetuate poor patient outcomes particularly when clinicians have learned over time that they may face reprisal for voicing concerns about broken processes that endanger patients. Experienced nurses may have acquired this learned behavior. They may have also become immune to recognizing that 'minor' process deviations can become significant factors in increasing the potential for catastrophic error (Reid & Catchpole, 2011)

Educational Preparation

The sample demographics regarding educational preparation revealed that 43% of the licensed nurses captured in the sample, were prepared in an associate's degree program and were licensed as registered nurses. This study found that 38.1% of the sampled licensed nurses were educated through practical/ vocational/ diploma programs for the licensed practical nurse. According to the NCBON (2016b), out of a total of 121,172 licensed nurses, 14.5% of nurses were licensed as practical nurses in the state, with the majority having been educated either in a vocational/ practical program or diploma program. The discrepancy in these findings may be due in part to the study sample being comprised of North Carolina licensees as well as actively licensed nurses working in the state of North Carolina under their Nurse Licensure Compact privilege. These findings are also consistent with findings from previous studies that stated that LPNs (and male nurses) are overrepresented in patient safety identification systems examining adverse events (Kenward, 2008; NCSBN, 2015; Zhong & Kenward, 2009; Zhong, Kenward, Sheets, Doherty, & Gross, 2009).

According to the U.S. Nursing Workforce Trends in Supply and Education Report (2013), LPNs made up approximately 19.8% of the active nursing workforce which totals approximately 3.5 million individuals which is in stark contrast to the 38.1% of LPNs sampled for this study from the TERCAP database. This report also stated that about 55% percent of the RN workforce holds a bachelor's or higher degree, although an associate's degree in nursing was the first nursing degree for many of these nurses (U.S. Department of Health and Human Services, 2013). The present study found that only 13.2 % of the sample had achieved a baccalaureate degree or higher. These findings are consistent with research from Hudson and Droppers V (2011), who argued that nurses with a higher level of education and/or licensure tend to commit fewer violations and are less frequently disciplined than their counterparts.

According to the Auerbach, Buerhaus and Staiger (2015), approximately 40% of the nation's licensed nurses hold an associate's degree as their highest level of education, however, employers increasingly prefer the baccalaureate degree. North Carolina specific data available through self-reported information from the NCBON (2016b) state that out of a total of 103,775 registered nurses holding North Carolina licenses, 40,812 (39.3%) hold an associate's degree in nursing, 36,005 (36.7%) hold a baccalaureate degree in nursing and 5, 932 (5.7%) hold a diploma in nursing.

Like nursing tenure, no association was found to exist between the educational preparation of the licensed nurse and commission of an error resulting in patient harm. The categories of educational preparation are also reflective of licensure level (LPN and

RN), therefore, the findings were also suggestive that there is no statistically significant association between licensure level and error resulting in patient harm. This finding is consistent with a previous study that reported that employing more baccalaureate prepared nurses in acute care hospitals had no significant impact on the incidence of medication errors or other nurse sensitive indicators (Blegen, Vaughn & Goode, 2001).

Conditions of the Work Environment

The Organization Accident Causation Model suggests that adverse events (i.e. errors resulting in patient harm) are attributable to latent and active failures. Latent failures may be the conditions of the work environment present at the time of the adverse event. The latent work environment factors examined in this study were shift worked, work environment, and prior employer discipline with respect to their influence on error resulting in patient harm.

Shift Worked

The majority of nurses (47.8%) in this sample worked 8-hour shifts. Those nurses working 10 or 12 hour shifts accounted for a large proportion (42.9%) of the sample as well. These proportions are aligned with current trends in the profession where more nurses working in hospital environments are working extended shifts of 10 or more hours (Stimpfel & Aiken, 2012; Townsend, 2013). However, given the majority of the nurses sampled worked in 'other' work environments, these work settings may be more conductive to 8-hour shifts with less opportunity to work extended shifts.

The length of the shift worked by licensed nurses and other workers that provide service on a 24-hour basis have been the subject of study as it relates to adverse physiological and psychological effects including fatigue and sleep disorders (Geiger-Brown et al., 2012) health problems (Eanes, 2015; Knoll, 2013), diminished performance at work and errors (Rogers, Hwang, Scott, Aiken, & Dinges, 2004; Eanes, 2015), and job dissatisfaction (Stimpfel, Sloane & Aiken, 2012). This study, however found that shift-worked (8 hour, 10 or 12 hour, and 'other') was not found to be predictive of or even associated with error resulting in patient harm. This finding is consistent with research stating that shift work by itself has not been found to be a risk factor for nurse's health or organizational outcomes including errors (Admi, Tzishinsky, Epstein, Herer, & Lavie, 2008).

Work Environment

Sample demographics from this study showed that the majority of licensed nurses worked in the category termed "other" for purposes of this study (refer to Table 6, Chapter 4). The U.S. Bureau of Labor Statistics (2013) has stated that the majority of licensed nurses (particularly registered nurses) work in acute care health systems and the majority of licensed practical nurses work in long-term care settings. This report also stated the second largest proportion of LPNs work in homecare settings which were included in the 'other' category for work environment. The sample demographic information from the study varies from data obtained by the North Carolina Board of Nursing for North Carolina licensees and as reported by the U.S. Bureau of Labor Statistics. According to self-reported data provided by 121,172 nurses holding North

Carolina licenses, the majority, accounting for 58,152 (48%) of RNs and LPNs reported working in the hospital setting, 12,381 (10.2%) reported working in nursing homes, extended care settings or assisted living facilities, and a large proportion 50,639 (41.7%) reported working in ambulatory care settings, academic settings, community health, correctional facilities, home health/ Hospice, insurance claims/ benefits, mental health facilities, occupational health, policy/ planning/ regulation, private duty, public health, school health services, owned their own practice or identified themselves as working in an 'other' category (NCBON, 2016b). It is noted the NCBON data are fairly consistent with national workforce trends. The majority of RNs (54.7%) reported working in the hospital setting while the majority of LPNs (39.8%) reported working in nursing homes, extended care facilities or assisted living facilities.

Findings from the present study revealed a statistically significant association between work environment and error resulting in patient harm. Specifically, of those licensed nurses who committed error resulting in patient harm, there was a significantly higher percentage of that error occurring in hospital and long-term care settings compared to other settings. Findings revealed that the largest proportion of error resulting in patient harm occurred in the long-term care settings although there was not a statistically significant difference between the hospital and long-term care setting. Notably, the largest proportion (43.2%) of nursing error resulting in no patient harm occurred in 'other' work environments. This is consistent with research stating that medication errors occur in all settings (Wittich, Burkle & Lanier, 2014) including ambulatory care (Brown, Frost, Ko, & Woosley, 2006). As such, this study's findings are indicative that error

incidents in ambulatory care, homecare, medical offices, and residential behavioral health settings may be underestimated or not fully explored, a finding also noted by the Agency on Healthcare Research and Quality (2015).

When assessing the predictive value of each of the independent variables, work environment was found to be a significant predictor of error resulting in patient harm. The findings revealed that the odds of a nurse committing an error resulting in patient harm while working in 'other' work environments were 58.9% lower when compared to licensed nurses working in the hospital setting, adjusting for all other factors. This finding is significant given that the majority of nursing professionals work in hospital settings and as noted previously the largest proportion of error occurs in 'other' work settings, yet those errors do not equate to patient harm. Likewise, the hospital setting had fewer error incidents, however, a significant number of those resulted in some type of patient harm. Differences noted between the work environments groups may be explained by differences in the acuity levels of patients among the three work environments. While there is limited information about the relationship between acuity and patient safety, the acuity levels of patients in acute care settings (hospitals) have been increasing and increase acuity has been shown to be associated with adult mortality (Jennings, 2008).

Similarly, the study findings revealed that work environment was also predictive of commission of a medication error resulting in patient harm. Findings from the present study are consistent with studies that argue that medication errors that occur in hospital settings remain a significant issue for healthcare providers (Keers, Williams, Cooke, &

Ashcroft, 2013) and adverse events associated with medication are chief causes of harm for hospitalized patients (de Vries, Ramrattan, Smorenburg, Gouma, & Boermeester, 2008).

Prior Employer Discipline

It is often said that the best predictor of future behavior is past behavior. Therefore, reviewing past errors committed by licensed nurses was considered a possible predictor of future error resulting in patient harm. This study found that while the majority of licensed nurses sampled had not been previously disciplined by their employer, a fairly large portion, 37.5%, had received prior discipline by their employers. This percentage falls substantially short of the 60% of licensed nurses found to have positive employer discipline histories in the TERCAP study conducted by Zhong and Thomas (2012). The present study found no association between a history of prior employer discipline on the part of the licensed nurse and error resulting in patient harm or medication error resulting in patient harm. Prior history of employer discipline was not predictive of error resulting in patient harm either. The findings are aligned with those of Zhong and Thomas (2012) that found that a high percentage of nurses who had a discipline history with their employer committed a practice breakdown, however, an association between prior employer discipline was not established. These same researchers did argue, however, that supervisors of newly hired nurses should be aware of a negative employer history so precautions could be taken to prevent patient harm. Such a statement may be an assertion on the part of the researchers that while causation may not be determined, prudent leaders would heed the evidence that an association exists.

Active Failure – Medication Errors

The active factor examined in this study, using the Organizational Accident Causation Model was commission of a medication error. According to Miller, Haddad and Phillips (2016), nurses spend 40% of their time administering medications and Treiber and Jones (2010) stated nurses also make the majority of medication administration errors despite the numerous safeguards and defenses put into place to prevent them. The present study found that two thirds of those nurses sampled (67.6%) committed a medication error and of those, 88 (24.0%) committed a medication error resulting in some type of patient harm. These findings align with results from an analysis of the Pennsylvania Patient Safety Reporting System (PA-PSRS) which showed that medication errors accounted for 62.1% (N=1601) of errors reported through the PA-PSRS between years 2004 and 2008 (Dubeck, 2014). Dubeck found, however, that only 2.3% of reported events resulted in serious injury, with only four instances of patient death (2014) which are lower proportions than those found in the present study.

This study's findings did not indicate that an association exists between commission of a medication error and error resulting in patient harm. Findings also revealed that commission of a medication error was not predictive of error resulting in patient harm. These findings are inconsistent with prior research noting an association between medication errors and patient morbidity and mortality (Agency on Healthcare Research and Quality, 2015; Kale, Keohane, Maviglia, Gandhi, Poon & 2012; Thompson-Moore & Liebl, 2012). A plausible explanation for why a relationship was

not determined may be that this study did not discern between various medication errors (i.e. dosing errors, medication omissions, delay in administration) some of which may have had less of an influence on patient outcomes.

This study also examined differences in the latent factors of shift worked, work environment, demographic characteristics of gender, age, educational preparation, nursing tenure and prior employer discipline as they relate to commission of a medication error that either did or did not result in patient harm. Findings revealed that there were no significant associations found among the variables of shift worked, educational preparation, nursing tenure or prior employer discipline and commission of a medication error resulting in patient harm. However, findings revealed that the work environment and the nurse's age were significantly associated with commission of a medication error resulting in patient harm as discussed previously. It is also noted that the factor of gender, while not statistically significant, showed a clinically significant association with commission of a medication error resulting in patient harm. Similar to the prior study findings indicating that gender was associated with error resulting in patient harm and predictive of error resulting in patient harm, the results revealed that gender is an important factor for continued investigation as it relates to commission of a medication error resulting in patient harm.

Conclusions

This sample of licensed nurses reflects the licensed nurses employed in North Carolina and the United States. Licensed nurses in this sample, generally were female educated at the associate degree level, had been employed for a relatively short period

prior to the error incident, most often worked 8-hour shifts in 'other work settings' and the errors committed most often did not result in patient harm. New knowledge was found in this study, to identify an association between the nurse's age and commission of error resulting in patient harm. Gender was found to be associated with error resulting in patient harm. This finding was assessed despite an over-representation of males in the study. Additionally, the work environment of the licensed nurse was found to be associated with patient harm. A higher percentage of error resulting in patient harm occurred in the hospital and long-term care settings when compared with 'other' work settings. This finding is consistent with literature on error incidence in hospital and long-term care settings (James, 2013; Szczepura, Wild & Nelson, 2011; The Office of the Inspector General, 2010).

This study not only examined independent associations between factors and error resulting in patient harm, but the study also assessed predictive factors of error resulting in patient harm. While the majority of factors were not significant predictors of error resulting in patient harm, the variables of gender and work environment were found to be significant predictors of error resulting in patient harm with male nurses have lower odds of committing error resulting in patient harm than female nurses. Nurses who had worked in 'other' settings had lower odds of committing error resulting in patient harm when compared with nurses working in the hospital setting. These same nurses also had lower odds of committing a medication error resulting in patient harm when compared with those nurses who worked in hospital settings. These findings may be attributed to

differences in the demands on the nursing staffs within each of the work environments, particularly regarding the commission of medication errors since significant portion of medication errors occur in acute care settings (IOM, 2007).

Interestingly, findings from this study revealed that nurse age was also a significant predictor of commission of a medication error resulting in patient harm. Further exploration revealed that older nurses (those aged 50 years and above) were at increased odds of committing a medication error resulting in patient harm when compared to nurses aged less than 50 years. The results of this study suggest that there is connection between demographic characteristics of nurses, latent factors, and patient outcomes.

Implications

The findings of the study were intended to add to the present body of knowledge regarding nursing error and assist boards of nursing, nurse employers, and individual licensees evaluate a nurse's ability to safely practice, particularly as it relates to commission of error resulting in patient harm. Nursing care is provided to aid patients in their journey towards wellness, prompting inquiry into instances when that goal is not achieved. The study findings have implications in the areas of nursing regulation and clinical practice.

Nursing Regulation

As a mandatory reporting state, [G.S. 90-171.47] licensed nurses suspected of violating the Nursing Practice Act should be reported to the North Carolina Board of Nursing. This mandate may place nurse administrators in a quandary because of a

perceived conflict between their employer mandates for confidentiality, citing legal privilege, and the licensing board. Results from this study may cue employers and regulators alike to share more information regarding nurse error and suspected violations of the Nursing Practice Act. The primary goal for both organizational entities is enhanced patient safety through the delivery of safe, competent nursing care, therefore employer sponsored initiatives aimed at evaluating and remediating errors (i.e. nursing peer review organizations) can be utilized in conjunction with services or tools offered through the NCBON to lessen future error. Proactive alignment between nurse employers and the NCBON can be enhanced by employer utilization of the Complaint Evaluation Tool (CET), a guide developed specifically to aid employers in their decision making to report practice violations, practice consultation with Board staff, participation in educational offerings on Just Culture, and referrals to the Practitioner Remediation Enhancement Program.

Regulatory policies may be enhanced by the results of this study's analysis of TERCAP data. The North Carolina Board of Nursing mandates all licensed nurses seeking renewal or reinstatement of a North Carolina license engage in activities to satisfy mandates enacted to support the ongoing education and competence of licensed nurses [21 NCAC 36.0232]. To satisfy this mandate, licensed nurses should engage in a self-reflective process to better ascertain their individual learning needs for practice enhancement. Study findings may help guide nurses in their self-directed assessment plan of their individual learning needs by providing information related to errors common to their own demographic. For example, nurses working in hospital or long-term care

settings may consider incorporating information about medication error prevention into their assessment plan and then take active steps to seek out continuing education on medication error prevention. Dissemination of the research findings provides nurses practicing in North Carolina with relevant and timely information which impacts their daily practice and can help support adherence to North Carolina continuing competence requirements.

Clinical Practice

There are additional implications of study findings with regards to nursing workforce. Findings revealed that the vast majority of nurses included in the sample had less than two years of experience working in their respective units at the time of the error incident. Findings also revealed that on average, the sampled nurses had approximately 14.5 years of nursing experience at the time of the error incident. These results suggest that experienced nurses who were relatively new to their work environments committed error resulting in patient harm.

The implications for nurse employers, particularly for those in staff development, are noteworthy because some nursing error could be potentially mitigated through the establishment of robust orientation programs for experienced nurses who are transitioning to different units, specialty areas, and work environments. According to Dellasega, Gabbay, Durdock and Martinez-King (2009), experienced nurses assume a novice role during transitions in nursing employment, however, this role may create difficulty and angst because there may be a perception that experienced nurses will have an easier adjustment than their less experienced colleagues. These authors argued that a) investing

in the orientation needs of experienced nurses will promote their retention, b) experienced nurses benefit from discussions about their expectations and anxieties regarding new roles, c) experienced nurses should be provided opportunities to identify their learning needs and assess their performance and d) experienced nurses often draw on their past work successes when transitioning to new roles and are able to identify sources of support in each other (Dellasega, Gabbay, Durdock, & Martinez-King, 2009). The potential benefits of investing resources into the orientation of experienced nurses may include increased employee satisfaction and engagement, increased retention of experienced nurses, reduction in nursing error, improved patient outcomes and reduced orientation costs to the organization.

This study's findings revealed that 80% of the sampled nurses either resigned from employment or were terminated from employment post error incident. This finding highlights the punitive nature of healthcare systems and also brings attention to the cyclical nature of nursing error due to the tremendous loss of learning that occurs with turnover within the nursing community. When nurses are displaced from a place of employment, they no longer have access to information related to why an error incident occurred, how their involvement may have impacted the error, what systems factors influenced the error, nor can they aide in establishing new processes to prevent the recurrence of the error.

Some of the displaced nurses may have been given information about their specific errors, however, none of these individuals had the benefit of continuing to work within a familiar environment to demonstrate any skills gained about error prevention

management. Specific figures are not available from the TERCAP database, however, it would be expected that at least a portion of the 80% of nurses displaced from employment (either voluntarily or by force) transitioned to another nursing position while some chose to leave the nursing profession altogether. Those nurses that sought nursing employment with another organization would again fall into the transition period of being a novice nurse in a new work environment where they may become the actualizer of nursing error thereby perpetuating the cycle.

Findings from this study should be applied to every nurse's desire to prevent harm. As the primary deliverers of healthcare in the nation, licensed nurses have a great responsibility to patients and their families. Nurse leaders, in particular, have accountability for the delivery of nursing services which includes implementation of "identified standards, policies and procedures to promote safe and effective nursing care for clients" [21 NCAC 36.0224(j)(2)]. As such, nurse administrators and managers should utilize findings from this study to improve nursing care delivery in their respective agencies.

Nurse managers and leaders can seek ways to effectively incorporate findings such as through agency policy review of continuous based learning activities required of nursing staff, where additional content may be needed or offered regarding error prevention and Just Culture initiatives; facilitation of direct care staff attendance at forums, conferences, or in other applicable activities related to error prevention

strategies; encouragement of nurse led research on contributing factors to nurse error utilizing internal incident reporting systems; and incorporation of said research findings into policy changes for practice enhancement.

Of particular interest to those involved in error management research may be to consider nurse led research exploring perceived versus actual gender differences in error commission. Additional research examining how gender influences daily patient interactions may mitigate error resulting in patient harm would be important to further the profession's knowledge about error prevention. Likewise further exploration regarding the influence, or lack thereof of nursing tenure on error commission and resulting patient harm are warranted. This study did not find an association between nursing tenure and error resulting in patient harm, however, given the positive association between nursing age and nursing tenure, future research should explore the effect of nursing tenure on error resulting in patient harm moderated by age. Such research efforts can determine how the nurse's experience level influences error commission and patient harm resulting from those errors.

Findings from this study are also suggestive of the need for nurse administrators to seek out ways to support the needs of older nurses working in direct care positions. The aging nursing workforce is not a phenomenon unique to the US (Fragar & Depczynski, 2011; Royal College of Nursing, 2011) and nurse employers will need to make concerted efforts to retain nurses in these challenging roles.

Assumptions and Limitations

This research study was conducted with several assumptions. It was presumed based on Reason's model that individual and system factors result in adverse outcomes (for purposes of this study, error resulting in patient harm). It was also presumed that the factors captured in the TERCAP database were contributing factors to error resulting in patient harm and that the licensed nurses to which practice breakdown is attributed actually committed the error. More specifically, and in the context of the literature, it was assumed that error resulting in patient harm was associated with younger licensed nurses, male gender, less nursing tenure (years of experience), less educational preparation, longer shifts worked, commission of a medication error and having a history of prior Board or employer discipline.

Additional research assumptions were: (a) the recording of information into the TERCAP database was complete and congruent with the developers of the TERCAP tool and NCSBN, (b) those licensed nurses reported in the database held an active nursing licensee with privileges to practice nursing in North Carolina at the time of the practice breakdown, (c) the licensed nurses reported in the TERCAP database were operating under their highest level of licensure at the time of the practice breakdown and (d) the licensed nurses reported in the TERCAP database were continuously actively licensed either in North Carolina or a participating compact state since their initial licensure date. Consistent active licensure was assumed because length of licensure was an independent variable examined within the study. It was also assumed that all NCBON investigators

entering information into the TERCAP database have undergone required training on case review and have engaged in inter-rater reliability activities to ensure consistency and accuracy of the information contained in the database.

This research study was conducted with several limitations as well. North Carolina is a mandatory reporting state, meaning that any person who suspects that a violation of the Nursing Practice Act has occurred *shall* report the relevant facts to the Board of Nursing [G.S. 90-171.47]. As a mandatory reporting state, North Carolina presumed that the reports received by individuals throughout the state were capturing a significant portion of allegations of misconduct on the part of licensed nurses within the state. It is important to note, however, that the North Carolina Board of Nursing cannot be assured that there was full compliance with state reporting statues, therefore, the reports made to the Board of Nursing (and therefore those case entries into the TERCAP database) may only be representative of violations of the Nursing Practice within certain geographical areas of the state that strictly adhered to the reporting statutes of the state.

Likewise, any regional differences in the sample reported at the state level may or may not be present within the national database. The TERCAP database is a collection of case entries from multiple state boards of nursing, each with separate and distinct reporting requirements promulgated by state legislatures. In addition, internal policies dictated which cases (outside of the defined criteria as set forth by NCSBN) were submitted to the database. Each BON has specific laws and rules governing disciplinary proceedings, therefore there is incongruence among state boards of nursing as it relates to sanctions rendered for similar offenses. As such, the setting in which the original

practice breakdown occurred may greatly influence the resulting discipline issued as well as the interpretation of the contributing factors of the practice breakdown event itself. This study was limited to the state of North Carolina and therefore it cannot be generalized to other states or jurisdictions. Readers are cautioned against extrapolating the study findings or interpreting them as being representative of all states.

It is also important that readers take heed when evaluating the findings related to several of the study variables. Results were suggestive that male nurses had lower odds of committing error resulting in patient harm, however, findings from this study did not compare raw numbers but compared the distribution of the gender data. It is recognized that the study sample was disproportionately female which while reflective of the nursing profession, provided limited information on male nurses and their influence on commission of error resulting in patient harm. Readers are again cautioned against extrapolating the study findings to be representative of the influence of gender on the commission of error resulting in patient harm.

The setting in which the nurses were employed may have also had bearing on the findings presented in this study. While work environments were examined as part of this study, a large proportion of the 'other' work environment was made up of nurses working in home care. Specifically, 24.1% of the 37.2 % of nurses working in 'other' work environments were comprised of nurses working in the home care environment. This figure is notable because home care clients are typically stable clients requiring skilled nursing services from a single clinician. Nurses working in home care environments have less direct supervisory oversight because each nurse is often working in isolation in

the home environment of the their client. Therefore, it may be more difficult to discern when errors occur because reporting is more dependent on the involved nurse who is central to the care provided to the client rather than through the oversight of management or other nurses that may have observed the error incident. It is therefore noted as a limitation of the study that the 'other' work environment category which was primarily comprised of nurses working in home care settings may have had fewer reported error incidents which may have had an impact on the findings of the present study.

Advantages and disadvantages exist for use of a quantitative methodology for research particularly through analysis of existing data. Quantitative research results are often limited as they provide numerical descriptions rather than detailed narrative which provide less information about the human experience (Streubert & Carpenter, 2011). Quantitative research is often carried out in an unnatural, artificial environment so that a level of control can be applied to the exercise, however, this level of control may limit the applicability of the findings (Polit & Beck, 2012).

The use of an existing dataset presented its own challenges. A limitation of secondary analysis is that, by using a study that was planned for a different research question, methods used and measures chosen inevitably differ from those that might have otherwise been selected. The researcher must have considered that the dataset has an appropriate sample, measures, and applicability and contains the specific information needed to answer the new research questions (Doolan & Froelicher, 2009). Concerns with the internal and external validity of the data must be addressed as well to limit bias which could render findings useless (Waltz, Strickland & Lenz, 2010). In regards to this

particular study, there has been limited ongoing testing of the reliability of the TERCAP tool, nationally and at the state level, which could potentially result in inaccuracies in data collection and resulting findings.

Chapter Summary

In summary, literature on medical error has been published for more than 60 years, however, well-publicized IOM reports from the late 20th century to date have increased the public's understanding about the limitations of medical and nursing science as well as health care professionals' awareness of the significance of the problem. The nursing profession is primed to lead efforts to transform healthcare delivery in North Carolina by identifying causation of nurse error and working to decrease error in all healthcare delivery settings. One way to contribute to this effort was to conduct an analysis of the North Carolina data in the TERCAP database assessing trends that were helpful in identifying opportunities that are amenable to intervention to reduce future nursing error. This analysis has expanded knowledge of medical error committed by nurses practicing in North Carolina, which to date has not been provided in the literature, provided information on contributing factors to those errors from a personal and system approach, and informed future intervention studies aimed at mitigating error based on those factors. This research study shifted the focus to the state level by examining factors contributing to errors by licensed nurses working in North Carolina. Examination of North Carolina specific data allowed for comparisons to occur between national and state findings. Investigating the root causes of nurse error in North Carolina helps nurses to

develop remediation activities to prevent recurrence of similar error. Such efforts may reduce the burden that nurse error places on the entire healthcare industry, potentially resulting in fewer deaths, reduction of expenses associated with medical error and lessening the intangible costs of error.

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APPENDIX A

A GUIDE TO THE NORTH CAROLINA BOARD OF NURSING'S INVESTIGATIVE PROCESS

What if Notices or Final Orders are not received by a nurse?

The Board is required to send orders for resolution to a nurse's address of record by restricted certified mail. By law, a nurse is required to notify the Board of address changes. If notification cannot be accomplished through mail service, notice may occur by publication in a newspaper of general circulation in the county of a nurse's last-known address.

Disciplinary Action is a public record and as required by law is reported to the following entities:

- **NURSYS®– State Board of Nursing linked national databank. Any adverse action on a nurse's license may affect a nurse's ability to practice in another state**
- **National Practitioner Data Bank (NPDB)**
- **Office of the Inspector General (OIG)**
- **NCBON website**
- **Any other state/jurisdiction in which the licensee is or has been licensed**

Dispute Resolution Process

If a nurse disputes the allegation(s) of violation(s) of the NPA/Rules and/or declines the resolution offer, he/she may request to meet with the Board for either a Settlement Committee Meeting or request that the matter be referred for an Administrative Hearing.

A **Settlement Committee** is an informal public meeting with members of the NCBON, who review the case and provide the licensee the opportunity to present any mitigating circumstances addressing why a lesser sanction other than the one offered may be appropriate. An offer (which may be the same sanction, a greater sanction, or a lesser sanction than previously offered may be made to a nurse in an attempt to settle the matter. A Settlement Fee of $300.00/hr is assessed if a settlement is reached. If a settlement is not reached, no fee is assessed, and the matter is referred for an Administrative Hearing.

An **Administrative Hearing** is a formal public forum (much like a court room setting) where members of the NCBON receives evidence, witnesses are heard through sworn testimony and the Board makes a decision of appropriate sanction based on the information presented. If the licensee is found in violation of the NPA/Rules in this forum, there is an hourly fee ($300/hr) associated with this option.

Summary Action

If a nurse holds a current North Carolina nursing license and has received discipline action against his/her license or privilege to practice in another state, the NCBON will review the facts and apply its own state laws to determine the appropriate action that should be taken against the nurse's NC license.

Reference

"Board of Nursing Complaint Process: Investigation to Resolution", a video produced by National Council of State Boards of Nursing is also available for viewing at **https://www.ncsbn.org**

NC BOARD OF NURSING

Mission Statement

The mission of the North Carolina Board of Nursing is to protect the public by regulating the practice of nursing

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A Guide to the North Carolina Board of Nursing's Investigative Process

Developed for the Licensed Nurse by Board Staff

The Investigative Process

The mission of the North Carolina Board of Nursing (NCBON) is to protect the public by regulating the practice of nursing.

North Carolina is a mandatory reporting state. Any person who has reasonable cause to suspect misconduct or incapacity of a nurse or who has reasonable cause to suspect that a nurse has violated the Nursing Practice Act (NPA) (law) shall report the relevant facts to the Board. The complainant is immune from criminal or civil liability for reporting concerns if the report was made in good faith (G.S. 90-171.47). Complaints may come from employers, co-workers, law enforcement, patients, relatives, other agencies, self reports, or made anonymously to the Board. Not all complaints reported to the Board are grounds for discipline by the Board.

The Board of Nursing takes all complaints about nurses seriously.

When the Board receives a complaint, the first step is to determine whether or not the reported allegation(s) violate existing laws (NPA) or regulations (North Carolina Administrative Code Rules) that govern a nurse's practice. By statute, the Executive Director is authorized to obtain nursing and patient files to investigate the complaint. The NC Board of Nursing has jurisdiction over licensed nurses and has no authority over employment/workplace issues, concerns about work hours, or co-worker conflicts.

Jurisdictional complaints are assigned to a Certified Investigator employed by the Board. The NCBON provides "due process" to a nurse by notifying him/her of the investigation, of the allegation(s), of his/her rights in the investigative process, and of the investigator's contact information. In rare circumstances, notification may be withheld if in doing so would impede the investigation.

The Investigator begins collecting evidence from a number of sources which may include witness interviews and document reviews/audits. The Investigator's role is to collect and report facts in a fair and impartial manner. A nurse is afforded the opportunity to respond to the allegations made against him/her and to offer evidence to be considered. A nurse may provide this information by participating in an interview and he/she may also be asked to submit a written statement.

If a nurse wishes to review the documents collected as evidence, he/she may come to the Board office (by appointment), as these documents will not be copied or made available prior to the conclusion of the investigation and the issuance of formal charges.

A nurse has the right to decline participation in the investigation and to have no contact with the Investigator; however, if a nurse declines participation, decisions will be based on the evidence collected. Failure to respond will not deter the Board from making a determination based on the facts available.

The process used to investigate and act on a complaint may vary depending upon the seriousness of the allegation(s) and the timeliness of the complaint. Investigations take time to complete. It may take a number of weeks to months depending upon the complexity and seriousness of the alleged conduct, the ability to locate witnesses, and the response time for record requests.

Can a nurse under investigation work while the investigation is being conducted?

The ability to work as a nurse is unrestricted during the investigation, as long as his/her license remains active and the nurse's continued practice poses no risk to the public. If the alleged violation poses a substantial threat to the public, the license is flagged on our website to alert prospective employers that the Board is conducting an investigation. A nurse's license to practice may be immediately suspended (Emergency Summary Suspension) if it is determined that the public health, safety and welfare of the public may be jeopardized by continued practice of a nurse.

Should an Attorney be Retained?

One of a nurse's rights in this process is the right to retain an Attorney. If a nurse elects to retain an Attorney, the nurse will be responsible for ensuring that their Attorney provides the Investigator with a Letter of Representation. The nurse is responsible for all attorney fees.

What if a nurse is working in NC on a Multistate License?

If a complaint is filed related to an incident that occurs in NC, while a nurse is working on a multistate license from another compact state, the NCBON will investigate the complaint in regards to the nurse's Privilege to Practice in NC. The home state of nurse will be notified and may impose a sanction on the nurse's license to practice.

Complaint Resolutions

If, after investigation, there is insufficient proof (unable to meet required legal standard of clear and convincing evidence) to substantiate a violation of the NPA, the case will be dismissed with **No Action**.

The Board may issue an informal **Letter of Concern/non-disciplinary warning** if there is cause for concern but there is not clear and convincing evidence to substantiate a violation(s). This letter may also include a suggestion for remedial course(s) that might be helpful for the nurse in learning how to improve his/her practice. Course work would be voluntary and not mandated by the Board.

An offer of a **Non-disciplinary Consent Order** (NDCO) is issued in cases where the nurse acknowledges his/her action/inaction in the reported matter is a violation of Nursing law/rules and it is agreed that his/her continued practice without restrictions would pose no threat to public safety. This resolution imposes a mandatory educational remedy (primarily on-line computer based course(s)) as a means of protecting the public and helping a nurse to improve and maintain safe practice.

If indicated, an offer to enter into one of the Board's Drug Intervention/Monitoring programs may be made. For more information regarding these programs, visit the NCBON's website at www.ncbon.com

Disciplinary Actions of the Board are public sanctions on the license/privilege to practice nursing that are imposed when there is clear and convincing evidence of a violation(s) of the NPA which may pose a risk to the public.

An offer to expedite settlement of a case in which there is clear and convincing evidence of a violation(s) that would result in disciplinary sanction may be made through a **Published Consent Order (PCO)** A PCO may include some form of required remedial education, either instructor led course(s) or on-line computer based course(s) and one a combination of the following sanctions:

- ***Reprimand*** – Formal discipline that expresses notice of a violation but does not restrict the nurse's continued practice.
- ***Probation*** –restrictions placed on a nurse's practice through monitoring for a prescribed period of time. Possible restrictions on work setting and/or hours of work, and/or screening requirements may be included.
- ***Stayed Suspension*** – withholds suspension of a license as long as the nurse complies with the Board Order.
- ***Suspension*** – restricts a nurse from practicing nursing for a specified time.
- ***Voluntary Surrender*** of license – A nurse may decide to voluntarily waive his/her rights to judicial review and relinquish his/her right to practice nursing for an indefinite period of time (no less than 1 year).
- ***Revocation*** -the right to practice nursing is revoked (withdrawn) for a specified period of time (more than five years).

APPENDIX B

EXECUTIVE DIRECTOR PERMISSION FOR TERCAP

Jennifer Lewis

From: Julie George
Sent: Tuesday, December 23, 2014 10:17 PM
To: Jennifer Lewis
Cc: Elizabeth H. Zhong; Maryann Alexander
Subject: Re: TERCAP - J. Lewis Dissertation

Hi Elizabeth,

I am writing to give permission for Jennifer Lewis to have full access to NCBON TERCAP data for her doctoral studies. I also grant full permission for Thomas McCoy to have the data as he assists Jennifer in her work.

We are very pleased that Jennifer is using NC TERCAP for research.

Please let me know if I can provide further clarification.

Thank you and I hope you have a very happy holiday season.

Julie

Sent from my iPad

On Dec 23, 2014, at 3:04 PM, "Jennifer Lewis" <jlewis@ncbon.com> wrote:

> Julie,
>
> You are aware that I plan to use North Carolina TERCAP data as part of my dissertation research in my doctoral studies. I plan to analyze case information from 2011 forward to 1) examine the influence of nurse characteristics, individual/ health care team, and system threats on types of nurse error, 2) examine the relationship between the primary type of nurse error and the incidence of patient harm, and 3) describe the characteristics of licensed nurses engaged in error. It is my desire to conduct research using the TERCAP database as early as January 2015. Dr. Elizabeth Zhong has advised that as the Executive Director for the NC Board of Nursing, your express permission is required for me to engage in this research and allow me access and use of the data. For full disclosure, I anticipate needing my statistics professor, Thomas McCoy, assist me in this research, particularly as it relates to converting the raw TERCAP data into a software program (SPSS) that will enable me to analyze the data. Dr. Zhong stated granting permission with knowledge of Mr. McCoy's assistance is sufficient so that both of us (she and I) can have a written record that my use of the TERCAP data is sanctioned by the Board.
>
> I am happy to provide you with a draft copy of my research proposal that outlines my anticipated study should you want more detail. Please let me know and I can forward it to you.
>
> Thank you and Happy Holidays!
> Jennifer Lewis
>
> **From:** Jennifer Lewis
> **Sent:** Tuesday, December 02, 2014 7:09 AM

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