ABSTRACT

PATIENT SAFETY AND STAFFING IN EMERGENCY DEPARTMENTS

By Nekole Ecklor

The purpose of this study was to investigate and describe nurse staffing methods, nurse skill mix, and patient safety in emergency departments (EDs) in order to address the question: How does nurse staffing impact patient safety in EDs? Although studies have revealed an association between nurse staffing and patient safety for inpatient populations, there is limited research on the relationship between nurse staffing methods, nurse skill mix, and patient safety in EDs.

The question was evaluated by examining the ED as a system using Katz and Kahn's Open Systems Theory. In this framework, patients enter the ED department (system) and their outcome (patient safety) is influenced by nurse staffing (throughput).

A descriptive cross-sectional design was used to investigate nurse staffing methods, nurse skill mix, and the impact on patient safety. The setting was EDs in the state of Wisconsin that were listed with the American Hospital Association (AHA). All ED managers on the AHA's list received the Emergency Department Survey (EDS). The EDS is a 12-item survey that investigated the nurse staffing method, nurse skill mix, and measured patient safety by examining the frequency of patient safety incidents in EDs. Fifty-seven usable surveys were returned out of the 115 distributed. With a research standard of 95% confidence level, 89 surveys were needed to produce meaningful findings.

The statistical analyses used to analyze the collected data and answer the research question were descriptive, analysis of covariance (ANCOVA), qualitative analysis, and multiple regressions. Findings from the statistical analysis are: (a) Industrial engineering method of nurse staffing had a higher level of errors than other methods; (b) Emergency medical technician-paramedics (EMT-P) were four times more likely to have a correlation of medication errors and sentinel events combined; (c) Registered nurses (RNs) have an inverse association with a positive impact on patient safety; (d) Incorrect labeling comprised 13.5% of total errors; (e) The largest category in the variable of patient safety was elopement, with 40% of reported errors; (f) Patient falls had an inverse correlation with licensed practical nurses (LPNs) and EMT-Ps; (g) Elopement had a positive correlation with RNs and EMT-Ps and an inverse correlation with LPNs; (h) Incorrect identification was inversely correlated with LPNs and unlicensed assistive personnel (UAPs) and positively correlated with EMT-Ps; (i) Incorrect specimen labeling was inversely correlated with LPNs and EMT-Ps.

The implications of this research have practical applications for ED managers to consider in addition to historical census data when determining the appropriate staff and skill mix. Administrators, policymakers, and managed care providers need to be cautious in allowing the proportion of RNs to drop for the sake of profit goals. For nurse educators, this study offers a better understanding of the potential consequences of nurse staffing and nurse skill mix related to patient safety in EDs.

Recommendations for future research include: (a) Investigate nurse staffing methods, focusing on productivity measures or management goals objectives and adjusting staffing needs based on historical patient census; (b) Explore the reasoning behind the reduction of the RN's role in the ED; (c) Investigate EMT-P role in EDs using relevant patient safety indicators (PSIs); and (d) Investigate why patients elope or leave EDs before receiving care.

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by

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I would like to thank my family. Without their love and support, none of this would have been possible. My daughter now knows the difference between a thesis statement and a thesis paper.

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Approximately 1.3 million patients are injured each year with nearly 98,000 deaths due to medical error (Kohn, Corrigan, & Donaldson, 1999). These numbers are alarming to the public and health care profession. Looking back in history, patient safety has always been a part of the health care field. Florence Nightingale, the founder of modern day nursing, can be quoted, "The very first requirement in a hospital [is] that it should do the sick no harm" (Maricle, Whitehead & Rhodes, 2007), demonstrating an awareness of patient safety. Patient safety has always been a concern to the health care community, but within the last few years, it has become a priority.

Patient safety is addressed in the literature but it is not well defined. Flippin (2006) defines patient safety as "protection from injury immediately prior to, during, and immediately after surgery" (p. 145) and further extends her definition to include personal care after discharge. The Spectrum Health Patient Safety Plan (2002) defines patient safety as "freedom from accidental injury while receiving healthcare services" (p. 13). The American Society for Healthcare Risk Management (ASHRM, 2006) states that patient safety is the prevention of harm (p. 155). Studies by Comeau and Adkinson (2007); Dang, Feroli, Gill, Paine, Shermock, Suflita, and Walrath (2007); Maricle, Whitehead, and Rhodes (2007); Miller, Elixhauser, and Zhan (2007); Wagar, Tamashiro, Yasin, Hilbourne, and Bruckner (2006); and Wolosin, Vercler, and Matthews (2006) do not define patient safety but imply patient safety as the prevention of harm from either

medical or medication error. Romano, Geppert, Davies, Miller, Elixhanser, and McDonald (2003) used patient safety indicators (PSIs) as a way to identify patient safety events that could have been prevented. Their definition of patient safety is "freedom from accidental injury due to medical care, or medical error" (p. 154).

Other definitions are provided by government and professional organizations including the World Health Organization (WHO), Institute of Medicine, National Patient Safety Foundation, and the Agency for Healthcare Research and Quality. The WHO (2007) cites two definitions of patient safety from different resources:

1. Freedom from accidental injuries during the course of medical care; activities to avoid, prevent, or correct adverse outcomes which may result in the delivery of health care.
2. The identification, analysis, and management of patient-related risks and incidents, in order to make patient care safer and minimize harm to patients.

The Medical College of Wisconsin (2007) provided definitions from the Institute of Medicine (IOM) and the National Patient Safety Foundation (NPSF). The IOM defines patient safety as freedom from accidental injury; ensuring patient safety involves the establishment of operational systems and processes that minimize the likelihood of errors and maximize the likelihood of intercepting them when they occur. The NPSF's definition of patient safety is the prevention of healthcare errors, and the elimination or mitigation of patient injury caused by healthcare errors. The Agency for Healthcare Research and Quality (AHRQ, 2007) defines patient safety as freedom from accidental or preventable injuries produced by medical care.

Currently the U.S. is experiencing a shortage of nursing personnel. In 2000 at the Nurse Staffing Summit of American Nurses' Association in Washington, DC, the

summit predicted that by the year 2010 the supply of registered nurses (RNs) would not meet the demand (Geolot, 2000). Health care providers are having difficulty finding experienced RNs for the chaotic environment of the ED (Hall, 2001). Emergency departments are open 24 hours a day, 365 days a year. Emergency departments are separate units from the hospital and are devoted to providing emergency medical treatment for all types of injuries that require immediate attention. Unlike inpatient settings such as hospitals and clinics where visits are scheduled, EDs operate under ambiguous conditions never knowing what will walk through the doors.

Managed care has changed how EDs operate. Insurance companies in today's environment control who, what, when, where, and how of patient care (Kongstvedt, 1993; Robert Wood Johnson Foundation, 2004). The survival of many EDs is dependent on administration's competitive drive to secure managed care contracts. The result is the emphasis on the "bottom line," even for not-for-profit organizations. Administration must critically review each item in their operating budget. According to the American Hospital Association (AHA), labor is nearly 55% of most budgets (1996). Registered nurses make up appropriately 23% of that number. The movement to reduce cost and the shortage of nurses has forced administrators to increase the number of unlicensed nursing personnel. Blegen and Vaughn (1998) claim in their research that "unlicensed assistive personnel (UAPs) provide the direct patient care activities that can be delegated within licensure and regulatory constraints and indirect patient care support to enable registered nurses to be more effective" (p. 8).

Managed care and administrators are questioning whether ED staffing can be accomplished with fewer personnel and lower paid staff while still maintaining quality patient care (Kongstvedt, 1993). With little existing research on ED staffing and patient

safety, this study has broadened the existing understanding of the impact between staffing and patient safety in EDs within Wisconsin. By focusing on adverse patient events as a measure of patient safety, this study has attempted to describe how nurse staffing methods and nurse skill mix impacted patient safety in EDs.

There are conclusive findings from the literature review on nurse staffing and patient safety. However, nearly all of these studies address inpatient or institutional settings. The findings in the literature review do not describe the diversity of nursing care required in EDs. In addition, most of the current research does not address the association between nurse staffing methods, skill mix levels, and quality of care (Verran, 1996). Limited research was available when linking nurse staffing and patient safety in EDs.

Multiple studies showed an inverse relationship between nurse staffing skill mix and adverse outcomes in inpatient settings (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; Hall, Doran, Pink, 2004; Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2002). The results from these studies indicated that as the proportion of RNs increased, the number of adverse patient outcomes decreased. One study examined the number of RNs needed on a children's ward to ensure the safety of patients and staff (King, 2000). Other studies investigated the relationship between number of hours worked by nurses and patient safety (Scott, Rogers, Hwang, & Zhang, 2006; Stone, Du, Cowell, Amsterdam, Helfrich, Linn, Gladstein, Walsh, & Mojica, 2006) with conflictingl findings. The findings identified as pertinent to the ED focused on four areas:

1. Identifying medical errors (Fordyce, Blank, Pekow, Smithline, Ritter, Gehlbach, Benjamin, & Henneman, 2003).
2. Improving medication safety and patient care (Schmidt, 2003).

3. Investigating how physicians, nurses, and out-of-hospital personnel differed in identifying, disclosing, and reporting medical errors (Hobgood, Xie, Weiner, & Hooker, (2004).
4. Examining the strategies used by nurses to recover medical errors (Henneman, Blank, Gawlinski, & Henneman, 2006).

Research has shown that a relationship between nurse staffing and patient safety exists in inpatient settings. While safety as a whole has been examined in the ED, it is unknown whether the relationship between nurse staffing and patient safety exists. This study sought to address this gap in the literature by examining how nurse staffing methods and nurse skill mix impacted patient safety in EDs.

Significance to Nursing

This study could affect ED managers, administrators, policy makers, the managed care industry, the nursing profession, and ultimately, the patients. For ED managers and administrators, the information gathered could provide insight for operating budgets, allocating resources, and bidding for insurance contracts. For policy makers and the managed care industry, the results of this study could influence their decision-making. For nurses, this study could broaden their understanding and knowledge of how the various methodologies of nurse staffing and nurse skill mix affect patient safety.

Statement of the Problem and Rationale

The problem of staffing and patient safety is complicated. Over the past few years, a number of studies have been completed on the topic of nurse staffing and

inpatient outcomes. Little research has been done to examine the relationship between nurse staffing methods, nurse skill mix, and patient safety in EDs. The purpose of this study was to investigate and describe how nurse staffing methods and nurse skill mix impacted patient safety in EDs. The Emergency Nurse Association (ENA) has attempted to determine nurse staffing within the U.S. The research results included the number of RN and UAP hours per patient visit along with wait time, length of stay and patient acuity (ENA, 1999). The study conducted by the ENA did not depict patient safety.

Purpose

The purpose of this study was to investigate and describe how nurse staffing methods and nurse skill mix impacted patient safety in EDs. Patient safety is the responsibility of all health care providers. This study may add to nursing knowledge the understanding of how nursing personnel working with ED physicians and nurse practitioners influences patient safety. Providers cannot be in every patient room for the patient's entire visit, especially in an ED setting. Therefore, it is imperative to make sure the ED is adequately staffed with the optimal number of nurses and skill mix to ensure patient safety.

Research Question

How does nurse staffing methods and nurse skill mix impact patient safety in EDs?

Definitions of Terms

Conceptual Definitions

Nurse staffing was investigated in two ways: the nurse staffing method and the nurse skill mix. The method of staffing is a systematic process to determine the number of nursing personnel that is required to provide a predetermined standard of nursing care to a group of patients in a particular care setting (Aydelotte, 1973). The nurse skill mix is the combination of RNs, licensed practical nurses (LPNs) and UAPs (Hall et al., 2004).

Patient safety is the "freedom from accidental injury due to medical care, or medical errors" (Kohn, Corrigan, & Donaldson, 1999).

Operational Definitions

Nurse staffing method was measured by asking the participants how the number of staff needed was determined.

Nurse skill mix was measured by asking for "the proportion or percentage of hours of care provided by one category of caregiver divided by the total hours of care" (Seago, 2001, p. 430) for RNs, LPNs, and UAPs.

Patient safety was measured through examination of specific adverse events (medication errors, patient falls, sentinel events, incorrect patient identification, incorrectly labeling specimens, and patient elopement) within the previous 12 months. The adverse patient events identified were specific patient safety related events for EDs. This information is commonly gathered due to the Joint Commission on Accreditation of Healthcare Organizations' (JCAHO) requirements. Sentinel events were defined as an unexpected occurrence involving death or serious physical or psychological injury, or the risk thereof. Serious injury specifically includes loss of limb or function. The phrase

"or the risk thereof" includes any process variation for which a recurrence would carry a significant chance of a serious adverse outcome (JCAHO, 2007).

Patient elopement was defined as disappearance (Corrigan, 2006).

Assumptions

1. Respondents were honest.
2. Safety is a function of quality patient care.
3. There is a shared language regarding patient errors because of JCAHO requirements.
4. ED staffing and safety occur within a variety of physical layouts and technologies, culture, volume, populations, and external environments.
5. Administrative records were kept up to date and were error free.

Summary

The background of the problem, purpose, its significance, definitions, and assumptions were discussed in this chapter. A critical review of pertinent research studies covered the variables of patient safety and nurse staffing. The conclusions of these studies asserted that a relationship existed between patient safety and nurse staffing in inpatient settings. Minimal research has been completed for EDs, with no available research investigating the impact that nurse staffing methods and nurse skill mix has on patient safety, thereby warranting this research study. In Chapter II, the theoretical framework, its application to EDs and review of literature are presented.

CHAPTER II

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Introduction

The purpose of this study was to investigate and describe how nurse staffing methods and nurse skill mix impacted patient safety in EDs. In this chapter, the theoretical framework of Katz and Kahn's Open Systems Theory is discussed and how it applies to this study and EDs. A brief chronological overview of the variables under investigation is presented along with a critical analysis of literature. Finally, an in-depth discussion of research studies combining the variables is presented.

Theoretical Framework

Open Systems Theory

Emergency departments do not practice in a vacuum, so it is important to look at it from a system approach. According to Ludwig von Bertalanffy, the founder of systems theory, to understand an "organized whole" it is essential to be familiar with the parts and the relationship between them (1976). An open system is influenced by its external environment, whether freestanding, or themselves part of other systems. Katz and Kahn (1978) propose that open-systems follow the theoretical model of input-throughput-output while paying special attention to the throughput (how to change the inputs) and output (service to the environment) (Figure 1).

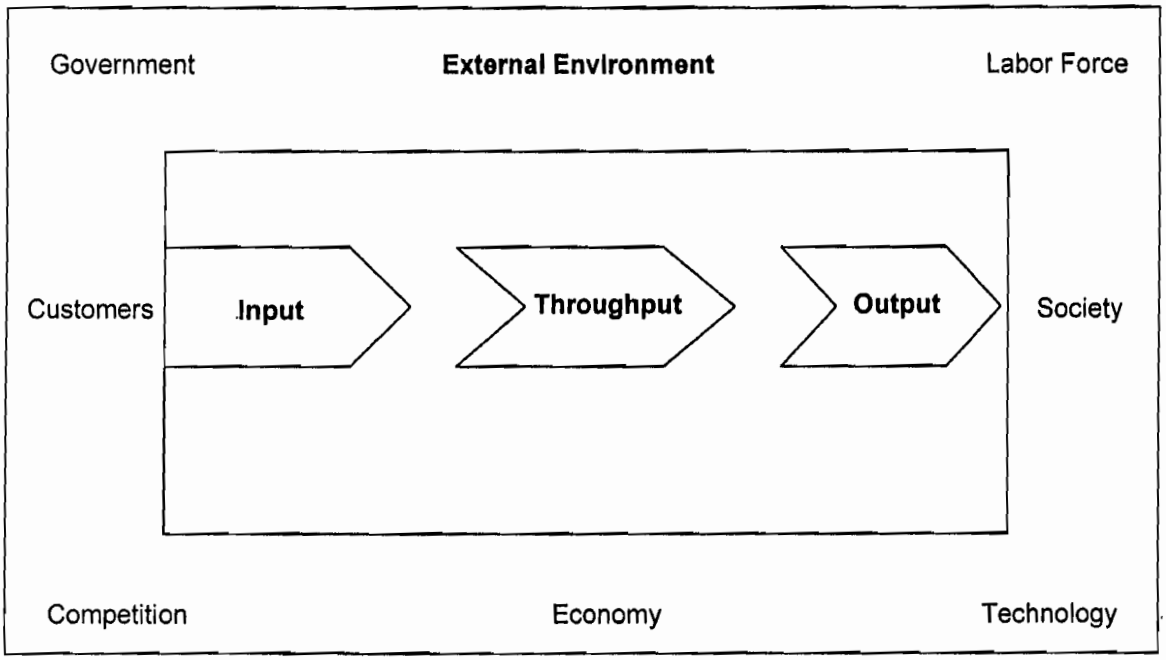


Figure 1. Adapted Katz and Kahn Open System Model (1978).

The Open System Theory (OST) is an interdisciplinary theory of organizations that stresses the importance of situational analysis. In system thinking, situational analysis identifies the variables that influence the behavior and responsiveness of the organization and examines how the dynamic nature and interdependency of the organization reacts with its environment. Without the constant flow of inputs from the environment, the organization cannot survive (Tregunno, Baker, Barnsley, & Murray, 2004).

Emergency departments are by nature an open system in that they must continuously interact with their external environment (Tregunno, et al., 2004) and their internal subsystems. An uninterrupted feedback loop is necessary for EDs to remain responsive to their environment and maintain its own equilibrium (Adams & Bohan, 2000). Emergency departments have a complex set of interdependent subsystems such as staff, tasks, equipment, structure, and culture (Leavitt, 1965). The subsystem of staffing and its outcome of patient safety are under investigation in this study. Figure 2 demonstrates the relationship between the input of patients, the throughput of nurse staffing, and the output of patient safety.

Emergency departments' complex interdependent subsystems (Croskerry, 2000) take in resources from the external environment, process them through, and return them back into the environment. As illustrated in Figure 2, the staffing subsystem takes in patients and relies on the other subsystems of direct and indirect patient tasks, technology, organizational structure, diagnostic testing, and culture to process their patients. The most obvious output for staffing is patient care (Fordyce et al., 2003). However, the purpose of this study was to investigate and describe how nurse staffing methods and nurse skill mix impacted patient safety in EDs. Patient safety is only one aspect of patient care (Needleman et al., 2002). Once the input, throughput, and output

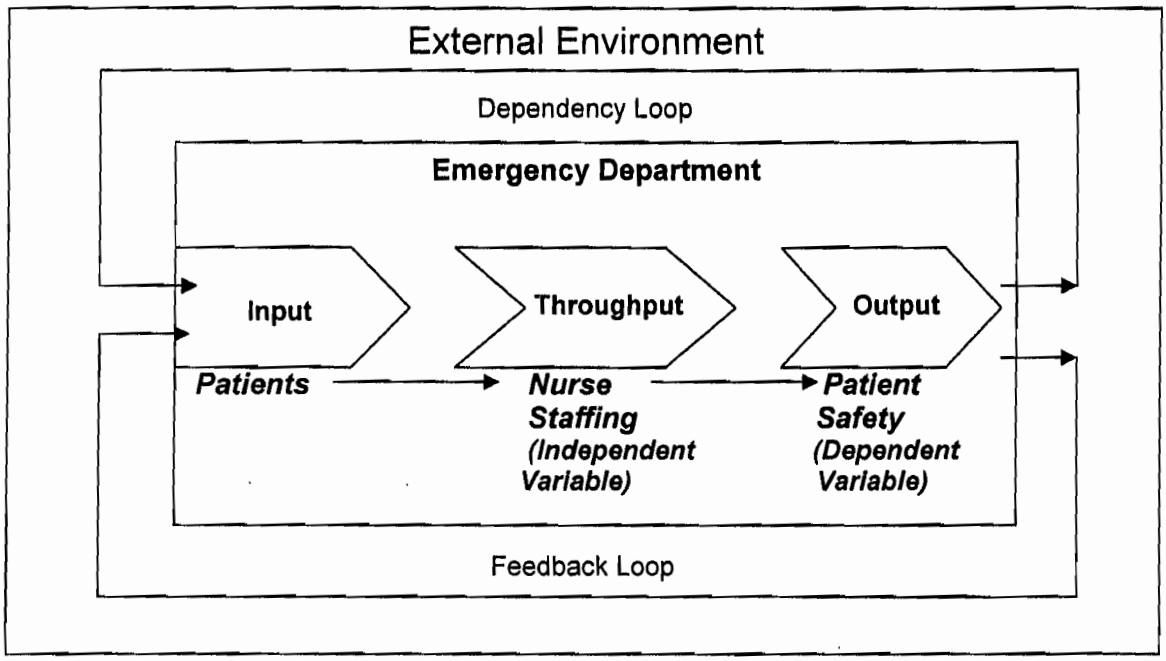


Figure 2. Emergency department as an open system.

cycle is complete, EDs receive feedback. Feedback can take the form of patient surveys, patient relations, other medical unit reports, admissions, and goodwill.

Case Study

As previously stated, a system approach recognizes that EDs are unique entities. Open systems are dependent on their own dynamic, interrelated subsystems and their environment. The ability to identify and analyze internal and external variables for their relations and interdependencies are necessary for fully understanding EDs as open systems. Staffing can be investigated through the organic systems of method and skill mix. While patient safety is a less tangible output than patient care, it has a significant impact on the entire system. As an open system, the output of poor patient safety will likely force the system to either change and evolve or the system will fail.

Model Case

Mrs. Smith is a 76-year-old female who presents to the ED with abdominal pain (input). She is first greeted by a volunteer who takes down her name, date of birth, and reason for coming to the ED. Mrs. Smith then goes to triage (interdependent subsystem of throughput). Here her vital signs are taken and information on chief complaint; height; weight; allergies; prescription and over the counter medications, including last dose; immunizations; substance use; abuse; and past medical and surgical history is obtained. At triage, the registrar (interdependent subsystem of throughput) ensures correct identification (ID) of Mrs. Smith by verifying the spelling of her full name and date of birth before placing the ID band. Mrs. Smith is then brought back into a room. Once in the room, Jane identifies herself as an RN (interdependent subsystem of throughput), assists Mrs. Smith into a gown and proceeds with her assessment. Before leaving the

room, Jane puts up the side rails and gives Mrs. Smith a call light. Dr. Doe (interdependent subsystem of throughput) then enters the room to evaluate Mrs. Smith. He also inquires about past medical and surgical history, allergies, and medications. Dr. Doe writes orders on Mrs. Smith and puts the chart in the orders bin. Nancy, an RN (interdependent subsystem of throughput), picks up the chart and puts the orders in the computer. Jane is busy with another patient so Nancy proceeds to carry out the orders. Nancy enters the room, identifies herself, verifies that she has entered the right room, and explains that Jane is busy with another patient. Nancy then explains the plan of care to Mrs. Smith and answers any questions she may have. Before drawing blood, Nancy checks the ID band. She then inserts an intravenous catheter (IV) and draws the blood per hospital policy. The tubes are immediately labeled according to policy and sent to the lab (interdependent subsystem of throughput). Next Nancy needs to give Mrs. Smith some pain medicine. Before administering the medication, Nancy checks Mrs. Smith's chart for allergies, double checks the allergies with Mrs. Smith, and educates Mrs. Smith on the purpose, side effects, and kinetics of the medication. Before leaving the room Nancy makes sure, the side rails are up and Mrs. Smith has the call light. After leaving Mrs. Smith's room Nancy locates Jane at the nurse's station and communicates what she has done for Mrs. Smith, what still needed to be done, and how Mrs. Smith was doing. Mrs. Smith's ED visit is free of any adverse patient events (output).

Contrary Case

John Doe presents to the ER with a fever for 7 days (input). He proceeds through registration and triage (interdependent subsystems of throughput) where patient ID is verified and information regarding chief complaint; height; weight; allergies;

prescription and over-the-counter medications, including last dose; immunizations; substance use; abuse; and past medical and surgical history is obtained. He is initially assessed by Becky, an RN, who identifies herself and makes sure the call light is within John's reach (interdependent subsystem of throughput). Dr. Spot (interdependent subsystem of throughput) then evaluates John and inquires about allergies, medications, and past medical history. The ER is busy and Lucy, another RN, grabs the chart from the orders bin and proceeds to carry out the orders. Lucy accidentally goes into John Smith's room, does not check the ID band, and draws his blood (interdependent subsystem of throughput). She immediately labels the tubes according to hospital policy with John Doe's labels and sends them to the lab. John Doe is put through unnecessary diagnostic testing due to the results of the blood tests (output).

Because EDs do not operate in isolation, research on this topic required a broader theoretical framework. Systems theories view interrelated components as parts of an "organized whole." The OST looks at how the system reacts with its environment and identifies variables that influence the inputs, throughputs, and the output. The research involved in this study explored how EDs act as open systems. Patients represent the inputs with the focus of the study concentrating on the subsystems of nurse staffing methods and nurse skill mix as throughputs and their impact on the output of patient safety. The preceding case studies demonstrate the theoretical framework's application to the real world.

Review of Literature

The review of literature discusses the subsystems of nurse staffing methods and nurse skill mix. Several studies talk about the relationship between staffing and patient

safety for inpatient units. There were no available studies addressing nurse staffing methods and nurse skill mix as it pertains to patient safety in EDs. The accessible literature dealing with patient safety in EDs is discussed. Finally, the theoretical framework was used as a guide to analyze the reviewed literature.

Nurse staffing has been under study for several decades. Staffing nurses became an issue during World War I and then again during World War II, when the demand for trained nurses increased and depleted hospitals of their staff (Aydelotte, 1973). In the 1950s, staffing nurse personnel saw its first push for the need to increase efficiency and began to look into the most effective combination of staff. By the 1970s, productivity was emphasized with the implementation of industrial application of work measurements, method improvement, and job simplification. From the 1970s to today, staffing research has focused on unit specialties of inpatient settings (Budreau, Balakrishnan, Titler, & Hafner, 1999).

Commonly used nurse staffing methods are described and grouped into four categories. These categories range from relying on personal experience, to division of work, to patient classification, to mathematical software. Nurse staffing evolution adapted many of its models from business such as:

1. Industrial engineering (division of work to eliminate wastes of time, money, materials, energy, and other resources).
2. Management engineering (attempts to apply standards such as measurements, testing, feedback, control loops, and work breakdown structures) and lastly.
3. Operation research (uses software or other mathematical modeling to arrive at the optimal decision).

Figure 3 highlights the core concepts or basis, theoretical framework, implementation of the method, key assumptions, and the inherent weakness of each staffing model.

Nursing Staffing Skill Mix

Any discussion of staffing is incomplete without looking at the levels of skill mix. According to Manuel and Alster (1994), using various ratios of skill mix might be one way to maintain quality care while maintaining costs. Skill mix is a controversial issue. For some it is viewed as nothing more than an excuse for substituting unqualified personnel for RNs (Hancock, 1993; Hayes, 1991). Others believe it is a threat to the profession. Freisen (1996), Manuel and Alster (1994), and Morris (1992) all question the reduction of RNs in the skill mix and placing heavier demands on them by requiring RNs to supervise larger numbers of UAPs. Skill mix can be broken into three classifications as outlined in Figure 4.

The AHRQ reports that they found no definitive evidence to determining specific model and percentage of RNs or nurse skill mix for various inpatient settings (Seago, 2001). The consistent findings emphasized in applicable literature are that the most rigorous of studies cannot be universally applied to all medical settings. Using a Complementary model of using LPNs and UAPs as support for RNs may work in one setting and not in another. Substituting RNs may be banned in one unit and acceptable in another of the same hospital. Blending roles so that all personnel work side by side, may be the optimal solution for RN shortage and cost saving in one unit, and yet be ill-advised in another. The skill mix should be looked at through the needs of the specific patient population (Buchan & Dal Poz, 2002) and adjusted for patient acuity at unit levels

Methodology	Descriptive	Industrial Engineering	Management Engineering	Operation Research
Basis	Experience & Judgment	Division of work. Increase use of UAP.	Staffing Index	Mathematical Model
Theory	Ratios Formulas	Work Sampling Time & Motion Studies Task Analysis.	Workload variation. Patient classification. Work simplification.	Redistributing staff and workload. De-emphasize critical thinking aspect of nursing.
Implementation	Guesswork to statistical analysis	Adjusting for cyclical staffing needs.	Adjusting for nurse, patient, and setting. variables.	Real-time & Forecasting.
Assumption	Quality of care described and measured by hours worked per day. Staffing is a function of patient census.	Quality of care is a function of efficiency of task performance. Staffing is a function of available personnel & task requirements.	Standardization of procedures. Skill/knowledge for tasks can be identified.	Describe and measure complexities of nursing tasks, patient needs classification, & cost.
Weakness	Inconsistency between users. Does not count for patient needs or setting variables.	Reliance on relationship between staff and census. Count for a few variables. Blanket transfer of tasks to UAP.	Site/unit specific. Procedures to use not well develop or require need of outside consulting firm.	Nursing care quality remains the same or increase through optimizing nursing workload.

Figure 3. Staffing methodologies adapted from Aydelotte (1973).

Name	Complementary	Substitution	Blended
Model	UAP as supplementary support to RN	UAP support with assigned responsibilities.	UAP roles created to work along with nurses.
Implementation	Response to nursing shortage	Realign positions to create new UAP roles	Reduction in RN positions.
Percentage of RN	88% RN	75% RN	66% RN
Cost Savings	Cost saving in salary	No cost savings after implementation	High cost savings

Figure 4. Skill mix classifications (Hall, 1997).

where the impact of nurse staffing and skill mix is more crucial (Aiken, et al., 2002; Blegen, Goode et al., 1998; McGillis Hall, Irvine Doran, Baker, Pink, Sidani, O'Brien-Pallas, Spence-Laschinger, Tourangeau, Besner, White, Tregunno, Thompson, Peterson, Seto, & Akeroyd, 2001).

Patient Safety

Harvard Medical Practice (Brennan, Leape, Laird, Hebert, Localio, Lawthers, Newhouse, Weiler, & Hiatt 1991) documented the types and numbers of errors occurring in New York. The results of this study were so startling that numerous other studies were conducted to see if the results would take place in other populations. By the mid-1990s, media sources began reporting various stories of medical errors, increasing the public's awareness and concern that started a grassroots safety movement. In response to the publics demand for safer medical care, various patient safety-related coalitions and organizations were created. In 1997, JCAHO implemented its controversial Sentinel Event Policy. This policy asked that the health care providers voluntarily report any unexpected occurrence involving death, serious physical/psychological injury, or the risk thereof to JCAHO and investigate the root cause of such incidences. Next, JCAHO revised standards and developed annual patient safety goals. The publication of the IOM—*To Err is Human: Building a Safer Health System* (1999) provided upsetting facts on how the health care field fell short in keeping patients safe and brought to the forefront the need for change. In response to the shocking statistics from the IOM, policymakers in Washington funded the creation of the AHRQ. AHRQ is the sister agency of the National Institutes of Health and specializes in patient safety, outcomes, delivery care systems, etc.

Staffing and Patient Safety

A collection of in-depth analysis of current research applicable to the purpose of this study is presented. Following individual examination of the listed studies combining the various variables under investigation, a chart (Figure 5) is provided highlighting how the theoretical framework was applied to breaking down each study.

Hours Worked Versus Outcomes

Stone et al. (2006) did a cross-sectional study comparing nurses working 8- and 12-hour shifts and quality patient outcomes. The researcher collected data from 99 adult inpatient units in 13 hospitals throughout New York City. Eight hundred-five nurses from the participating hospitals returned the nurse survey. The quality of patient care outcomes were measured using incident reports, patient discharge abstracts, and nurses' perceptions of quality were attained from the survey. Quality of patient care was also measured using incident reports by assessing medication errors per patient bed, patient falls per patient bed, and decubitus ulcer prevalence per patient bed. The results showed no difference in quality of patient care outcomes between 8- and 12-hour shifts. Scott et al. (2006) did a descriptive, exploratory study to determine if there was a relationship between the incidence of errors and the hours worked by critical care nurses. Logbooks were mailed to a random sample of 5,261 nurses that were members of the American Association of Critical-Care Nurses. Of the 5,261 nurses, 1,148 were eligible to participate in the survey, and 502 nurses returned completed logs. The logbooks collected information for 28 days on the hours worked, time of day worked, days off, sleep-wake pattern, and errors or near errors. The results indicated that the chance of errors or near errors increased with longer work hours.

Study	Input	Throughput	Output
Stone, et al.	Number of hours worked for RN. 8 vs. 12 hour shifts	Secondary analysis of incident reports & discharge abstracts. Nurse survey.	No difference in patient outcomes between 8 & 12-hour shifts.
Scott, et al.	Number of hours worked.	Secondary analysis of nurses' logbooks. Self-reporting.	Chances of errors or near misses increased with hours worked.
King	DOH guidelines of 2 RSCN on duty 24 hour per day.	Nurse Survey.	Recommendation of 3 RSCNs.
Aiken, et al.	Nurse - patient ratio & Mortality	Secondary analysis of discharge abstracts. Nurse survey.	Risk of mortality increased by 7% for every additional patient added on to nurse's workload after 4 patients.
Needleman, et al.	Relationship between mix, amount of care, & patient outcomes.	Secondary analysis of administrative data.	Higher portion & hours of nursing care by RN was associated with better care of hospital patients.
Hall, Doran, & Pink	Effects staffing level & mix on patient outcomes.	Questionnaire to Unit Managers. Secondary analysis of administrative data.	Lower the number of RNs the higher the medication errors & wound infections.
Smith & Bottoni	Improving medication errors and patient care.	Staff survey. Assess ED's pyxis.	Findings of how staff would react to reporting medication errors.
Fordyce, et al.	Investigate ED errors.	Personal Structured Interview of Staff.	Reported errors: 22% diagnostic studies. 16% admin procedures. 16% pharmacotherapy. 13% documentation. 12% communication. 11% environmental. 9% other.
Hobgood, et al.	Error identification, disclosure, & reporting experiences of ED nurses, physicians, & out-of-hospital personnel.	Nurses, physicians, & out-of-hospital personnel survey.	Did not identify clinical error in previous year. All participants were equally unlikely to report errors to care team. Physicians more likely to disclose errors to patients.
Henneman, et al.	How nurses recover medical errors in ED.	Focus groups with ED nurses.	Methods used by nurses to identify, interrupt, & correct errors.

Figure 5. Theoretical framework to applicable studies.

Levels and Patient Safety

King (2000) conducted a study in England to examine if the current Department of Health's (DOH) guideline of two registered sick children's nurses (RSCN) on duty 24 hours a day were adequate staffing levels on children's wards to provide a safe environment for the children and staff. King surveyed 13 nurses on the same children's ward to explore if the nurse's basic needs were being met and how many nurses were needed to ensure staff and patient safety. The results supported the need for at least three RSCNs on duty 24 hours a day to ensure the safety of children and staff.

Staffing Mix and Patient Outcomes

Aiken et al. (2002) performed a cross-sectional analysis to investigate the relationship between nurse-to-patient ratios and patient mortality. The study was conducted in Pennsylvania. Data were obtained from 10,184 staff nurse surveys, 232,342 discharge abstracts from general, orthopedic, and vascular surgery inpatients, and administrative data from 168 hospitals. The results showed the risk of patient mortality increased by 7% for every additional patient added to the nurse's workload after four patients.

Needleman et al. (2002) used administrative data of medical and surgical patients from 799 hospitals in 11 states to investigate the relationship between the amount of care provided by nurses and patient outcomes. The results indicated that a higher proportion of hours of nursing care by RNs and a higher number of hours of care by RNs were associated with better care of hospitalized patients. For medical patients, a higher proportion of hours of care provided by RNs and a higher number of hours of care provided by RNs per day were associated with a shorter length of stay and lower rates of urinary tract infections (UTIs) and upper gastrointestinal bleeding. A higher

proportion of hours of care provided by RNs were associated with lower rates of pneumonia, shock or cardiac arrest, and failure to rescue. For surgical patients, a higher proportion of care by RNs was associated with lower rates of UTIs. A higher number of hours of care provided by RNs were associated with lower rates of failure to rescue. There was no association between increased levels of staffing by RNs and the rate of in-hospital deaths. There was also no association of increased levels of staffing by LPNs and nurses' aides and the rate of adverse outcomes.

Hall et al. (2004) conducted a descriptive correlational study to examine the effect of staffing levels on patient outcomes (patient falls, medication errors, wound infections, and UTIs). The sample included 77 adult medical, surgical, and obstetric inpatient units from 19 hospitals in Ontario, Canada. Data were obtained through questionnaires to unit managers and administrative records. The results indicated the lower the number of professional nurses (RNs and registered practical nurses), the greater the number of medication errors and wound infections.

Emergency Department Specific

Schmidt and Bottoni (2003) conducted a survey in one ED of 58 staff members on barriers to reporting medication errors and "near misses." The ED secured machine containing medications (pyxis) was also assessed for medications that resembled each other, had similar sounding names in close vicinity, and medications with different doses. The researcher found that half of the participants would be more likely to report a "near miss" if the patient was not harmed, about half would report a colleague's medication error under certain circumstances, and 51% of the staff believed that there would be repercussions for reporting medication errors but felt they would receive support from their supervisors. The examination of the 278 medications in the ED pyxis machine

showed that nearly one-quarter were similar in appearance, name, or had different doses available.

Fordyce et al. (2003) conducted a prospective observational study to describe the types of errors taking place in an ED. The results demonstrate reported errors in diagnostic studies (22%), administrative procedures (16%), pharmacotherapy (16%), documentation (13%), communication (12%), environmental (11%), and other (9%).

Hobgood et al. (2004) investigated the error identification, disclosure, and reporting experiences of the three major types of emergency providers. Forty-two physicians, 33 nurses, and 41 out-of-hospital personnel (EMTs) from a tertiary care academic medical center were surveyed. The results indicated that 21% of physicians, 56% of nurses, and 45% of EMT had not identified a clinical error in the previous year. When errors were identified, physicians became aware of the errors through dialogue with nurses, patients, pharmacy, and attending physicians. All providers were equally unlikely to disclose to the team caring for the patient when errors were known. Disclosure to patients was limited and varied depending on provider type, with physicians being more likely (74%).

Henneman et al. (2006) performed a qualitative study to investigate how nurses recovered medical errors in the ED setting. Twenty nurses from the same ED participated in focus groups led by one of the researchers. The researcher discovered themes to describe the methods used by nurses to identify, interrupt, and correct medical error. The themes for identifying were surveillance, anticipation, double-checking, awareness of the "big picture," and experiential "knowing." The themes for interrupting included patient advocacy, offer of assistance, clarification, verbal

interruption, and creation of delay. The themes for correcting errors were assembling the team and involving leadership.

Using the theoretical framework of the OST model the above literature has been analyzed through the prism input–throughput–output. Figure 5 highlights the study, its focus of who and what (input), the sample design (throughput), and results (outputs).

Summary

In this chapter, the theoretical framework of the OST was presented. How the concepts of the OST related to EDs as a system was explored. A lengthy investigation into the available research was reviewed with the findings demonstrating that there is a relationship between staffing and patient outcomes. However, there is a gap in the research related to staffing and patient safety in EDs. In addition, the variable of patient safety is not specifically measured, it is assumed associated with patient care outcomes. Figure 5 highlights a summary of the reviewed literature within the framework of the OST. In Chapter III, the methodology of this study will be discussed, as well as the procedure of data collection and statistical analysis to interpret the raw data.

CHAPTER III

METHODOLOGY

Introduction

The purpose of this study was to investigate and describe how nurse staffing methods and nurse skill mix impacted patient safety in EDs. In this chapter, the methodology of the research study is presented beginning with the study design. A brief discussion of the identified variables is covered. Population, sampling plan, instrument for data collection, and data analysis are also presented.

Design of the Study

A descriptive cross-sectional research design was used in this study due to the lack of research and available information on ED staffing and patient safety as previously discussed. The aim of surveying ED managers in Wisconsin was to investigate and describe how nurse staffing methods and nurse skill mix impacted patient safety. Polit and Beck (2004) recommend using a cross-sectional design when collecting data during one period.

Variables

The independent variables in this study were the staffing methodologies and the nurse skill mix in the EDs. This was evaluated for their impact on patient safety, the dependent variable. As previously described, the nurse staffing method was measured through investigation of how the number of staff needed is decided. The nurse skill mix

was examined by looking at the proportion of hours of care provided by one category of caregiver (RN, LPN, UAP) divided by the total hours of patient care. Adverse patient events were used to measure patient safety. The adverse patient events that were looked at were specific to the ED and included: (a) medication errors, (b) patient falls, (c) sentinel events, (d) incorrect patient identification, (e) incorrectly labeling specimens, and (f) patient elopement.

Population, Sample and Setting

The target population for this study was any ED within the state of Wisconsin. The accessible population for this study was any ED on the AHA's mailing list. The AHA's mailing list contained the addresses and contact personnel for the use of research. The AHA required approval from their research department before the mailing list was purchased. A sample of 115 EDs from Wisconsin on the AHA mailing list were asked to participate in the study.

The setting was all EDs in the state of Wisconsin that were on the AHA's mailing list. The ED managers received the Emergency Department Survey (EDS) (Appendix A), which was self-administered. There was no face-to-face or verbal contact with the ED managers.

Data Collection Instrument

The majority of the available tools were for inpatient settings and not appropriate for ED usage. Other survey instruments located were for outpatient or ambulatory settings voiding their ability to gather the necessary data unique to EDs. A number of emergency and patient safety organizations were contacted with no success. Several

referrals to academic emergency medicine research departments were fruitless; however, guidance was offered on the construction of this tool. One hundred-fifteen surveys were mailed out to ED managers on the AHA mailing list.

The EDS was a researcher-developed, self-administered questionnaire. Questions one through seven consisted of the demographic background profile of the ED. Information on the location, ownership, trauma level, annual patient volume, and number of beds in the ED were collected. The background questions encompassed ED demographic information that may have an impact on the variables. Questions 8 through 10 investigated the staffing method of the ED and elicited qualitative data. Question 11 examined the nurse skill mix. The final section of the questionnaire assessed the number of adverse patient events specific to the ED in the previous 12 months as the measurement of patient safety.

This tool allowed the surveys to be mailed out across the state of Wisconsin. Self-administering questionnaires preserved the anonymity and confidentiality of the respondents, increasing the likelihood of participation and reducing response bias. Interviewer error and biases were reduced with mailed questionnaires according to Munro (2005). Constancy of communication was maintained through all of the participants receiving the same information, the same survey, and the same directions. Mailed questionnaires were convenient for the respondent to fill out when they had time. The self-administered survey allowed participants time to provide accurate data or consult with upper management if approval was needed.

Validity and Reliability

The reliability and validity of the EDS tool was unknown prior to mailing out the surveys. The reliability of a tool "is the consistency with which it measures the target attribute," according to Polit and Beck (2004, p. 416). The reliability of EDS occurred after the study. A panel of experts evaluated the content validity and provided feedback: "It is...common to use a panel of substantive experts to evaluate and document the content validity of new instruments" (Polit & Beck, p. 423). Feedback from the panel of experts guided modifications of the tool to increase its reliability and validity for future use.

Data Collection Procedure

Institutional Review Board (IRB) approval was obtained from the University of Wisconsin Oshkosh (Appendix B). The AHA's mailing list contained addresses of EDs for the use of research. The researcher assumed implied consent with the return of the survey. Information about EDs was collected and no information on individual patients was gathered. The cover letter (Appendix C) and information sheet (Appendix D) discussed confidentiality and reminded the ED managers not to use any identifying markers, such as hospital stationary. The ED managers received a self-addressed, stamped envelope to return the surveys. The ED managers had the opportunity to request a copy of the summary of the results of this study by emailing the researcher. Participation in the study was not required to receive a copy of the summary of results.

Participants, as described earlier, received a questionnaire with no identifying characteristics. The length of time needed to complete the survey was unknown. Three days prior to mailing out the survey, the researcher mailed an advance notice postcard

(Appendix E) to watch for the questionnaire. A reminder letter along with another copy of the survey was mailed out 2 weeks after the initial survey mailing. The deadline for inclusion in the study was 4 weeks after the initial mailing. The surveys was returned to a secured post office box and kept in a safe.

Data Analysis

This cross-sectional study utilized the Statistical Package for the Social Sciences (SPSS) program for analysis. The specific tests used were descriptive statistics, qualitative analysis, Pearson's r, analysis of covariance (ANCOVA), and multiple regressions to analyze the collected data and answer the research question. The purpose of the study was to investigate and describe how nurse staffing methods and nurse skill mix impacted patient safety. When describing the relationship between two variables, correlational statistics is used (Polit & Beck, 2004). Nurse staffing methods were analyzed using cue words from the literature review. The categories were then evaluated by two ED managers and an ED physician to ensure correct interpretation of data. Nurse skill mix and patient safety were measured using interval and ratio scales. Pearson's r is a type of correlation statistic utilized for variables measured on either an interval or a ratio scale. The researcher used Pearson's r to investigate the relationship between each of the independent variables (nurse staffing method and mix) and the dependent variable (patient safety). Multiple regressions were used to understand "the simultaneous effects of two or more predictors on a dependent variable" (Polit & Beck, p. 724). Multiple regression analysis was used to assess how nurse skill mix affected patient safety.

Limitations

1. The instrument was researcher developed and the reliability and validity is still in question due to low response rate and the standard confidence level of 95%.
2. The instrument measured patient safety by asking managers to review incident reports. It is known that incident reports depict a fraction of actual medical errors. (Khare, Uren, & Wears, 2005).
3. The findings were limited to EDs within the state of Wisconsin.
4. EDs with high adverse patient safety events may not have answered the survey accurately.
5. Not all surveys were completed.

Summary

This chapter discussed the proposed methodology of this descriptive cross-sectional study. A discussion of the independent, dependent, and extraneous variables was examined. The population, sample, and data collection process were discussed. An in-depth analysis of the researcher-developed instrument was presented using an expert panel to ensure validity and reliability. The data analysis techniques used were descriptive statistics, ANOVA, and multiple regression. A brief discussion of limitations was examined. Chapter IV will discuss the research findings from this study with a brief discussion of how they relate to the studies discussed in Chapter II.

CHAPTER IV

FINDINGS AND DISCUSSION

Introduction

The purpose of this study was to investigate and describe how nurse staffing methods and nurse skill mix impacted patient safety in EDs. Preliminary data analyses are reported, including examining all surveys for completeness and accuracy. Following these findings is the description of the demographic data, the results of the survey questions and statistical analyses. A comparison to previous research studies is laid out and discussed. Briefly, the validity and reliability of the researcher designed data collection tool will be examined.

Preliminary Data Analysis

Collected surveys were reviewed for incomplete and missing data. As surveys were returned without identifying data, discrepancies could not be corrected. Incomplete and missing data were left blank during data entry to distinguish between no answer versus an answer of zero. Qualitative questions were independently coded and checked for correctness of interpretation against coding performed by two ED managers and an ED physician. The reliability between coders was 0.91.

Sample Description

Of the 115 surveys mailed out, 59 were returned. One was returned unopened and one was from a long-term facility, leaving 57 surveys for analysis, a return rate of 49%. Survey questions one through seven-collected background information about the

participating ED. From the responses to these questions a comprehensive demographical account of participating EDs was developed.

Description of Demographic Data

As stated earlier, the sample consisted of all EDs listed on the AHA's mailing list. The demographic data from this population are presented below and summarized in Table 1. The location of EDs were 66.7% (n=38) rural and 31.6% (n=18) urban. Most of the participating EDs were private not-for-profit (87.7%, n=50) with 5.3% (n=3) being government nonfederal, 3.5% (n=2) being private investor owned, and one (1.8%) marked both private not-for-profit and private investor owned. Twenty-eight (49.1%) of the EDs offered urgent care in the ED and considered it when staffing EDs. Trauma levels of participating EDs are as follows: 1.8% (n=1) Level I, 3.5% (n=2) Level II, 50.9% (n=29) Level III, 28.6% (n=22) Level IV, 1.8% (n=1) Level V, 3.5% (n=2) non-designated. The annual patient volume (census) ranged from 1,300 to 80,000 with a mean volume of 15,881.37 and a median of 13,400. The number of beds in the ED ranged from 2 to 36 with a mean number of beds being 12.35 and median of 11 beds.

Table 1

Demographic Characteristics of Sample Population

Variable	n	Percent
Location		
Rural	38	66.7
Urban	18	31.6
Ownership		
Government nonfederal (1)	3	5.3
Private not-for-profit (2)	50	87.7
Private investor owned (3)	2	3.5
2 & 3	1	1.8
Provide Urgent Care		
Yes	28	49.1
No	29	50.9
Urgent Care Included in Staffing ED		
Yes	28	49.1
No	16	28.1
No answer	13	22.8
Trauma Level		
Level I	1	1.8
Level II	2	3.5
Level III	29	50.9
Level IV	22	38.6
Level V	1	1.8
Non Designated	2	3.5

Variables

Research Question

How does nurse staffing methods and nurse skill mix impact patient safety in EDs? The independent variables in this question were nurse staffing methods and nurse skill mix. Survey questions 8 through 11 collected this data. The dependent variable was patient safety. Patient safety was measured using relevant JCAHO PSI

and participating EDs' incident reports. Survey question 12 collected this information. The following discussion reports the findings of each of these survey questions and the results of various statistical analyses used to interpret the data.

Independent Variables

Nurse Staffing Methodologies

In staffing the EDs, 40.4% (n=23) utilized a descriptive methodology, 26.3% (n=15) utilized Industrial engineering, 31.6% (n=18) utilized management engineering, and 1.8% (n=1) utilized operational research (Figure 6). The methodologies were used to staff the EDs for more than 1 year (87.7%, n=50), 1 year (5.35%, n=3), and less than 1 year (7.0%, n=4).

Nurse Skill Mix

The majority of the participants provided an estimated (54.4%, n=31) versus actual (29.8%, n=17) reporting of skill mix. Nine (15.8%) EDs had a skill mix of 100% RNs, 6 (10.5%) had a complementary mix, 13 (22.8%) had a substitution mix, 10 (17.5%) had a blended mix, and 9 (15.8%) were classified as other (Figure 7).

Dependent Variables

Patient Safety

Adverse patient events were used to measure patient safety (Figure 8). The adverse patient events that were looked at were specific to the ED. Table 2 details the results of the data collected.

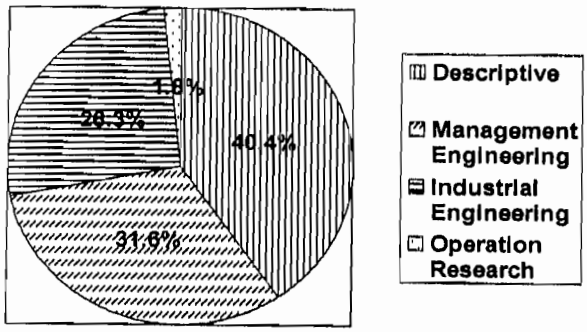


Figure 6. Staffing methods.

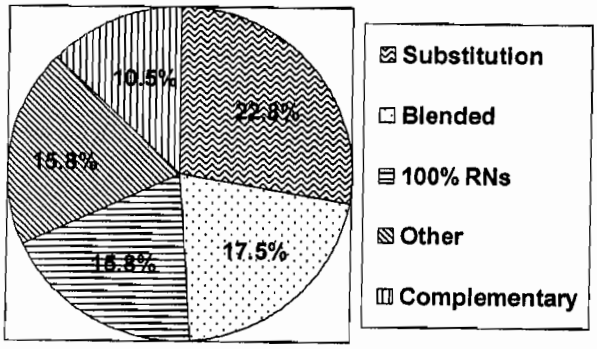


Figure 7. Nurse staffing mix.

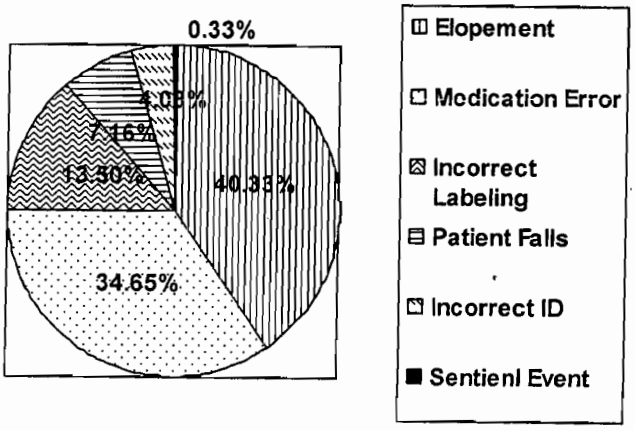


Figure 8. Percentages of reported adverse patient outcomes.

Table 2

Measures of Central Tendency—Outcome Variables

Variable	n	Mean	Standard Deviation (SD)
Medication Error	49	8.59	21.355
Patient Falls	50	1.76	1.954
Sentinel Events	48	0.08	0.279
Elopement	46	10.63	32.969
Incorrect ID	51	0.96	1.928
Incorrect Specimen Labeling	48	3.42	6.671
Medication Error & Sentinel Events	46	9.24	21.9

Statistical Analyses

Fifty-seven usable surveys were mailed back from the 115 distributed. According to Polit and Beck (2004), a comparatively small sample is sufficient if a strong relationship is known. With a 95% confidence level, a power analysis indicated that 89 surveys were needed to produce meaningful findings.

ANCOVA

ANCOVA was used to analyze how nurse staffing methods impacted patient safety in the EDs. ANCOVA is suggested for analysis between two or more group means when the independent variable has nominal level measurement and there is a need to control one or more covariates (Polit & Beck, 2004). The qualitative analysis of question eight placed the nurse staffing methods into different categories, nominal level measurement. ANCOVA allowed each ED's method to be evaluated while controlling for the covariate of volume. There was no significant relationship between staffing

methodologies and total errors (f = 3.47 = 0.14; p = .94; partial eta squared = .009). Table 3 shows the results of the ANCOVA between staffing methodologies and total errors. Staffing methodologies were then examined against medication errors and sentinel events combined (f = 3.40 = 0.14; p = 0.28; partial eta squared = 0.089). In this analysis, the Industrial Engineering staffing methodology had a higher rate of errors relative to the other methodologies. The rate was not significant due to sample size, but given the severity of outcomes and the sample size the difference is worth noting. Table 4 presents the results of the ANCOVA between staffing methodologies and the combined medication errors and sentinel events.

Table 3

ANCOVA Between Staffing Methodologies and Total Errors

Staffing Method	Mean	SD	*n*	*f*	*p*
				0.14	0.94
Descriptive	19.61	34.58	23		
Industrial Engineering	29.91	41.69	11		
Management Engineering	25.29	46.96	17		
Operation Research	24		1		
Total	23.73	39.56	52		

Table 4

ANCOVA Between Staffing Methodologies and Medication Errors/Sentinel Events

Staffing Method	Mean	SD	*n*	*f*	*p*
				0.14	0.28
Descriptive	5.05	7.43	19		
Industrial Engineering	20.82	42.53	11		
Management Engineering	6.27	6.39	15		
Operation Research	6		1		
Total	9.24	21.9	46		

A closer inspection was required after reviewing the standard deviations between nurse staffing methods and medication errors/sentinel events. One data point of 146 errors skewed the results in the category of industrial engineering. Removing this data point lowered the statistical mean (8.3; SD = 9.7). However, the results maintained a substantial error rate over other nurse staffing methods with a 40% increase between industrial engineering and descriptive methodologies. Due to the severity of the consequences to patient safety, a least significant difference (LDS) post hoc analysis was completed. Post hoc testing examines the combination of variables to identify significant differences between them (Munro, 2005). This analysis revealed a difference between industrial engineering and descriptive nurse staffing methodologies at p = .28. the post hoc analysis was also limited by the sample size and lacked adequate power.

Multiple Regressions

Multiple regressions were used to analyze how nurse skill mix impacted patient safety in the EDs. The nurse skill mix used were actual data supplied from the EDS and was examined as continuous variables, instead of categorical measurement, to provide for better data analysis. Multiple regressions were initially calculated with all of the variables to see if they predicted total errors (Table 5). Number of ED beds approaches significance (p = 0.054). Multiple regressions were then used to analyze the variables as predictors for medication errors and sentinel events combined as major indicators of patient safety (Table 6). From this analysis, annual patient volume and number of ED beds were significant predictors of medication errors and sentinel events (p = 0.003, p = 0.000, respectively). The analysis showed that the trauma level could also be a contributing factor (p = 0.092). The regression was then repeated with only variables that appeared to be approaching significance for medication errors and sentinel events

to increase the degrees of freedom given the current sample size (Table 7). Annual patient volume and the number of ED beds remained significant predictors of medication errors and sentinel events while the trauma level only approached significance ($p = 0.000$, $p = 0.000$, $p = 0.063$, respectively).

Table 5

Multiple Regressions With Total Errors as Dependent Variable

Variable	Beta	*p*
Location	.384	.208
Urgent Care	.084	.877
Annual Patient Volume	-.627	.106
Number of ED Beds	.741	.054
Nurse Skill Mix	.084	.661
Trauma Level	.251	.369

Table 6

Multiple Regressions With Medication Errors/Sentinel Events

Variable	Beta	*p*
Location	.014	.953
Urgent Care	.041	.922
Annual Patient Volume	-.968	.003
Number of ED Beds	1.249	.000
Nurse Skill Mix	-.871	.394
Trauma Level	.388	.092

Table 7

Repeated Multiple Regressions With Medication Errors/Sentinel Events

Variables	Beta	*p*
Annual Patient Volume	-.876	.000
Number of ED Beds	1.133	.000
Trauma Level	.299	.063

Pearson Correlation

A two-tailed Pearson correlation was calculated between all of the variables in the study. Pearson correlation indicates the degree of the relationship between two variables (Polit & Beck, 2004). The noteworthy information related to answering the research question is illustrated in Table 8. The full correlation matrix can be found in Appendix F.

Table 8

Pearson Correlation Matrix

	RN	*p*	LPN	*p*	UAP	*p*	EMT-P	*p*
Patient falls	-.034	0.825	-.616	0.104	.168	0.350	-.936	0.229
Elopement	.183	0.266	-.438	0.278	.042	0.833	.987	0.104
Incorrect patient ID	.002	0.990	-.427	0.291	-.253	0.156	.773	0.437
Incorrect specimen label	-.079	0.625	-.553	0.123	-.012	0.949	-.936	0.229
Medication errors/sentinel events	-.124	0.444	.108	0.798	-.153	0.413	.639	0.558

Note: n ranges from 3 to 44

Discussion

The research results address nurse staffing methodologies, nurse skill mix, and patient safety in EDs. Each variable is discussed below in comparison to other research contained in this study. In addition, the reliability and validity of the data collection instrument is discussed.

Nurse Staffing Methods

Staffing is the systematic process of determining the number of nursing personnel needed to provide a certain level of care to patients (Aydelotte, 1973). There was an

endless list of descriptions used to establish the number of nursing personnel required to deliver care in the ED. Several appeared to be specific to their ED. While a few descriptions repeated, such as "grid," "MESH," and "ENA Staffing Matrix," most responded that staffing was based on historical patient census. The most rigorous of studies cannot be universally applied to all medical settings (Seago, 2001). The results of this study reinforced that no universal application of staffing can be made to EDs. Each ED had a unique description of how the ED was staffed.

With a larger sample, the consequence of using the industrial engineering nurse staffing method may show a statistical significance. Due to the number of errors contributed to this staffing method, the results of this study may have practical significance. The industrial engineering method of staffing focuses on productivity and/or management's performance goals. This method had a noteworthy higher level of errors than other methods.

Nurse Skill Mix

Nurse skill mix is the combination of RNs, LPNs, and UAPs (Aiken, et al., 2002; Blegen et al., 1998; Buchan & Dal Poz, 2002; Hall et al., 2004; Mc Gillis et al, 2001; Seago, 2001). An additional personnel category was identified from the surveys. Emergency medical technicians-paramedics were found to be delivering care to patients in EDs as well. Hall's (1997) skill mix taxonomy may need to be adapted to include a category below her current blended classification of 66% RNs. Nearly 16% of EDs were using less than a 3 to 1 ratio for direct and indirect care of patients. A research question that may warrant further investigation is the reason behind the further reduction of the RNs' role in the ED. Is it because of cost savings (Manuel & Alster, 1994) or RNs

adapting as effective managers, enabling additional supporting cast (Blegen & Vaughn, 1998), or the shortage of qualified personnel (Geolot, 2000)?

With a larger sample, the small correlations between RNs and EMT-P with the combination of medication errors and sentinel events may have become significant findings. The EMT-P in this study was four times more likely to have a correlation of medication errors and sentinel events combined than any other nursing personnel. Only three EDs wrote EMT-Ps as a separate category; it is unknown whether additional EDs employed EMT-Ps and categorized them in another classification. A larger sample in the current study may have reinforced other studies findings that have shown RNs to have an inverse association with errors and, therefore, a positive impact on patient safety (Hall et al., 2004; Needleman et al., 2002).

Patient Safety

Like other research, this study measured patient safety using adverse patient outcomes based on PSIs from JCAHO's National Patient Safety Goals (2003) as a way to identify events that could have been prevented (Hall, et al., 2004; JCAHO, 1997; Needleman, et al., 2002; Romano, et al., 2003; Scott, et al., 2006; Stone, et al., 2006). The PSIs studied were medical errors, patient falls, sentinel events, incorrect identification, and incorrect specimen labeling. Schmidt and Bottoni (2003) researched how staff reacted to reporting medication errors in the ED. Fifty-one percent believed that there would be repercussions. Even with guaranteed anonymity, 20% of the participating EDs did not complete the incident report section of the survey. This was reinforced by the Hobgood et al. (2004), who investigated errors identifications, disclosure, and reporting experiences. Again, all major providers of emergency healthcare were equally unlikely to disclose errors. Incorrect labeling at 13.5% of total

errors in this study reflects the findings of Fordyce et al. (2003) observational study of errors taking place in the ED. The largest category in the variable of patient safety was elopement, with 40% of reported errors. Patient elopement is the disappearance of patients (Corrigan, 2006).

With a larger sample, the small correlations between nurse staffing methods, nurse skill mix, and the combined PSI of medication errors and sentinel events may have shown significant findings. Potentially significant correlations may have been:

1. The inverse correlation between patient falls, LPNs ($p = .104$), and EMT-Ps ($p = .229$).
2. A positive correlation between elopement, RNs ($p = .266$), and EMT-Ps ($p = .104$), with an inverse correlation with LPNs ($p = .278$).
3. An inverse correlation between incorrect patient identification, LPNs ($p = .291$) and UAPs ($p = .156$) with a positive correlation with EMT-P ($p = .437$).
4. An inverse correlation between incorrect specimen labeling, LPN ($p = .123$), and EMT-P ($p = .229$).

Summary

In this chapter, the preliminary data analyses were reported and how the collected data was processed prior to being entered in for statistical analysis. The demographic characteristics of the sample were described. The results of the survey questions and statistical analyses were reported and analyzed. Finally, the results were connected to the other research studies contained in the Introduction and Review of Literature.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

Chapter V presents an overview summary of the study and its results, beginning with the validity and reliability of the data collection tool. Conclusions will be drawn from this investigation and describe how nurse staffing methods and nurse skill mix impacted patient safety in EDs. The relevance of the theoretical framework used to guide this study is discussed. Implications and the practical applications of the results will be presented. Finally, the recommendations for future research will be discussed.

Validity and Reliability

The underlying assumption of this investigation was that the guaranteed anonymity would create a sense of security for ED managers to response without reprisal. A further assumption was that incidents would be tracked, correct, and up-to-date for the last 12 months. It was assumed that terminology definitions were uniform and language was shared. Overall, EDS measured what it was intended to measure.

The survey could be further modified by including specific categories of nurse staffing models with descriptions to make the measurement of that variable quantifiable instead of qualitative. An additional classification of EMT-P in skill mix could also be added to gather a more accurate accounting of the nursing personnel delivering care in EDs. A scale may improve the data collected by question 10: What is the approach used to staff the department based on skill mix?

Reliability of the EDS was 91.2% agreement between the panel members when interpreting the qualitative questions. Further testing will be required to confidently conclude that the EDS is a reliable data collection instrument as reliability is based on "the consistency with which its measures the target attribute" (Polit & Beck, 2004, p. 416).

Study Summary

The purpose of this study was to investigate and describe how nurse staffing methods and nurse skill mix impacted patient safety in EDs in order to address the question: How does nurse staffing methods and nurse skill mix impact patient safety in EDs? Although the literature review revealed an association between nurse staffing and patient safety for inpatient populations, there was limited available research on the relationship between nurse staffing methods, nurse skill mix, and patient safety in EDs.

The research question was evaluated by examining the ED as a system using Katz and Kahn's Open Systems Theory. In this theoretical framework, patients are the inputs into the system (EDs), nurse staffing methods and nurse skill mix are the throughput and patient outcomes in the form of PSIs are the output. PSIs are widely used as indicators for measuring patient safety across the healthcare field.

A descriptive cross-sectional design was used to investigate nurse staffing methods, nurse skill mix, and their impact on patient safety. The setting was Wisconsin's EDs listed with the AHA. All ED managers on this list received the EDS. The EDS was a researcher-designed data collection tool that investigated nurse staffing method, nurse skill mix, and measured patient safety by examining the frequency of PSI in EDs.

Survey questions one through seven gathered demographic data of the EDs. Questions 8 through 11 collected specific data on nurse staffing methodologies and nurse skill mix. Question 12 collected the frequency of adverse patient events from incident reports that mirrored the relevant PSI for measuring patient safety in EDs. Fifty-seven surveys were mailed back from the 115 distributed. According to Polit and Beck (2004), a relatively small sample is adequate if a strong effect is expected. Based on the required 95% confidence level, 89 surveys were needed to produce significant findings. As a result, 57 usable surveys led to inconclusive results (Polit & Beck, 2004, p. 301).

The statistical analyses used to analyze the data and attempt to answer the research question were descriptive, analysis of covariance (ANCOVA), qualitative analysis, and multiple regressions. The first set of tests developed the demographical description of the participating EDs. The qualitative analysis categorized the staffing methodologies so an ANCOVA could be used to compare nurse staffing methodologies and adverse patient outcomes. Finally, multiple regressions were completed to identify predicting variables. Findings from the statistical analysis are highlighted:

1. Industrial engineering method of nurse staffing had a higher level of errors than other methods.
2. The ET-Ps were four times more likely to be correlated with medication errors and sentinel events combined.
3. Registered nurses have an inverse association with medication errors/ sentinel events.
4. Incorrect labeling was 13.5% of total errors.
5. The largest category in the variable of patient safety was elopement, with 40% of reported errors.

6. Patient falls had an inverse correlation with LPNs and EMT-Ps.
7. Elopement had a positive correlation with RNs and EMT-Ps and an inverse correlation with LPNs.
8. Incorrect identification was inversely correlated with LPNs and UAPs and positively correlated with EMT-Ps.
9. Incorrect specimen labeling was inversely correlated with LPNs and EMT-Ps.

Conclusions

Eighty-nine surveys were needed to produce meaningful findings. Fifty-seven usable surveys were mailed back from the 115 distributed; as a result, no definitive conclusions could be drawn from this study. However, there maybe evidence linking industrial engineering to a higher rate of errors. Another conclusion is that EMT-Ps have higher rates of medication errors and sentinel events combined in EDs. Yet another conclusion is that RNs have an inverse correlation with the same combination of errors. Finally, patients are eloping or leaving EDs before receiving care. Despite this study's limitations, it served to test the validity and reliability of the data collection instrument.

From a theoretical application, the conclusion that can be gleamed from this study is that ED is a system, not only in theory, but also in reality. The results from this study demonstrated the dynamic nature and interdependency of nurse staffing, nurse skill mix, and patient safety. No one variable happens in a vacuum. Patient safety is one of the most publicized variables in this study because of the publication of *To Err Is Human: Building a Safer Health System* (Kohn et al., 1999).

Nurse staffing and nurse skill mix are so tightly interwoven that they were interchangeable throughout the review of literature. Nothing can happen without the

input of a patient. Without the input, there would be no need to study nurse staffing or nurse skill mix. In order to complete the cycle, the obvious output to evaluate the throughput of nurse staffing and nurse skill mix is patient safety by examining adverse patient events.

Implications

The practical application of this research would be for ED managers to consider more than just historical census data when determining the appropriate number of staff. As indicated by the higher rate of errors in EDs when using the industrial engineering method. In addition, closer evaluation of the EMT-P knowledge, skill, and ability is warranted due to the correlation of increased medication errors and sentinel events combined. An action plan needs to be developed to reduce the elopement rate of patients.

Administrators, policymakers, and managed care providers need to be cautious in allowing the proportion of RNs to continue to drop for the sake of profit goals. The inverse correlation between the higher number of RNs and the lower number of medication errors and sentinel events combined, demonstrates the need for a higher level of RNs in the skill mix. The potential cost of doing nothing could result in loss of reputation, community goodwill, and legal wrangling from lawsuits.

For the education of nursing professionals, this study, despite its limitation offers a better understanding of the potential consequences of nurse staffing and nurse skill mix toward the adverse patient outcome; patient safety in EDs. A broader view of determining the personnel needed to deliver care is needed beyond reviewing patient volume, patterns, and making blanket task assignments. Planning, organizing, leading,

and controlling are essential skills needed by all RNs and especially NPs in today's health care environment of managed care.

Recommendations for Further Research

Mechanics

1. The most incontrovertible recommendation for future research is the need for a larger sample. Narrowing the scope to the state of Wisconsin and a list of 115 EDs was too limiting. The required responses for such a small population would have necessitated at least 89 surveys to be mailed back. Research states that most self-administered mail survey will only see a 6% to 8% return rate (Munro, 2005).
2. Reuse the data collection procedure. Return rate of surveys was 49%.
3. Make modifications: (a) Add classification of EMT-P and other in skill mix, (b) include specific categories of nurse staff models with descriptions to make the measure of that variable quantifiable rather than qualitative, and (c) add definitions to terms to ensure a shared language.

Findings

1. Investigate nurse staffing methods that have the following characteristics: Focus on productivity measures or management goal objectives, adjust staffing needs based on historical patient census. These characteristics may result in higher patient safety incidences than any other nurse-staffing model.
2. Additional research may alter Hall's (1997) taxonomy to include a classification with lower than 65% RN. What is the reasoning behind this

further reduction of RNs' role in the ED? Are RNs adapting to their new leadership and managerial role, enabling a greater use of LPNs, EMT-Ps, and UAPs without affecting patient care?

3. Investigate EMT-P role in EDs using relevant PSI. Is there a correlation between EMT-P and medication errors/sentinel events?
4. Finally, investigate why patients are eloping or leaving EDs before receiving care.

Chapter Summary

In this chapter an overview of the research study was given and its results. Several conclusions were specified as to how nurse staffing methods and nurse skill mix impacted patient safety in EDs. The relevance of the theoretical framework was discussed showing how the inputs, throughputs, and outputs were used to guide this study. An outline of the potential implications of the results for nursing practice, education, and administration was explored. Finally, two categories of recommendations for future research were discussed.

APPENDIX A

Emergency Department Survey

Emergency Department Survey

1. What is the location of your Emergency Department?

Rural ___ Urban ___

2. What is the ownership type of your Emergency Department?

Government nonfederal (public) ___ Private not-for-profit (voluntary) ___

Private investor owned (proprietary) ___

3. Does your Emergency Department offer Urgent Care?

Yes ____ No _____

4. Is the Urgent Care considered in the staffing and statistics of the Emergency Department?

Yes____ No_____

5. What is the designated Trauma Level of your Emergency Department?

Level I ___ Level II ___ Level III ___ Level IV ___ Level V ___

Non designated ___

Please respond to the following questions.

6. What is the annual patient volume (census)?

_____

7. Number of Beds in the department?_____

8. How do you determine the number of staff needed in the Emergency Department at one time?

_____

_____

_____

_____

9. How long has your current method of staffing been used?

Less than 1 year ____ 1 year ____ More than 1 year ____

10. What is the approach used to staff the department based on the skill mix of staff? (RN, LPN, Unlicensed Assistive Personnel) (Explain process used for a 24-hour period)

_____

_____

11. What is the estimated or actual skill mix? (The percentage of hours of care provided by one category of caregiver divided by the total hours of care.)

Registered Nurses _____ Licensed Practical Nurses _____

Unlicensed Assistive Personnel ____

These are (circle one) Estimated Actual

Please review incident reports and indicate the number of occurrences within the last twelve months for each patient safety incident.

Medication errors _____ Patient falls _____

Sentinel events _____ Elopement _____

Incorrect patient identification _____ Incorrectly labeling lab specimens _____

The following are questions pertaining to the survey.

How long did the survey take to complete? _____

The survey was easy to use. (Circle one)

5 – Strongly Disagree 4 – Disagree 3 – Neutral 2 – Agree 1 – Strongly Agree

Feedback on ways to improve the study.

Does the survey appropriately measure staffing? (Circle one) Yes No

Please explain.

Does the survey appropriately measure patient safety? (Circle one) Yes

No

Please explain.

Any other comments.

THANK YOU FOR YOUR TIME!

APPENDIX B

UW Oshkosh IRB Approval Letter

December 3, 2007

Ms.Nekole Ecklor
W7023 Everglade Rd.
Greenville, WI 54942

Dear Ms. Ecklor:

On behalf of the UW Oshkosh Institutional Review Board for Protection of Human Participants (IRB), I am pleased to inform you that your application has been approved for the following research: Patient Safety and Staffing in Emergency Departments.

Your research has been categorized as EXEMPT. This means you will not be required to obtain signed consent. However, unless your research involves **only** the collection or study of existing data, documents, or records, you must provide each participant with a summary of your research that contains all of the elements of an Informed Consent document, as described in the IRB application material. Permitting the participant, or parent/legal representative, to make a fully informed decision to participate in a research activity avoids potentially inequitable or coercive conditions of human participation and assures the voluntary nature of participant involvement.

Please note that it is the principal investigator's responsibility to promptly report to the IRB Committee any changes in the research project, whether these changes occur prior to undertaking, or during the research. In addition, if harm or discomfort to anyone becomes apparent during the research, the principal investigator must contact the IRB Committee Chairperson. Harm or discomfort includes, but is not limited to, adverse reactions to psychology experiments, biologics, radioisotopes, labeled drugs, or to medical or other devices used. Please contact me if you have any questions (PH# 920/424-7172 or e-mail:rauscher@uwosh.edu).

Sincerely,

Dr. Frances Rauscher
IRB Chair

cc: Jill Collier
1267

APPENDIX C

Cover Letter

December 9, 2007

Dear (ED Manager Name),

My name is Nekole Ecklor. I am a graduate student from the University of Wisconsin Oshkosh. I am conducting a study as a partial requirement of my master's degree in nursing. I obtained a list of emergency room addresses from the American Hospital Association and your emergency department was selected to participate in a pilot study. The purpose of this study is to validate the survey for understandability and reliability of the measurements. I appreciate and welcome your feedback.

The aim of this study is to describe the impact of nurse staffing and patient safety in emergency departments. The enclosed Emergency Department Survey (EDS) requests information regarding nurse staffing and medical errors (incident reports). Throughout my coursework there has been limited studies found regarding this topic. Your contribution could help make our Emergency Departments safer. If you would like a copy of the summary of the results of the study, please email me requesting a copy at necklor@milwpc.com. Participation in the study is not required to receive a copy of the summary of the results.

YOUR ANONIMITY AND CONFIDENTIALITY IS GAURANTEED.

There are no identifying characteristics on the survey or return envelope. To maintain anonymity and confidentiality, do not put identifying information on the survey or return envelope. Please answer the survey in its entirety and return in the stamped, self-addressed envelope by **December 30, 2007.**

If there are any questions, you may reach me at either (920)757-9089 or necklor@milwpc.com. Thank you for taking time to complete this survey.

Sincerely,

Nekole Ecklor

Nekole Ecklor

APPENDIX D

Information Sheet

Information Sheet

The purpose of this summary is to describe the research study, Patient safety and staffing in emergency departments, and to explain the study's scope, aims, and purpose.

1. The reasonably expected benefits of the project include:
   a. The benefit to your Emergency Department on gaining more information on how staffing impacts patient safety.

   b. The benefit to society due to the acquisition of knowledge that may eventually lead to improved patient safety.

2. The procedure that will be used involve the completion of the Emergency Department Survey.

3. There are no risks of harm that could result from your participation in the project.

4. The expected duration of your participation is about 30 minutes.

5. Your participation in this study is completely voluntary. You do not have to participate and you can stop at any time. If you refuse to participate now, or withdraw from the study later, it will have no effect on any regular services or benefits available to you at the University of Wisconsin Oshkosh.

6. Any personal information used in this study will be treated confidentially. Information which identifies you as an individual will not be released, without your consent, to anyone for the purposes which are not directly related to this research study.

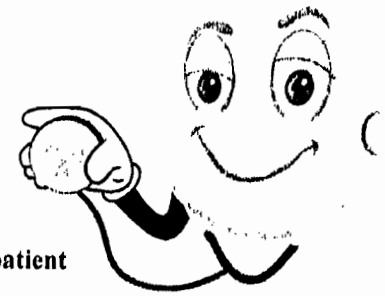
7. If you have any question about this study, or your rights, you may call or write:
   Nekole Ecklor, W7023 Everglade Road, Greenville, WI 54942 920-757-9089
   or
   Chair, Institutional Review Board for protection of Human Participants
   c/o Grant Office UW Oshkosh, Oshkosh, WI 54901 920-424-1415

8. This is your copy of this statement, which serves to acknowledge the fact that you have been informed about the project and that you voluntarily agreed to participate.

APPENDIX E

Advance Notice Postcard

Emergency Dept Survey



Your department has been selected to participate in a study investigating the relationship between nurse staffing and patient safety!

I am a graduate student at the University of Wisconsin, Oshkosh. Within the next week you will receive the Emergency Department Survey. The survey will collect data on staffing and patient safety incidents.

Prize: A copy of the results.

Your cooperation would be appreciated!

Mandy Eaton

APPENDIX F

Full Correlation Matrix

Correlation Matrix

		RN	LPN	UAP	EMT_P	Total Error
Location	Pearson correlation	-.126	-.505	.281	-.936	.125
	Sig (2-tailed)	.397	.166	.097	.229	.377
	N	47	9	36	3	52
Urgent Care	Pearson correlation	.164	-.570	-.035	.936	.056
	Sig (2-tailed)	.265	.109	.838	.229	.694
	N	48	9	37	3	52
Staffing Stat	Pearson correlation	.203	-.341	.009	1.00**	-.075
	Sig (2-tailed)	.242	.454	.965	.	.652
	N	35	7	26	2	39
Volume	Pearson correlation	-.176	-.552	.221	-.721	.084
	Sig (2-tailed)	.233	.124	.188	.488	.553
	N	48	9	37	3	52
Beds	Pearson correlation	-.179	-.591	.107	-.845	.166
	Sig (2-tailed)	.224	.094	.528	.360	.239
	N	48	9	37	3	52
RN	Pearson correlation	1	-.627	-.641**	-.923	.040
	Sig (2-tailed)		.071	.000	.252	.792
	N	48	9	37	3	45
LPN	Pearson correlation	-.627	1	-.397	.a	-.047
	Sig (2-tailed)	.071		.330	.	.904
	N	9	9	8	0	9
UAP	Pearson correlation	-.641**	-.937	1	-1.00**	-.188
	Sig (2-tailed)	.000	.330		.	.287
	N	37	8	37	2	34
EMT_P	Pearson correlation	-.923	.a	-1.00**	1	-.031
	Sig (2-tailed)	.252	.	.		.980
	N	3	0	2	3	3
Total Error	Pearson correlation	.404	-.047	-.188	-.031	1
	Sig (2-tailed)	.792	.904	.287	.980	
	N	45	9	34	3	52
Patient Falls	Pearson correlation	-.034	-.616	.168	-.936	.140
	Sig (2-tailed)	.825	.104	.350	.229	.338
	N	44	8	33	3	49
Sentinel Events	Pearson correlation	.095	.a	.118	.a	-.115
	Sig (2-tailed)	.544	.000	.519	.000	.442
	N	43	8	32	3	47
Elopement	Pearson correlation	.183	-.438	.042	.987	.821**
	Sig (2-tailed)	.266	.278	.833	.104	.000
	N	39	8	28	3	46
Incorrect ID	Pearson correlation	.002	-.427	-.253	.773	.123
	Sig (2-tailed)	.990	.291	.156	.437	.389
	N	44	8	33	3	51
Incorrect Label	Pearson correlation	-.079	-.553	-.012	-.936	.141
	Sig (2-tailed)	.625	.123	.949	.229	.340
	N	41	9	30	3	48

Medication_Sentinel	Pearson correlation	-.124	.108	-.153	.639	.577**
	Sig (2-tailed)	.444	.798	.413	.558	.000
	N	40	8	31	3	46
ContTrauma	Pearson correlation	.085	.435	-.151	.987	-.010
	Sig (2-tailed)	.571	.282	.379	.104	.944
	N	47	8	36	3	50

		Patient Falls	Sentinel Events	Elopement	Incorrect ID	Location
Location	Pearson correlation	.392**	-.058	.124	.257	1
	Sig (2-tailed)	.005	.698	.411	.068	
	N	49	47	46	51	56
Urgent Care	Pearson correlation	-.103	.000	.187	-.083	.000
	Sig (2-tailed)	.475	1.000	.213	.565	1.000
	N	50	48	46	51	43
Staffing Stat	Pearson correlation	-.124	.087	.052	-.162	-.057
	Sig (2-tailed)	.459	.607	.764	.323	.717
	N	38	37	36	39	43
Volume	Pearson correlation	.571**	-.187	.048	.531**	.704**
	Sig (2-tailed)	.000	.202	.750	.000	.000
	N	50	48	46	51	56
Beds	Pearson correlation	.627**	-.172	-.060	.418**	.665**
	Sig (2-tailed)	.000	.242	.690	.002	.000
	N	50	48	46	51	56
RN	Pearson correlation	-.034	.095	.183	.002	-.126
	Sig (2-tailed)	.825	.544	.266	.990	.397
	N	44	43	39	44	47
LPN	Pearson correlation	-.616	.a	-.438	-.427	-.505
	Sig (2-tailed)	.104	.000	.278	.291	.116
	N	8	8	8	8	9
UAP	Pearson correlation	.168	.118	.042	-.253	.281
	Sig (2-tailed)	.350	.519	.833	.156	.097
	N	33	32	28	33	36
EMT_P	Pearson correlation	-.936	.a	.987	.773	-.936
	Sig (2-tailed)	.229	.000	.104	.437	.229
	N	3	3	3	3	3
Total Error	Pearson correlation	.140	-.115	.821**	.123	.125
	Sig (2-tailed)	.338	.442	.000	.389	.377
	N	49	47	46	51	52
Patient Falls	Pearson correlation	1	-.054	.194	.182	.392**
	Sig (2-tailed)		.725	.212	.215	.005
	N	50	45	43	48	49
Sentinel Events	Pearson correlation	-.054	1	-.059	-.136	-.058
	Sig (2-tailed)	.725		.707	.361	.698
	N	45	48	43	42	47
Elopement	Pearson correlation	.194	-.059	1	.045	.124
	Sig (2-tailed)	.212	.707		.765	.411
	N	43	43	46	46	46

Incorrect ID	Pearson correlation	.182	-.136	.045	1	.257
	Sig (2-tailed)	.215	.361	.765		.068
	N	48	47	46	51	51
Incorrect Label	Pearson correlation	.181	-.119	-.052	.160	.518**
	Sig (2-tailed)	.234	.446	.735	.282	.000
	N	45	43	44	47	48
Medication_Sentinel	Pearson correlation	-.037	-.086	.038	.026	-.113
	Sig (2-tailed)	.811	.595	.817	.865	.453
	N	44	41	40	45	46
ContTrauma	Pearson correlation	-.411**	.108	-.005	-.157	-.621**
	Sig (2-tailed)	.004	.476	.973	.281	.000
	N	48	46	44	49	54

		Urgent Care	Staffing Stat	Volume	Beds	Incorrect Label
Location	Pearson correlation	.000	-.057	.704**	.665**	.518**
	Sig (2-tailed)	1.00	.717	.000	.000	.000
	N	56	43	56	56	48
Urgent Care	Pearson correlation	1	.902**	-.156	-.159	-.050
	Sig (2-tailed)		.000	.246	.237	.733
	N	57	44	57	57	48
Staffing Stat	Pearson correlation	.902**	1	-.164	-.169	-.165
	Sig (2-tailed)	.000		.288	.274	.329
	N	44	44	44	44	37
Volume	Pearson correlation	-.156	-.164	1	.859**	.345*
	Sig (2-tailed)	.246	.288		.000	.016
	N	57	44	57	57	48
Beds	Pearson correlation	-.159	-.169	.859**	1	.418**
	Sig (2-tailed)	.237	.274	.000		.003
	N	57	44	57	57	48
RN	Pearson correlation	.164	.203	-.176	-.179	-.079
	Sig (2-tailed)	.265	.242	.233	.224	.625
	N	48	35	48	48	41
LPN	Pearson correlation	-.570	-.341	-.552	-.591	-.553
	Sig (2-tailed)	.109	.454	.124	.094	.123
	N	9	7	9	9	9
UAP	Pearson correlation	-.035	.009	.221	.107	-.012
	Sig (2-tailed)	.838	.965	.188	.528	.949
	N	37	26	37	37	30
EMT_P	Pearson correlation	.936	1.00**	-.721	-.845	-.936
	Sig (2-tailed)	.229	.	.488	.360	.229
	N	3	2	3	3	3
Total Error	Pearson correlation	.056	-.075	.084	.166	.141
	Sig (2-tailed)	.694	.652	.553	.239	.340
	N	52	39	52	52	48

Patient Falls	Pearson correlation	-.103	-.124	.571**	.627**	.181
	Sig (2-tailed)	.475	.459	.000	.000	.234
	N	50	38	50	50	45
Sentinel Events	Pearson correlation	.000	.087	-.187	-.172	-.119
	Sig (2-tailed)	1.00	.607	.202	.242	.446
	N	48	37	48	48	43
Elopement	Pearson correlation	.187	.052	.048	-.060	-.052
	Sig (2-tailed)	.213	.764	.750	.690	.735
	N	46	36	46	46	44
Incorrect ID	Pearson correlation	-.083	-.162	.531**	.418**	.160
	Sig (2-tailed)	.565	.323	.000	.002	.282
	N	51	39	51	51	47
Incorrect Label	Pearson correlation	-.050	-.165	.345*	.418**	1
	Sig (2-tailed)	.733	.329	.016	.003	
	N	48	37	48	48	48
Medication_Sentinel	Pearson correlation	-.111	-.139	-.092	.232	.014
	Sig (2-tailed)	.461	.432	.545	.120	.932
	N	46	34	46	46	42
ContTrauma	Pearson correlation	.044	.003	-.538**	-.580**	-.353*
	Sig (2-tailed)	.748	.984	.000	.000	.016
	N	55	43	55	55	46

		Medication_Sentinel	ContTrauma
Location	Pearson correlation	-.113	-.621**
	Sig (2-tailed)	.453	.000
	N	46	54
Urgent Care	Pearson correlation	-.111	.044
	Sig (2-tailed)	.461	.748
	N	46	55
Staffing Stat	Pearson correlation	-.139	.003
	Sig (2-tailed)	.432	.984
	N	34	43
Volume	Pearson correlation	-.092	-.538**
	Sig (2-tailed)	.545	.000
	N	46	55
Beds	Pearson correlation	.232	-.580**
	Sig (2-tailed)	.120	.000
	N	46	55
RN	Pearson correlation	-.124	.085
	Sig (2-tailed)	.444	.571
	N	40	47
LPN	Pearson correlation	.108	.435
	Sig (2-tailed)	.798	.282
	N	8	8
UAP	Pearson correlation	-.153	-.151
	Sig (2-tailed)	.413	.379
	N	31	36
EMT_P	Pearson correlation	.639	.987

	Sig (2-tailed)	.558	.104
	N	3	3
Total Error	Pearson correlation	.577**	-.010
	Sig (2-tailed)	.000	.944
	N	46	50
Patient Falls	Pearson correlation	-.037	-.411**
	Sig (2-tailed)	.811	.004
	N	44	48
Sentinel Events	Pearson correlation	-.086	.108
	Sig (2-tailed)	.595	.476
	N	41	46
Elopement	Pearson correlation	.038	-.005
	Sig (2-tailed)	.817	.973
	N	40	44
Incorrect ID	Pearson correlation	.026	-.157
	Sig (2-tailed)	.865	.281
	N	45	49
Incorrect Label	Pearson correlation	.014	-.353*
	Sig (2-tailed)	.932	.016
	N	42	46
Medication_Sentinel	Pearson correlation	1	.105
	Sig (2-tailed)		.497
	N	46	44
ContTrauma	Pearson correlation	.105	1
	Sig (2-tailed)	.497	
	N	44	55

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

a. Cannot be completed because at least one of the variables is constant.

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