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Patient Complexity Factors and their Influence on Nurses' Perception of Staffing Adequacy

Margaret Mary Duffy

This research was completed as part of the degree requirements for the [Nursing](#) Department at Molloy College.

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Molloy College
The Division of Nursing
PhD in Nursing Program

PATIENT COMPLEXITY FACTORS AND THEIR INFLUENCE ON NURSES'
PERCEPTION OF STAFFING ADEQUACY

a dissertation

by

MARGARET MARY DUFFY

submitted in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

April 22, 2016

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2016

MOLLOY COLLEGE
DIVISION OF NURSING

The dissertation of Margaret Mary Duffy entitled PATIENT COMPLEXITY FACTORS AND THEIR INFLUENCE ON NURSES' PERCEPTION OF STAFFING ADEQUACY in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Division of Nursing had been read and approved by the Committee:

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Abstract

PATIENT COMPLEXITY FACTORS AND THEIR INFLUENCE ON NURSES' PERCEPTION OF STAFFING ADEQUACY

By

MARGARET MARY DUFFY

Nurse leaders must consider the influence of nurse-specific and patient-specific factors on nursing workload and nurses' perception of staffing adequacy when developing nurse staffing plans. All of the factors that influence individual nurses' perception of staffing adequacy are not known. Using a synthesis of the Roy Adaptation Model (RAM) and economic theory as a guiding model, the purpose of the current study was to determine if selected patient complexity factors that are not consistently captured in the measurement of patient acuity by an automated workforce management system influence nurses' perception of staffing adequacy.

The current study employed a complex predictive correlational research design, which included repeated measures of patient data and nurses' perception of staffing adequacy at the shift-level. A selection of repeated measures data from 26 Registered Nurses (RNs) and 1,605 patients over 328 shifts was entered into the initial analysis. The number of shifts with complete data used for final analysis was $N = 294$. Disruptive behavior ($r = -.274$) and family demands ($r = -.186$), were negatively correlated with nurses' perception of staffing adequacy and explained 10% of the variance in a regression model. There was a negative correlation between total shift factor score ($r = -.418$), derived from the presence of patient complexity factors, and nurses' perception of staffing adequacy. No correlation was found between perception of staffing adequacy and nurse staffing variables.

A theoretical proposition of RAM was tested to describe the interaction between the group subsystems and the RAM modes in relationship to the goals of an organizational system. Study findings supported the RAM proposition and contribute to the middle range theory of adaptation, production decision-making process, and nurses' perception of staffing adequacy. The findings inform the science of nurse staffing, but indicate further opportunities for research since other factors might exist that contribute to the perception of staffing adequacy.

Dedication

In loving memory of my parents, John and Joan Connelly.

To my dad, who taught me the value of reading and education.

And to my mom, who taught me how to persevere in the face of hardship.

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TABLE OF CONTENTS

LIST OF TABLES	vi
LIST OF FIGURES	vii
CHAPTER 1: STATEMENT OF THE PROBLEM.....	1
Introduction.....	1
Background.....	3
Purpose.....	6
Theoretical Framework.....	6
Study Aims.....	7
Significance.....	8
Conclusion	9
Definitions.....	10
CHAPTER 2: LITERATURE REVIEW	11
Overview.....	11
Conceptual Framework.....	12
<i>Roy Adaptation Model</i>	12
<i>Economic Theory</i>	18
<i>Explication of the Linkages</i>	22
<i>Testing the Roy Adaptation Model Proposition</i>	24
Development of Knowledge about Nurse Staffing.....	24
<i>Florence Nightingale</i>	24
<i>Defining Nursing Workload</i>	26
<i>Workload Measurements</i>	28
<i>Nursing Shortages</i>	30
<i>Establishing Staffing Ratios</i>	34
Significance of Nurse Staffing.....	38
<i>Nurses' Perception of Staffing Adequacy</i>	38
<i>Nurse Staffing and Patient Safety</i>	42
<i>Nursing Work Environment</i>	46
<i>Nurses' Education and Quality Care</i>	49

<i>Missed Nursing Care</i>	50
Patient Complexity Factors	51
<i>Obesity as a Patient Complexity Factor</i>	53
<i>Limited English Proficiency</i>	55
<i>Disruptive Behavior</i>	57
<i>Restraint Use</i>	58
<i>Continuous Observation</i>	59
<i>Family Demands</i>	60
Conclusion	61
CHAPTER 3: METHODS	63
Study Design	63
Study Question.....	64
Procedures	65
<i>Independent Variables</i>	68
Instruments.....	70
<i>Practice Environment of the Nursing Work Index (PES-NWI)</i>	70
<i>Staffing Adequacy Perception - VAS</i>	72
<i>Dependent Variable</i>	73
Data Collection	74
<i>Data Cleaning</i>	76
Data Analysis	77
Human Subjects Protection.....	78
Chapter 4: FINDINGS	80
Quality of Data Collected	80
Descriptive Statistics.....	84
<i>Sample of Nurse Participants</i>	84
Psychometric Analyses	85
<i>Exploratory Factor Analysis</i>	86
<i>Convergent Validity</i>	88
Research Question	89
Study Aim #1	90

Study Aim #2	91
Study Aim #3	92
Testing the Roy Adaptation Model Proposition	92
Summary	93
Chapter 5: DISCUSSION AND RECOMMENDATIONS	95
Patient Complexity Factors	97
Patient Acuity	100
Nurse Staffing	101
Instrument	102
Conceptual Framework	103
Testing the Roy Adaptation Model Proposition	106
Patient Complexity Properties	107
Limitations	109
Recommendations	111
Future Research	112
Conclusion	113
References	115
APPENDICES	131
Appendix A	131
Appendix B	133
Appendix C	134
Appendix D	135
Appendix E	136
Appendix F	137
Appendix G	141
Appendix H	142
Appendix I	144
Appendix J	146

LIST OF TABLES

Table 1.1 Descriptors of Patients' Need for Nursing Care Services.....	4
Table 3.1 Study Variables.....	67
Table 3.2 Data Sources, Study Variables, and Measurement.....	68
Table 4.1 Missing Data: Categorical and Continuous Variables.....	81
Table 4.2 Descriptive Analysis of the Continuous Variables.....	83
Table 4.3 Descriptive Analysis of the Categorical Variables.....	83
Table 4.4 Reliability of the PES-NWI Tool.....	85
Table 4.5 Comparison of the Mean PES-NWI Scores.....	85
Table 4.6 Comparison of PES-NWI Scores – Lake Research and PES-NWI Reported Scores...86	
Table 4.7 Current Study Factor Loadings of the PES-NWI.....	88
Table 4.8 Pearson's Correlation Coefficients between Patient Complexity Factors - VAS.....	90

LIST OF FIGURES

Figure 1. Proposed Middle Range Theory of Adaptation, Production Decision-Making Process, and Nurses' Perception of Staffing Adequacy.....	23
Figure 2. Middle Range Theory of Adaptation, Production Decision-Making Process, and Nurses' Perception of Staffing Adequacy.....	104

CHAPTER 1: STATEMENT OF THE PROBLEM

Introduction

Professional nursing in the United States has changed rapidly in response to the increased demand for acute, complex health care. Nursing shortages have existed for decades, extending back into the first half of the twentieth century. In the 1980's the American Nurses Credentialing Center (ANCC) introduced the Magnet Recognition Program® to stabilize the existing labor force out of concern for workforce issues (McClure, 2005). The ability of Magnet hospitals to retain nurses and create professional practice environments has been associated with improved patient outcomes and healthier nursing work environments. However, in a study comparing Magnet and non-Magnet hospitals on the perceived adequacy of staffing, nurses in both types of facilities responded almost identically that they deliver patient care differently from day to day due to inadequate staffing (Schmalenberg & Kramer, 2009). According to the *American Nurses Association (ANA) Principles for Nurse Staffing* (2012), administrative decisions regarding staffing should be based on the needs of patients and families. Environmental turbulence described by Jennings (2008), also adversely affects safe patient loads for nurses. In the ongoing effort to achieve safe staffing and patient care outcomes, outcomes-driven acuity software systems have been developed to predict staffing needs based upon patient acuity and environmental turbulence such as admissions, discharges, and transfers. The *ANA Principles for Nurse Staffing* lists components beyond patient acuity for consideration in staffing such as continuity and complexity of care needs, cultural and linguistic diversities, communication skills, and multiple co-morbid conditions (ANA, 2012). The identification of patient complexity factors beyond patient acuity, which influence nursing workload and nurses'

perception of staffing adequacy, might inform the scientific knowledge regarding effective staffing models.

Traditional nurse staffing decisions have relied on retrospective data that can come from three main data sources. The first data source, nursing hours of actual care provided per patient day (NHPPD) is calculated by the number of productive hours worked by nursing staff with direct patient care responsibilities per patient day for each inpatient unit in a calendar month. The second data source called nurse-to-patient ratio, is calculated by dividing the number of RNs providing direct patient care by the unit census per shift. The third data source is the number of full time equivalent nursing positions (FTEs) per adjusted patient day. Adjusted patient days is a commonly used patient load indicator in hospitals and is calculated by the number of inpatient days plus the estimated outpatient days of care. The measure of FTEs per adjusted patient day is calculated by multiplying the number of FTEs by 365 and then dividing that number by the number of adjusted patient days (Jiang, Stocks, & Wong, 2006). These three data sources treat nurses and the nursing care they deliver as fixed-quantity resources. However, patients have individual variations that do not fit into such formulas (Jones & Yoder, 2010). The allocation of annual budgeted FTEs limits the maximum possible volume and quantity of services that can be provided on a shift-by-shift basis. However, decisions to allocate nurses are usually made each shift to accommodate changes in patient acuity, hospital volume, and/or availability of nursing personnel. Staffing decisions based solely on data sources such as NHPPD or nurse-to-patient ratio do not meet the ANA staffing goal, which is to ensure a match between nursing expertise and actual patient needs at all times (ANA, 2012). Therefore, nurses' perception of staffing adequacy might provide information from the experiences of staff nurses to help explain why these other data sources are insufficient.

Background

The structure of the nation's healthcare system underwent major transformations in the late 1980s and early 1990s in response to changes in payment systems and the pressing need to deliver cost effective care. Some changes included reductions of the professional nursing workforce in terms of skill mix and numbers of nursing personnel providing care at the bedside. In 1994, the U.S. Congress directed the Department of Health and Human Services to charge the Institute of Medicine (IOM) to examine the need to increase the number of nurses in hospitals and nursing homes to promote quality patient care and reduce the incidence of work-related illnesses and injuries among nurses. Concerns had been raised about the effects of nursing workforce reductions on the quality of patient care as well as the effect of the nursing work environment on nursing staff who were experiencing increased rates of work-related illnesses and injuries (Wunderlich, Sloan, & Davis, 1996). One objective was to "explore the existing ratios of nursing personnel to other measures of demand for health care such as the numbers of patients or numbers of beds and how those ratios might vary by type of facility, geographic location, or other factors" (Wunderlich et al., 1996, p. 3). The committee members agreed that "nursing is a critical factor in determining the quality of care in hospitals and the nature of patient outcomes" (Wunderlich et al., 1996, p. 92).

The final report issued in 1996, *Nursing Staff in Hospitals and Nursing Homes: Is it Adequate?* acknowledged that very little research had been done at the time on safe staffing levels. The report concluded that "a high priority should be given to obtaining empirical evidence that permits one to draw conclusions about the relationships of quality of inpatient care and staffing levels and mix" (Wunderlich et al., 1996, p. 127).

In 1997, the ANA convened a panel of experts to “develop an understanding of factors contributing to nursing workload and the adequacy of staffing decisions” (ANA, 2005, p. 4). Their report, the *ANA Principles for Nurse Staffing*, was published in 1998. The panel determined that establishing minimum staffing levels at one point in time was not feasible or appropriate given the shift-by-shift complexity variation in patient needs. According to the panel establishing “static minimums would be meaningless and possibly harmful” (ANA, 2005, p. 5). Evaluation of staffing systems should include the quality of nurses’ work life and patients’ outcomes.

In 2003, the American Organization of Nurse Executives (AONE) issued a policy statement on mandatory nurse staffing ratios. AONE was critical of staffing ratios, citing the need to view patient care staffing as a complex management decision that needs to be based on multiple variables and not arbitrary ratios. AONE recommended the conduct of evidence-based and outcomes-based research to include acuity in determining appropriate staffing guidelines (AONE, 2003).

Several terms have been used to categorize the unique perspective of patients’ needs for nursing care services. Terms such as patient acuity, patient intensity, patient burden, and complexity of care have been used interchangeably, often without precise definitions, to categorize patient needs. The following published definitions of these terms in Table 1.1 reveal their similar, but distinctly different nature (Medical Dictionary, 2014).

Table 1.1: Descriptors of Patients’ Need for Nursing Care Services

Term	Definition
Acuity	Severity of patient condition
Intensity	Strength, force, or concentration
Burden	A heavy oppressive load
Complexity	The state of consisting of many inter-related parts

In a concept analysis of patient acuity by Brennan and Daly (2009) the attributes of acuity were organized into four classifications: non-patient, patient, provider, or system, derived from Holzemer's Outcomes Model for Health Care Research (Holzemer, 1994). The severity attribute indicates the physiologic status of the patient while the intensity attribute indicates patient complexity and subsequent nursing care needs. Both attributes can affect nurses' workloads (Brennan & Daly, 2009) and can influence nurses' perception of staffing adequacy.

Physicians also recognize the importance of identifying patient care complexity within populations they serve. Grant et al. (2011) developed an algorithm to identify complex patients in primary medical care. Five physician complexity domains were identified: medical-decision making, care coordination, patient's personal characteristics, patient's diagnosed mental health issues, and patient's socioeconomic status. Patient's personal characteristics were defined as "individual behaviors of the patient that increase the challenge of providing effective care" (Grant et al., 2011, p. 798). Similarly, Peek, Baird, and Coleman (2009) define patient complexity as "the person-specific factors that interfere with the delivery of usual care and decision-making for whatever conditions the patient has (p. 291)."

Capturing the acuity and complexity of the patient and translating that data into an estimation of nursing care requirements to create staffing plans has been an ongoing challenge for nurse leaders. Since 2005, California state legislation has mandated nurse staffing ratios. Concurrently, electronic acuity systems were developed to identify the variability in patients' nursing care needs and predict staffing needs. These systems rely on structured data such as vital signs and counts of treatments and medications documented by nurses in the patient's electronic medical record. Predictive modeling techniques for patient demand are now being used to predict nurse staffing requirements and to assist in decision-making for the allocation of staff

(Birmingham, Nell, & Abe, 2011). However, certain types of labor and time-intensive work cannot be counted with structured data. Traditional nurses' notes contain unstructured, qualitative patient data that may not be able to be captured by electronic acuity systems. The inability to accurately pick up certain aspects of patient care found within nurses' narrative notes can affect the determination of patient acuity and the nurses' perception that the acuity system accurately reflects the status of the patient.

Purpose

The purpose of the current study was to determine if selected patient complexity factors that are not consistently captured in the measurement of patient acuity by an automated workforce management system influence nurses' perception of staffing adequacy.

Theoretical Framework

The theoretical framework for the current study was a synthesis of the Roy Adaptation Model (RAM) (2009) at the individual and group levels and economic theory (Jones & Yoder 2010). The RAM conceptual framework was originally published in 1970 (Roy, 1970) and has been used extensively to guide clinical nursing practice, education, and research. Roy Adaptation Model in Administration (RAMA) was published in 1989 as a variation of RAM for nursing administration (Roy & Anway, 1989). While the original focus of RAM was the individual person as an adaptive system, RAMA broadened the model to include groups of people as an adaptive system capable of responses that will promote change and survival. Since 1999, RAM has been written for use with individuals and groups. The RAM has been continually updated and refined.

In addition to the RAM, economic theory as applied to health care (Jones & Yoder, 2010) supports decision-making for the allocation of staffing resources. Several studies have been

conducted demonstrating the effect of nurse staffing on patient care outcomes and health care costs (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; Aiken et al., 2010; Bolton et al., 2007; Dall, Chen, Seifert, Maddox, & Hogan, 2009; Estabrooks, Midodzi, Cummings, Ricker, & Giovanetti, 2005; Needleman, Buerhaus et al., 2011). Within the context of economic theory, Jones and Yoder (2010) proposed that nursing units can be conceptualized as production firms with “nursing care as the primary service produced by these firms, and a nurse as the primary (but not exclusive) factor used to produce the service” (p. 45). Jones and Yoder (2010) caution that “economic theory can be very useful in explaining how decisions about nursing time allocation and nursing care production are made, but it will not address the issue of how they should be made” (p. 52). Executive decision-making regarding nurse staffing and allocation of resources will be analyzed in the current study using conceptual model concepts from RAM with compatible concepts from economic theory.

Study Aims

The study aims were:

1. To determine patient complexity factors that predict nurses’ perception of staffing adequacy on selected inpatient units.
2. To examine the effect of staffing based on the predicted staffing requirements made by an automated outcomes-driven acuity software system on nurses’ perception of staffing adequacy.
3. To determine if uncaptured data about selected patient complexity factors affects the nurses’ perception of staffing adequacy.

Significance

The effect of hospital, nursing unit, nurse, and patient characteristics on nurses' perception of staffing adequacy was examined by Mark (2002). Perception of inadequate staffing was associated with larger unit size and higher levels of patient technology (used as a proxy variable for patient acuity). The relationships among total staff, skill mix, and perception of staffing adequacy were less consistent leading the researcher to conclude "that nurses' perception of the adequacy of staff on their units depends on more than just the number and mix of personnel" (Mark, 2002, p. 240).

Pearson et al., (2006) conducted a systematic review of the effect of nurse staffing and nursing workload on healthy work environments. Their objective was to determine the effect of patient, nurse, and system characteristics on nursing workload and on productivity. Pearson and colleagues (2006) concluded that nursing workload was the result of the interaction of these factors and that patient characteristics such as "age, gender, socioeconomic status, available informal support, diagnosis, and health status may impact on staffing and workload needs" (p. 357).

In 2008, the Agency for Healthcare Research and Quality (AHRQ) and the Robert Wood Johnson Foundation (RWJF) jointly sponsored the development of a handbook for nurses on quality and patient safety. Recognizing the debate over research findings on nurse staffing and quality of care and the lack of consistency in appropriate guidelines for nurse staffing, Clarke and Donaldson (2008) summarized the state of the science on nurse staffing and made recommendations for future research. Despite an increased number of research studies on nurse staffing and patient outcomes, Clarke and Donaldson (2008) concluded that further research was needed to identify all variables linked to quality nursing care and that achieve results of desirable

as well as adverse patient care outcomes. Software systems are now available that can identify variability in patients' nursing care needs and track patient outcomes through routine electronic nursing documentation (Pickard & Warner, 2007). Inconsistent documentation by staff nurses can lead to errors in the estimation of nursing care requirements by these systems.

A large number of research studies have examined the relationship between nurse staffing and patient care outcomes. However, a gap in the literature exists with identification of all elements, including nurse staffing indicators and patient factors, which influence nurses' perception of staffing adequacy. Examining staffing measures and selected patient factors and their relationship on individual nurses' perception of staffing adequacy on a shift-by-shift basis will provide important insight into nurse staffing. Continued identification of factors that influence nurses' perception of staffing adequacy will improve the ability of nurse administrators to develop staffing plans that will enable nurses to deliver quality patient care by providing adequate resources based upon these factors.

Conclusion

Nurses' work can contribute a benefit of high quality patient care and patient safety, but often the contribution is thwarted by not enough nurses to meet the increasing demands. The development of useful nurse staffing plans is a complex, dynamic process that must include consideration of two main groups of factors: 1) nurse-specific factors such as nurses' educational preparation and years of nursing experience and 2) patient-specific factors such as number of patients, patients' acuity level, and patient care complexity. Factors that influence nurses' perception of staffing adequacy might be important considerations in determining the effectiveness of these staffing plans.

Definitions

For the purposes of the current study, the following concepts have been defined as follows:

Patient complexity: The degree of difficulty of inter-related patient care needs resulting from specific patient-related factors.

Patient acuity: “Measurement of a patient’s severity of illness related to the amount of nursing care resources required to care for the patient” (Finkler, Jones, & Kovner, 2013, p. 375).

Nurse staffing: The staffing plan that determines the appropriate number and type of nursing resources required to meet the workload demand for nursing care on a patient care unit.

Staffing adequacy: “A match of registered nurse expertise with the needs of the patient in the context of the practice setting and the situation” (ANA, 2012, p. 6.). It describes the situation where there are enough nurses to deliver care safely factoring in all of the aspects of the care environment into the allocation of staff.

CHAPTER 2: LITERATURE REVIEW

Overview

Ever since Florence Nightingale's era, nurse administrators have confronted the challenge of providing adequate numbers of nursing staff to ensure quality patient care (Nightingale, 1863). A growing body of research focuses on the relationships between nurse staffing and aspects such as healthy work environments for nurses, job satisfaction, patient safety, and quality care. The adequacy of nurse staffing has been commonly measured with financial indicators, such as nursing care hours per patient day or nurse-to-patient ratios. Also, nurse-sensitive patient outcomes such as patient falls, hospital acquired pressure ulcers, and central line associated bacterial infections have been used as measures of staffing adequacy. However, direct care nurses' perception of staffing is an important consideration because perception of inadequate staffing might indicate nurses' inability to effectively deliver care. Measuring nurses' perception of staffing adequacy and linking nurses' perceptions to shift-level factors can provide important insights about the effect of staffing adequacy at the point of care.

This chapter provides an overview of the conceptual framework used for the current study, a comprehensive review of nurse staffing literature, and a synthesis of the research on nurses' perception of staffing adequacy. The definition of the construct of patient complexity factors is presented and six patient related factors, called patient complexity factors are identified. Perspectives on nurse staffing are discussed, beginning with Florence Nightingale, and concluding with current issues in nurse staffing such as nursing workload, mandatory nurse staffing ratios, and the concept of missed nursing care.

Conceptual Framework

Roy Adaptation Model

The conceptual framework for the current study was synthesized from the most recent edition of the Roy Adaptation Model (RAM, 2009) and from an economic theory as proposed by Jones and Yoder (2010). Roy developed the RAM as a Master's student under Dorothy Johnson. Roy's clinical background in pediatrics led to her recognition of the resilience displayed by children. During her course work she proposed that one of the goals of nursing is to promote adaptation. Roy was encouraged by Johnson to develop the concept of adaptation as a framework for nursing. Roy viewed the person as a holistic adaptive system and defines *adaptation* as "the process and outcomes whereby thinking and feeling people, as individuals or in groups, use conscious awareness and choice to create human and environmental integration" (Roy, 2009, p. 26). The elements of RAM that were used to direct the analysis of study results were the RAM group adaptive modes of physical, group identity, role function, and interdependence; the organizational coping subsystems of innovator and stabilizer; and for unit-level data, the individual modes for staff nurse and patient-level data.

The early scientific assumptions of the RAM model were based on von Bertalanffy's open systems theory and Helson's adaptation-level theory (Roy, 2009). According to von Bertalanffy, an open system contains a set of interrelated parts that function as a whole for a defined purpose. Von Bertalanffy (1968) clarified open systems theory by stating that behavior is not determined by mechanistic conditions, but by free interplay of the organismic forces. Roy (2009) defines the term *system* as "a set of parts connected to function as a whole for some purpose and that does so by virtue of the interdependence of its parts" (p. 27). She applied systems theory in her description of people as adaptive systems. The inputs of the system, which

Roy identified as stimuli and the outputs or behaviors of adaptive systems are influenced by controls, which she describes as coping processes.

In 1989 Roy and Anway, published an expanded version of the RAM for nursing administration (RAMA). Roy and Anway (1989) stated that the goal of nursing administration is “to ensure the most effective delivery of services to clients by adapting organizational systems and their resources” (p. 78). Coping processes for individuals are categorized into two subsystems, the cognator and regulator. Roy and Anway (1989) expanded on Roy’s early work so that nurse administrators would be able to use the RAM for groups. At that time, Roy and Anway identified coping processes for groups and social systems, categorizing them into two additional coping subsystems, the innovator and the stabilizer. The processes inherent in the coping subsystems can be identified, but according to Roy, cannot be directly observed. The responses that are created can be observed in behaviors that Roy calls adaptive modes. The four adaptive modes were originally developed to describe adaptation by individuals. Later they were expanded to include groups and systems (Roy, 2009). The comprehensiveness of the RAM along with the intricacies contained in the subsystems and adaptive modes provided a holistic theory of adaptation for individual persons and social group systems.

Helson’s description of environmental stimuli informed the three levels of stimuli in the Roy model. Helson’s adaptation level theory (1964) is the parent theory for Roy’s adaptation concept. Roy described adaptation as a response to the environment and the types of stimuli that individuals or groups encounter. The three levels of stimuli identified by Helson and used in the RAM are focal, contextual, and residual stimuli (Roy, 2009). A focal stimulus is of primary awareness to the individual or group and the most immediate stimulus that must be confronted. Contextual stimuli are factors that are present, but are not the most immediate stimulus of the

individual or group. Contextual stimuli can be external or internal and can influence how the individual or group deals with the focal stimulus. Residual stimuli are those factors whose effects on the individual or system are unclear and are not within the consciousness of the individual, the group, or anyone else. The level of stimuli can evolve from one level to another. Once residual stimuli become known, they change to either contextual or focal stimuli. Changes in patient acuity and the presence of patient complexity factors can become contextual or focal stimuli for nurses. Nurses must respond to the stimuli of changing patient demands. These stimuli can affect the perception of staffing adequacy.

In addition to the various types of stimuli, an important input is the adaptation level of the individual or group (Roy, 2009). This is a type of stimuli that provides feedback to the focal, contextual, or residual stimuli. Adaptation outcomes occur at three levels: integrated, compensatory, or compromised. Integrated adaptation describes the structures and functions of the life processes work to meet human needs. Compensatory adaptation occurs when there is a challenge to the integrity of the system, which stimulates responses to reestablish adaptation. Coping processes are activated in response to a challenge to the system. These coping processes are the cognator or regulator for individuals and the stabilizer or innovator for groups. Compromised adaptation level occurs when the human adaptive system is not able to adapt and maximal nursing help is required.

Adaptation is observed through behaviors that Roy categorized into four adaptive modes. The modes were originally developed to describe behaviors demonstrated by individuals and later, they were expanded to include groups and systems (Roy, 2009). The physiologic mode for individuals is comprised of five physiologic needs and four complex processes. The theoretical background for the physiologic mode lies in the basic life sciences (Roy, 2009). Nurses gather

data on individual patients' physiologic needs and formulate an assessment of behaviors. The self-concept mode for individuals is a composite of the beliefs and feelings an individual has about oneself. These beliefs are formed from a combination of one's internal perceptions of self and the perceptions of other individuals' responses to the person. The demographic variables in the current study of RN education, RN experience and RN unit tenure reflect the self-concept mode. The role function mode for the individual is the position the individual assumes in society. The basic need for this mode is social integrity. The interdependence mode for the individual focuses on the mutual giving and receiving respect and love. The basic need is relational integrity, which is a feeling of security in relationships.

The physical adaptive mode defines how groups adapt using allocation of operating resources to achieve operational goals. These resources include human resources, such as numbers and types of staff, physical plant, equipment, and fiscal resources. The need for groups within the physical mode is adaptation to changes of available resources in order to maintain resource adequacy. How nurse staffing decisions are made and any changes to staffing levels would be examples of this adaptive mode in the current study. The theoretical basis for this mode includes fiscal resources (Roy, 2009), which is further supported by the addition of economic theory, an adjunct conceptual framework for the current study (Jones & Yoder, 2010). According to economic theory, nursing units are "production firms," (Jones & Yoder, 2010, p. 45) whereby nursing care is the service produced, and nurses are the human resources needed to produce the service. Decisions regarding adaptation of human resources are defined within the physical adaptive mode of RAM. Marginal cost in economics is the cost of acquiring or producing one additional unit of service (Finkler et al., 2013). Increasing nurse staffing is an example of increasing a unit of service. Marginal analysis is the process of assessing cost of

purchasing an additional unit of service compared to the benefit of adding that service. As nursing resources are added, the benefit of additional resources should be examined. Benefits to patients can include increased access to nursing care and improved quality care. Additional resources for nurses can result in higher perceptions of staffing adequacy and improved job satisfaction. Marginal analysis as defined in economic theory is used during decision-making regarding allocation of staffing resources. The intersection of these concepts, RAM physical adaptive mode and marginal analysis from economic theory, was tested in the current study.

The group identity mode refers to some aspects of interpersonal relationships, culture, and shared values that exist within groups and systems. The basic need for groups within the group identity mode is identity integrity, which allows group members to relate to each other in a positive manner. Healthy work environments contribute to group members' satisfaction and improve nursing staff's ability to provide high quality patient care. Flexibility in functions is an indicator of positive adaptation for groups. This can be seen when changes to staffing assignments are made in real-time based upon changing patient needs.

The role function mode is the process through which the goals of the group and system are accomplished. For the members of the group, job performance contributes to this adaptive mode. How work is assigned and divided among the group members promotes achievement of common goals and serves as a basic need for this adaptive mode. The independent variables in the current study that represent role function mode are: RN skill mix, nurse-to-patient ratio, and assigned care hours. For nurse administrators, factors such as making staffing decisions, conducting performance evaluations, and managing communication of information are essential functions. It is important for nursing leaders to acknowledge both formal and informal role

structures within the system. This helps to enhance role clarity, which promotes achievement of common goals and serves as a basic need for this adaptive mode.

Three interrelated components comprise the interdependence mode: internal and external influences that affect the group, the infrastructure within the system, and the group members (Roy, 2009). The internal components include the group's goals and strategic operational plans. The use of marginal analysis in making staffing decisions reflects the interdependence group mode in the life processes of resource adequacy. External influences involve such components as laws and governmental requirements, the economy, resource availability, and inter-organizational relationships. For health care organizations, the interplay among these components affects the ability of the group to adapt. For example, legislation mandating nurse-to-patient ratios will significantly affect the allocation of staff and decisions regarding staffing for an organization.

Key elements of the nurse administrator role as defined in the *ANA Nursing Administration: Scope and Standards of Practice* (2009) include overseeing the practice environment, providing adequate numbers of clinically competent staff, providing access to technology, and ensuring patient satisfaction (ANA, 2009). These role functions are dynamic in nature, requiring nurse administrators to routinely adapt their responses as internal and external environmental changes occur.

Coping processes in RAM were expanded to include two group subsystems, the stabilizer and the innovator. The stabilizer refers to organizational structures and processes that prevent chaos and promote system maintenance and stability. This subsystem acts to provide equilibrium for the group and/or organization. According to Roy and Anway (1989) "stabilizers involve the established structure, values, and daily activities whereby staff accomplish the

primary purpose of the organization” (p. 79). The second adaptive subsystem is the innovator. The innovator provides strategies for growth and change within organizations and social systems. Higher levels of functioning can occur for organizations through the innovator subsystem.

The expanded group modes along with the organizational coping subsystems provide a conceptual model to study nursing organizations as adaptive systems. Roy and Anway (1989) identified four theoretical propositions and premises to describe the interaction between the group subsystems and the RAM modes in relationship to the goals of a relational adaptive system. The following proposition was tested in the current study: “The organizational system develops priorities among internal and external influencing factors, which determine the intensity of the effect of a change on any one mode; these priorities, however, are fluid” (Roy & Anway, 1989, p. 82).

Economic Theory

Systems theories have been used widely to understand the complexities of health care environments. RAM and economic theory share a foundation in systems theory. Inputs include nursing staff labor, such as numbers of registered nurses and clinical nursing assistants; health care technology, such as electronic medical records, equipment, supplies; and the physical setting for care delivery (Jones & Yoder, 2010). Throughputs are processes used by workers to deliver nursing care. In health care, service includes nursing interventions that constitute patient care. Outputs follow the interaction between inputs and throughputs. Outputs can be qualitative or quantitative. Nurses’ perception of staffing adequacy is an output that was measured in the current study.

Malloch and Dunham-Taylor (2015) caution that while a linear open systems model is helpful at a basic staffing level, the complexity of healthcare requires consideration of additional characteristics such as fluctuations in census and the ability to identify and plan for unknown variances. The business of health care is complex, so it is difficult to apply basic economic principles to health care. Health care is not a material good or physical object. The desired outputs of patient care outcomes depend on the patient's response to treatment and patient engagement in treatment. Therefore, delivery of quality outcomes cannot be uniformly guaranteed. Economic theory applied to health care is based on two central tenets: how best to allocate scarce resources and how efficiently those resources are used (Scott, Solomon, & McGowan, 2001). Allocation of nursing resources affects the delivery of nursing care and ultimately the health outcomes of patients and the financial performance of health care organizations.

In the analysis of the financial effect of mandatory nurse staffing ratios, Buerhaus (2009) recommended the use of economic principles, primarily production function. Production function "provides a straightforward approach to identify and analyze the relationships between combinations of capital and labor inputs used by a firm or business to produce a given output" (Buerhaus, 2009, p. 107). Jones and Yoder (2010) proposed two applications of economic theory that may assist nurse administrators in understanding how nurses allocate their time in the delivery of patient care and how nurse administrators could potentially regulate nursing care production. One application is the development of a conceptual model for individual nurse decision-making where the nurse is the consumer. Nursing time becomes the currency and nurses make decisions on how to allocate their currency in the purchase of services for patients (Jones & Yoder, 2010). The second application is a conceptual model of decision-making

whereby the department of nursing is considered a production firm within an organization. The second application of production decision-making was used in the current study. The relationship between the nurse staffing variable of assigned care hours and nurses' perception of staffing adequacy was examined to determine if compliance with predicted staffing by an automated staffing system influences nurses' perception of staffing.

The production firm decision-making process in an economic market has similarities to the workforce management cycle as described by Malloch and Dunham-Taylor (2015). Production factors such as labor, technology, and capital comprise inputs needed to convert the factors into goods and services. Decision-making for resource allocation and services production results in throughput, the actual work accomplished by nurses to achieve output, which is quality patient care. The RAM interdependence group mode, which includes resource adequacy, is used along with marginal analysis in making staffing decisions. Consideration of job performance and how work is assigned is an essential component of staffing. The staffing methods of RN skill mix, nurse-to-patient ratio and assigned care hours are part of the RAM role function mode and were measured in this current study.

The life processes of interdependence are relational adequacy, developmental adequacy, and resource adequacy (Roy, 2009). Relational group dynamics are present in work settings. A support system exists among nursing staff on a work unit. Support is given among peers and support from nurse leaders is an expectation of nurses. Developmental adequacy is defined as the processes associated with group learning and development. Nurses on a given work unit will be at different levels of nursing practice, with different knowledge, skills, and abilities, depending on their developmental stage. The developmental level of the nurse must be taken into consideration by nurse leaders when assigning patients. The third integrated life process is

resource adequacy. This process refers to the system's need for resources such as financial resources and relationships, which are required for effective functioning. Nurse leaders use marginal analysis when deciding to increase or decrease nursing resources based on the benefit to patients and nurses. The interdependence mode at the group level is based on the mutuality of organizational relationships. An example of giving and receiving at the organizational level according to Roy (2009) is that in return for giving their time and knowledge, caregivers receive a salary. As nursing resources are given and received based on patient need, nurses' perception of staffing adequacy is affected by staffing decisions.

Jones and Yoder (2010) identified two important assumptions regarding administrative decision-making that drives staff production of nursing care. The first assumption is that quality nursing care is a fixed resource and production of services is driven by a desired volume of required patient care. This perspective assumes that the volume of nursing care needed is already known and the number of nurses needed can be accurately predicted. The second assumption accepts that resources such as staff nurses are fixed and that patient care volume and quality of care will be limited by available resources.

In determining the allocation of nursing resources, the use of marginal analysis allows administrators to weigh the costs and benefits of adding additional staff resources. According to supply and demand, an increase in nursing care (increased allocation of nurses as a resource) should result in an increased benefit to the patient due to increased production of services called nursing care. An increased production of care can also occur through changes in other production factors that can improve efficiency and care delivery. Production factor changes such as identifying non-value added activities performed by nurses that can be performed by non-professional employees will help nurse administrators develop more efficient, effective nursing

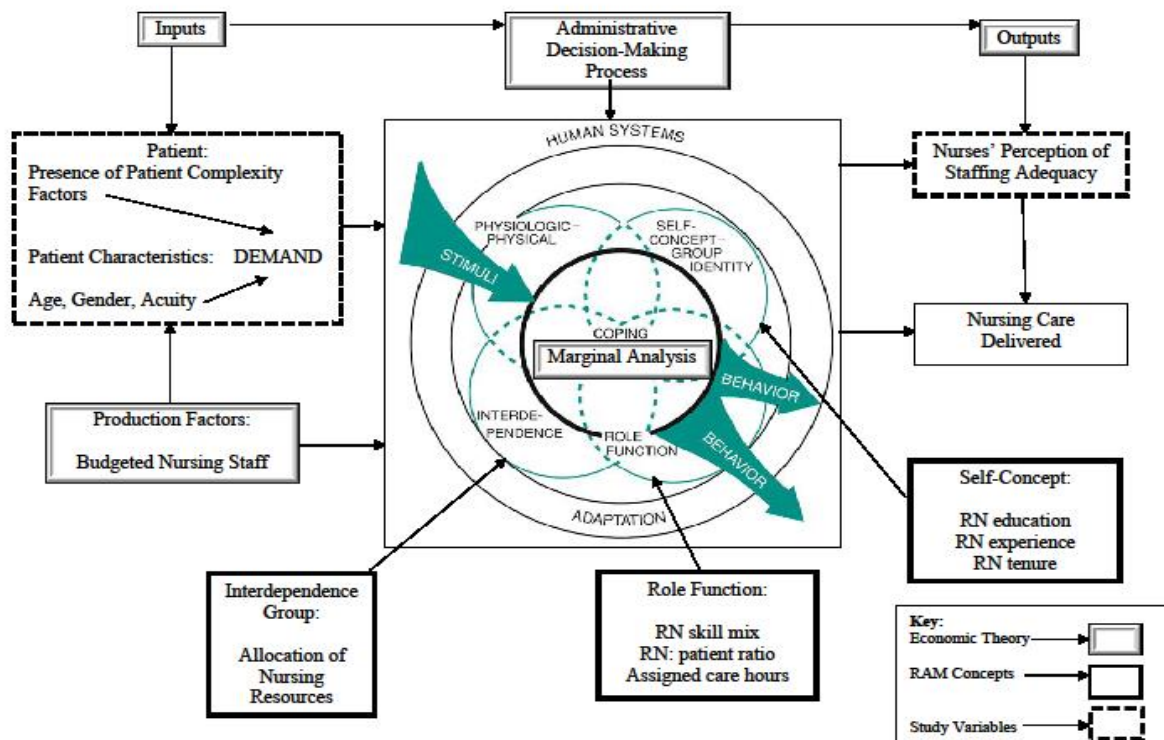
care delivery models (Storfjell, Ohlson, Omoike, Fitzpatrick, & Wetasin, 2009). Aligning the performance of nursing care activities to skill level reflects the developmental adequacy and resource adequacy processes of RAM interdependence mode.

Explication of the Linkages

The RAM and production firm decision-making process in a free economic market (Jones & Yoder, 2010) were synthesized to form a conceptual framework for the current study as depicted in Figure 1, p. 23. The conceptual model concepts from RAM used in the current study are the group adaptive modes: physical mode, group identity mode, role-function mode, and interdependence mode; and the group coping processes of stabilizer and innovator (Roy 2009). These concepts were combined with Jones and Yoder's ideas regarding economic theory of decision-making in order to explain the influence of patient complexity factors on nurses' perception of staffing adequacy.

The Jones and Yoder production firm decision-making process is represented by inputs such as production factors, the decision making process using marginal and production possibility analyses, and the outputs or the price, quality, and supply of goods and services established. Production factors include the labor, capital, and technology that are needed to produce the services. Planning is a focus of maintaining integrity in the RAM physical mode (group level). Resource management is one process that groups use to meet their needs for operating integrity. The physical mode defines how groups adapt basic operating resources to achieve group goals. Resource management in the RAM physical mode and Jones and Yoder's production firm decision-making process are used by nurse administrators to ensure an adequate supply of nurses to achieve the group goal of patient care.

FIGURE 1: Proposed Middle Range Theory of Adaptation, Production Decision-Making Process, and Nurses' Perception of Staffing Adequacy



Important in the allocation of nursing staff is the proportion in the workplace of registered nurses with a baccalaureate or higher degree. The RAM self-concept adaptive mode (individual level) relates to job performance, which is reflected in the variable of highest nursing degree obtained. This variable was collected as demographic data, but was not tested in the current study.

Another type of input in Jones and Yoder's (2010) production firm decision-making process is patient demand for nursing care. Likewise, the RAM interdependence adaptive mode also accounts for the demand for resources. Demand for resources is influenced by inputs such as the presence of patient complexity factors and patient characteristics. Demand for nursing

care was measured in the current study by the independent variables of patient complexity factors: patient obesity, limited English proficiency, disruptive behavior, restraint usage, use of continuous observation, and family demands. Patient characteristics of age, gender, and acuity level score were measured as independent variables.

According to Jones and Yoder (2010), nurse administrators use marginal and production possibility analyses to allocate staff. Likewise, during this phase the RAM group-level coping processes of stabilizer and innovator are used. When the stabilizer coping process is used effectively, staffing changes will promote equilibrium and organizational coping. Outcomes of the resources that are allocated are measured in the outputs under quality of services. These measurements include the dependent variable of nurses' perception of staffing adequacy.

Testing the Roy Adaptation Model Proposition

In the current study, patient complexity factors not consistently captured in the measurement of patient acuity by an automated workforce management system were examined for their influence on nurses' perception of staffing adequacy. The RAM proposition that was tested was: "the organizational system develops priorities among internal and external influencing factors, which determine the intensity of the effect of a change on any one mode; these priorities, however, are fluid" (Roy & Anway, 1989, p. 82). Study results were analyzed to determine the influence of the RAM group adaptive modes and coping processes of the stabilizer and innovator on study variables combined with economic concepts.

Development of Knowledge about Nurse Staffing

Florence Nightingale

In *Notes on Hospitals* (1863), Florence Nightingale, described the effect of hospital construction decisions on the care of sick patients. She provided recommendations for

improving hospital plans. More than a century before the 1999 IOM Report, *“To Err is Human,”* which served as a catalyst for the recent patient safety movement, Nightingale wrote in the preface of the text “It may seem a strange principle to enunciate as the very first requirement in a Hospital that it should do the sick no harm” (Nightingale, 1863, p. iii.). Hospital statistics in Nightingale’s time revealed that patients with similar diagnoses treated in hospitals experienced higher mortality rates than those treated outside the hospital setting (Nightingale, 1863, p. iii.).

Besides identifying principles for hospital construction to improve the outcomes for hospitalized patients, Nightingale explained staffing patterns to enhance nurses’ ability to provide quality nursing care. She described the state of the ratios of attendants to sick patients in different types of hospitals and compared the cost of staffing in different facilities. She classified staffing of a thirty-two bed ward in the Lariboisiere Hospital in Paris as “serving the ward efficiently” with “1 sister, 1 nurse, and 2 orderlies on the men’s side, and 1 sister, 2 nurses, and 1 orderly on the female side” (Nightingale, 1863, p. 54). An orderly in today’s health care organizations would be equivalent to a male nursing assistant. Nightingale did not provide a rationale for the numbers of different types of staff for each ward.

Efficiency and cost of staffing were also examined by Nightingale as she documented examples of effective and ineffective systems. Small wards were considered inefficient and difficult to staff. “Four wards of ten patients each cannot be attended by one night nurse, taking the average of London cases. Forty patients in one ward can be fully attended by one night nurse” (Nightingale, 1863, p. 51). Nightingale concluded that thirty-two patients was the appropriate ward size when taking into consideration sanitary and administrative factors. In support of this decision she provided a cost analysis of the existing staffing in two military hospitals; one with small wards of nine beds, the other with 30 bed wards. She predicted the

annual cost savings for staffing a 1,000 bed military hospital with thirty bed wards would be £207,775 (Nightingale, 1863, p. 55), which translates in 2016 into \$33,073,832 United States (U.S.) dollars.

Defining Nursing Workload

Providing quality nursing care depends on an adequate supply of nurses and consideration of workload factors that will affect nurses' ability to provide care. The ANA defines nursing in functional terms as the "protection, promotion, and optimization of health and abilities, prevention of illness and injury, alleviation of suffering through the diagnosis and treatment of human response, and advocacy in the care of individuals, families, communities, and populations" (ANA, 2013). However, nursing work also encompasses indirect, non-patient care related activities such as looking for people and equipment and administrative paperwork. Finkler and colleagues (2013) defined nursing workload as "the amount of work performed by a patient care unit" (p. 233). Morris, MacNeela, Scott, Treacy, and Hyde (2007) propose that nursing workload must include all of the activities, both direct and indirect, that are carried out by the nurse. Upenieks, Akhavan, Kotlerman, Esser, and Ngo (2007) conducted a workflow study dividing all nursing activities into value-added activities described as direct and indirect care tasks and non-value added activities, which include looking for equipment, attending staff meetings, and documentation. Nursing activity and time were compared between two telemetry units and a medical-surgical unit to determine variability in workload intensity. Study results demonstrated a large degree of variability in nursing workload among the three units. Nurses on the telemetry units spent 60% of their time on value-added activities while these activities only accounted for 54% of the time of nurses on the medical-surgical unit (Upenieks et al., 2007, p. 250). These differences were found to be statistically significant. The authors cited limitations

in the study that could have accounted for the variation such as differences in the physical layouts of the units and lack of patient diversity on the unit level.

Malloch and Dunham-Taylor (2015) describe a workload management cycle that can be used by nurse leaders to ensure efficient nursing care delivery. Several tools have been used in health care to define workload and measure resource utilization. The ANA has endorsed several nursing classification systems such as NANDA International nursing diagnosis classifications, Nursing Intervention Classification (NIC), and Nursing Outcome Classification (NOC) (Lundberg et al., 2008). NANDA diagnoses were developed in the mid-1970s and have evolved into a system used to identify human responses to illness, injury, or health promotion. The taxonomy structure provides for consistent communication with documenting patient needs and is used to develop problem lists and plans of care.

The NIC system is a comprehensive set of nursing interventions arranged in eight functional domains with over 500 nursing interventions and more than 1200 selected activities targeted to the interventions. Researchers included indirect care interventions such as checking the emergency cart as one of the foundational domains (Malloch & Dunham-Taylor, 2015). Complementary to NANDA and NIC is NOC, which provides nurses with the ability to use a common language in documenting the outcomes of care provided to patients and families. NOC was developed in 1991 and is organized into 31 classes and 7 domains. Every outcome is defined by a group of indicators, which reflect different aspects of an outcome label. All indicators and outcomes have a measurement scale such as a 5-point Likert scale. An example of a NOC outcome would be pain control, which can be measured on a 10-point scale. Adapting NOC for use in electronic health records can provide an opportunity for comparative

effectiveness research because outcome data can be measured at different intervals and retrieved electronically (Lundberg et al., 2008).

Workload Measurements

Nurses commonly refer to the nurse-to-patient ratio when describing their workload for a shift. However, workload can be measured in many of ways. Carayon and Gurses (2005) proposed four levels of intensive care unit (ICU) nursing workload: unit level, job level, patient level, and situation level. Nurse-to-patient ratio is the most common unit of measure at the unit level. The authors recommend that this measure should also take into consideration the education and experience level of the nurse. Job level workload has been linked to outcomes in the nurse such as stress and job dissatisfaction and has been measured by job satisfaction scales. Several measurement tools have been developed to measure patient level workload such as the Therapeutic Intervention Scoring System used in many ICUs to quantify patients' condition. The last category, the situation level workload, was proposed by the authors to explain the nurses' workload due to the healthcare system design. This level takes into consideration such factors as the physical layout of the unit, availability of supplies and equipment, family members' need for nurses' time, and interdisciplinary communication.

Workload measurement for budgetary purposes begins with defining the unit of service. This is measured according to the type of work completed at the unit-level such as patient days, visits, procedures, or treatments. The unit of service is frequently adjusted based upon patient needs. This can be accomplished with use of a patient classification system that "requires rating patients based on the likely nursing resource requirements resulting from the acuity of their illness" (Finkler et al., 2013, p. 159). Patient classification systems have been in existence since the 1930s and can assist in the process of measuring workload (Malloch & Dunham-Taylor,

2015). An integrative review (Fasoli & Haddock, 2010) of patient classification systems found that validity and reliability are problems for many systems. The authors found seven studies of sufficient quality from which five different patient classification systems were validated. These include the following: The Army Classification Instrument, the Patient Intensity for Nursing Index, the RAFAELA/PAONCIL patient classification system (system named for the authors), Project Nursing in Research 80, and the Resource Information Management System (Fasoli & Haddock, 2010). One theme was the lack of a standardized language to adequately describe nurses' work. The authors concluded that measuring nursing workload was problematic and there is still a need to link workload to nurse-sensitive indicators and outcomes.

Measuring the adequacy of the nursing workforce is complex and metrics used to calculate nursing workforce adequacy vary. Spetz and Kovner (2011) recommended a "need for both a National Minimum Data Set based on relicensure surveys and continued use of sample surveys" (p. 100). This approach is similar to that used by the U.S. Census and has the potential to better estimate potential RN supply, which in turn can be used to predict future supply models. Effectively measuring the demand for RNs is equally complex. Spetz and Kovner (2013) recommended a two-pronged approach to measuring RN demand based on the goals for data collection. Current demand is best measured by employer surveys, which to date, are not conducted at a national level. The most current method of measuring RN supply is the primary source data collected by the U.S. Bureau of Labor Statistics (BLS). BLS data are also the most reliable source of RN employment projections at present. In addition, Spetz and Kovner (2013) recommend use of the Health Resources and Services Administration (HRSA) forecast models as a way to predict future demand for RNs.

Nursing Shortages

Professional nursing in the U.S. has grown rapidly due to increased demand for acute, complex health care. The term *shortage* has been defined in different ways, resulting in challenges when attempting to define the factors that influence the state of a nursing shortage and when identifying solutions (Goldfarb, Goldfarb, & Long, 2008). Spohn (1954) illustrated this fact in her analysis of a perceived nursing shortage from the 1930s to the 1950s. She identified factors that significantly affected the supply, demand, and workload of the nurse. Although the number of U.S. hospitals did not change appreciably during that time frame, the number of beds increased fifty percent from 1932 to 1952 and the number of professional nurses employed during this same time period rose nearly 12 percent (Spohn, 1954, p. 865). Despite the perception that the supply of nurses had kept pace with hospital development, the increased numbers of professional nurses was due to part-time nurses who did not work as many hours as full-time nurses. Spohn also identified hospital level changes that affected nurses' workload such as more beds, higher average daily census, and decreased average length of stay from 16 days to 10 days. These changes in patient admission, discharge, and length of stay continue to affect nurses' workload today.

Spohn (1954) concluded her analysis with several questions that are still being considered sixty years later regarding the nurse's workload and how the work environment affects nurse staffing. She recommended studying the type of nursing care required by patients who need long-term versus short-term care and identifying the types of diagnoses that could predict the level of patient care that needs to be delivered. Spohn also recommended analyzing the effect of decreasing length of stay and if "the rapid turnover of the patients increases the fatigue factor for the nurse" (Spohn, 1954, p. 867).

The enactment of Medicare and Medicaid in 1965 coincided with a period of tremendous growth in hospital services. Health care costs reached unparalleled levels in the 1960s and 1970s driven by two major factors. More Americans had access to public and private insurance, which resulted in an increased demand for services. A fee-for-service structure of retrospective reimbursement was instituted, which also resulted in a rapid rise in health care use and health care expenditures (Wunderlich et al., 1996). The need for cost containment in health care became necessary in the 1980s. The Tax Equity and Fiscal Responsibility Act of 1982 placed a cap on inpatient Medicare revenues. That spending limit was followed in 1983 by enactment of Medicare's Prospective Payment System (PPS). The PPS used standard national rates for hospital Medicare reimbursement based on diagnoses called diagnosis-related groups (DRGs). Enactment of these federal measures began to restructure health care financing. This first brief economic downturn led to a short-lived decrease in hospital admissions and decrease in hospital inpatient days of care, which affected hiring of nurses. Despite a substantial decrease in the total number of hospital employees between 1983 and 1987, there was a twenty-six percent increase in the ratio of nurses to patients during this time period (Aiken, 1987, p. 1617). This growth in nursing was due to an increase in the complexity of patient care, shorter lengths of stay, and increased use of expensive medical technology. During this time period, intensive care units expanded as more sophisticated monitoring techniques were developed. Critical care medicine and nursing became a specialty and the understanding of critical illness grew rapidly due to an increase in intensive care research (Vincent, 2013).

Throughout the 1990s hospitals reengineered care models to address reductions in reimbursement. The main effort to reduce operating costs, led to massive downsizing nationwide. Executive and leadership nurses such as chief nursing officers, clinical directors,

nurse managers, clinical nurse specialists (CNS), and clinical educators were terminated to reduce cost burden. For example, by 1996 only 23% of the 61,601 CNSs in the United States were practicing in CNS positions due to a decline in the number of CNS positions available in hospitals (Cockerham & Keeling, 2014). Nurse assistant (NA) positions were upgraded and some direct care activities that had been performed by RNs were delegated to NAs under the supervision of the RN. That effort was strongly resisted by the ANA and other nurse champions. Two major national nursing shortages occurred during this time period. The first shortage during 1990-91 was brief. It was marked by an eleven percent vacancy rate of unfilled full-time RN positions nationwide (Buerhaus, 1995). In 1997, a second shortage developed. By 2001, the average national vacancy rate was thirteen percent with twenty percent of all hospitals reporting institutional vacancy rates over twenty percent (Buerhaus, Donelan, Ulrich, Norman, & Dittus, 2005, p. 61).

Measurement of the effect of hospital reengineering on the reduction of costs and on patient outcomes lagged behind implementation of the changes. In 1993, the U.S. Congress responded to these concerns by requesting the Department of Health and Human Resources to ask the Institute of Medicine (IOM) to appoint a panel of experts to undertake a study on the adequacy of nurse staffing (Wunderlich et al., 1996). Committee members explored such topics as supply and demand for nurses, existing staffing ratios of nursing personnel and how staff mix ratios might vary by factors such as type of facility or geographic location, the relationship of nursing care quality to patient outcomes and nurse staffing levels, and other factors that influence nursing work environment. In analyzing the relationship of nursing staff to the contribution of quality patient care, the committee concluded there was a lack of recent research on the effects of staffing on the quality of patient care (Wunderlich et al., 1996). The committee recommended

that the National Institute of Nursing Research (NINR) and other agencies fund research studies to examine the effect of nurse staffing levels on quality of care. Citing several studies on the benefits of clinical nurse specialists, the committee also recognized the contribution of advanced practice nurses in delivering high quality, cost effective care to hospitalized patients with significant co-morbidities.

In response to the 1996 IOM Report, *Nursing Staff in Hospitals and Nursing Homes: Is it Adequate?* the ANA convened a panel of experts in 1997 to “develop an understanding of factors contributing to nursing workload and the adequacy of staffing decisions” (ANA, 2005, p. 4). The discussion centered around several topics such as the need to identify minimum safe staffing levels, the level and variability of patient acuity, and the organizational and individual nurse factors that need to be considered in determining safe staffing. Environmental and organizational factors include sufficient resources, support, and the overall architecture and working environment. Individual nurse factors include educational background, years of experience as a nurse, and experience in the nurse’s specialty.

The panel of experts determined that establishing minimum staffing levels was not feasible or appropriate given the complexity of and variation in patient needs. According to the panel establishing “static minimums would be meaningless and possibly harmful” (ANA, 2005, p. 5). Evaluation of staffing systems should include both the quality of the nurses’ work life in addition to the patients’ outcomes. Principles for nurse staffing were developed and were organized into four categories; patients, intensity of unit and care, context, and nursing expertise. These principles were published as the “ANA Principles for Nurse Staffing” in 1999.

Goldfarb and colleagues (2008) described four concepts of a shortage that can be used to analyze the current nursing shortage. Using a *professional standards shortage* concept, a

nursing shortage would exist when nurse staffing fell below a predetermined standard that would ensure adequate numbers of professional nurses to deliver quality care. This kind of shortage is not tied to actual budgeted positions, but to patient needs. A second concept is that of *projected future shortages*. Projections are forecasted for the adequacy of future nursing supply needed to meet potential healthcare demands. Current levels of RN demand and projections of the size and demographics of the population and changes in medical technology are considered in such projections. The last two concepts are based on economic concepts of supply-demand. A *static shortage* exists when the demand for nurses, as evidenced by unfilled budgeted positions, exceeds the supply. A lack of qualified applicants to fill hospital vacancies is an example of static shortage. Two reasons for such a short supply of professional nurses are: 1) increased RNs retiring and 2) increased numbers of potential students turned away from study due to a lack of nurse educators. The fourth concept, *dynamic shortage*, exists when wage increases cannot keep pace with demand because as wages increase, the number of positions actually needed cannot be added. Similar to the static shortage concept, this concept is driven by existing budgeted positions, and not the actual demonstrated need for nursing care.

Establishing Staffing Ratios

In 1999, California became the first state in the U.S. to pass legislation requiring mandatory minimum RN staffing ratios in acute care hospitals in an effort to improve nursing workforce adequacy and provide high quality patient care. The California Nurses Association sponsored Assembly Bill (AB394) required hospitals to meet staffing ratios as of January 1, 2004. Spetz, Seago, Coffman, Rosenoff, and O'Neil (2000) used historical staffing data from two publicly reported sources: financial data from California's Office of Statewide Planning and Development and the Annual Survey of Hospitals from the American Hospital Association, to

provide evidence to be used in recommending nurse staffing ratios. Spetz and colleagues (2000, p. 60) cautioned that the evidence did not show any benefit with minimum ratios since there was little research supporting “safe” staffing levels. The California Department of Health Services was responsible for determining and implementing the staffing ratios (Institute for Health & Socio-Economic Policy, 2001). Kravitz et al., (2002) investigated the relationship between nurse staffing and quality of care in order to make recommendations on safe staffing levels using publicly reported data and a hospital staffing survey designed by the California Department of Health Services to collect cross sectional data on hospitals’ workforce and staffing plans. Although these authors (Kravitz et al., 2002) found a statistically significant relationship between nurse staffing and patient outcomes, they stated the literature did not support “establishing minimum nurse-to-patient ratios for nursing units in acute-care hospitals, especially in the absence of adjustments for case mix and skill mix” (p. 10). The California Department of Health Services received varying recommendations for nurse staffing ratios from several key stakeholders including three labor unions: the California Nurses Association, the Service Employees International Union Nurse Alliance, and the American Federation of State, County, and Municipal Employees in addition to the California Healthcare Association (California State Department of Health Services, 2003). Both studies, (Kravitz et al., 2002; and Spetz et al., 2000), arrived at proposed ratios that were compromises between the California Nurses Association and union recommendations.

Since implementation of the ratio law in California, several studies have been conducted to assess the effect of this type of staffing on patient care outcomes. The first analysis was conducted by Donaldson et al. (2005) to determine the effect of mandatory staffing ratios on two nurse sensitive indicators: incidence of patient falls and pressure ulcer prevalence. Researchers

examined pre- and post-ratio data at the unit level from hospitals participating in the California Nursing Outcomes Coalition project. Although staffing levels, as measured by RN hours per patient day and mean total nursing hours per patient day on medical/surgical units, had statistically significant increases, there were no statistically significant changes in patient falls and/or pressure ulcer prevalence (Donaldson et al., 2005, p. 205). A follow-up study comparing nurse staffing and nursing-sensitive outcome data from 2004 and 2006 also failed to demonstrate a relationship between the increased staffing levels post-ratio implementation and the incidence of patient falls and pressure ulcer prevalence (Bolton et al., 2007).

A systematic review was conducted by Donaldson and Shapiro (2010) to examine the effect of the ratio legislation on cost, quality, and patient care outcomes in acute care hospitals in California. Twelve studies were selected for analysis and the most consistent finding was that the goal of decreasing the number of patients assigned per nurse was achieved. However, there was no associated improvement on the Nursing Quality Forum measures of nursing quality and/or the Agency for Healthcare Research and Quality Patient Safety Indicators. One study noted that the case mix index had increased in California during the implementation of the staffing ratios. Case mix index is a relative value assigned to a diagnosis-related group of patients and is used to estimate the amount of resources needed to provide care for patients. The higher the case mix index, the more resources are needed for patient care. Case mix index has been used as a proxy for patient acuity and complexity (Donaldson & Shapiro, 2010). Researchers noted that stabilization of quality indicators and adverse events could have been attributed to the improved staffing levels in the context of higher acuity. Also, a lack of variability was noted in the staffing as California hospitals had started to move towards staffing at the prescribed ratio levels prior to implementation. Increased staffing levels that had been

established before the ratios were implemented could have resulted in this lack of change in quality indicators.

Aiken and colleagues have continued to study the relationship between nurse staffing and patient care outcomes and have used the minimum ratios established in California as a benchmark for comparison both within and between California hospitals and between California and other states. A study conducted by Aiken and colleagues (2010) on surgical patients in California, New Jersey, and Pennsylvania found lower patient mortality in California because nurses in New Jersey and Pennsylvania cared for one to two more patients on medical and surgical units respectively than nurses in California.

The effect of mandatory staffing ratios on safety-net hospitals that provide care to the most vulnerable poor, uninsured populations was studied by McHugh et al. (2012). A concern expressed prior to the start of ratio legislation was the potential for skill mix to be reduced, particularly in safety-net hospitals due to their economic environment. Both safety-net and non-safety-net hospitals experienced increased staffing levels, but a non-significant statistical difference was seen in the RN skill mix because safety-net hospitals' skill mix remained unchanged. A subsequent study by McHugh, Kelly, Sloane, and Aiken (2011) demonstrated similar findings of increased staffing levels with no reduction in skill mix.

Advocates of the nurse staffing ratio legislation proposed that increasing staffing levels would not only improve the quality of care for patients, but would also improve the nursing work environment, and therefore, RN job satisfaction. Aiken's 2010 study comparing staffing levels in California, Pennsylvania, and New Jersey also demonstrated that when nurses' workload matched the California mandated ratios in all three states, nurses consistently reported better care, less burnout, and less job dissatisfaction. Nurses' perception of their working conditions

pre- and post-ratio implementation, examined by Spetz (2008, p. 18), demonstrated that nurse satisfaction increased significantly in many ways between 2004 and 2006. The largest improvement was noted in adequacy of RN staffing ($p \leq .05$). The current study examined nurse staffing variables such as RN skill mix, nurse-to-patient ratio and assigned care hours and the influence on nurses' perception of staffing adequacy at the shift level.

In 2011, the ANA convened a workgroup to review evidence along with insights from the 2010 IOM Report on *The Future of Nursing: Leading Change and Advancing Health* to make recommendations for changes to the *ANA Principles for Nurse Staffing* (Weston, Brewer, & Peterson, 2012). The most recent ANA definition of *appropriate* nurse staffing is: "a match of registered nurse expertise with the needs of the recipient of nursing care services in the context of the practice setting and situation" (ANA, 2012, p. 6). The 2012 revised principles, which emphasize the practice environment, state that no single staffing method or assessment, for example, nurse-to-patient ratios, or nursing hours per patient day, or nursing intensity weights, will be optimal for all practice settings. The evaluation of staffing plans and staffing adequacy should focus on outcome factors such as nurse-sensitive patient indicators; staffing structures such as vacancy and turnover rates, use of overtime; and work-related staff illness and injury rates.

Significance of Nurse Staffing

Nurses' Perception of Staffing Adequacy

While the *ANA Staffing Principles* mentioned the importance of the work environment and nurses' ability to have time to coordinate and provide nursing services, nurses' perception of staffing adequacy and its measurement was missing from the ANA recommendations. A gap in the literature exists in the examination of nurses' perception of staffing adequacy at the shift-

level. Research studies have examined the effect of nurses' perception of staffing adequacy on the structure and processes of staffing. Mark's research (2002) on perception of staffing adequacy used data obtained from nurses' responses to a single item that asked nurses to evaluate staffing adequacy on a scale, which described staffing as "very much above average, somewhat above average, average, somewhat below average, and very much below average" (p. 236). Two patient measures were evaluated for their effect on perception of staffing adequacy. Patient technology was used as a proxy for patient acuity, and patient age was the only patient characteristic collected. Patient age was found not to be associated with perceptions of staffing adequacy, but patient technology was inversely related to staffing adequacy perceptions. As nurses reported higher scores of patient technology, indicating that patients had more complex needs, their perception of staffing adequacy declined. Recommendations from Mark's study included further study of relationships among the perception of staffing adequacy, nurse satisfaction, nurse turnover, and patient acuity. Laschinger (2004) used a researcher-developed one-item scale to measure nurses' perceptions of staffing adequacy in a study that tested the antecedents and consequences of nurses' perception of respect in the hospital setting. The indicators of work effectiveness, for example, the perceived adequacy of staffing to provide required care and the perception of the quality of nursing care, were found to be positively related to organizational respect.

The Magnet Recognition Program® awards Magnet status to health care organizations that have developed and sustained healthy work environments that support delivery of high quality nursing care. Since the inception of the program, surveys and tools have been created to measure the nurse practice environment in both Magnet and non-Magnet organizations. An early survey to measure characteristics of hospital practice environments was the Nursing Work Index

(NWI) developed by Kramer and Hafner (1989). The survey was designed to measure: work values related to job satisfaction, perceived productivity, job satisfaction, and perception of an organizational environment conducive to high quality nursing care (Kramer & Hafner, 1989). However, the survey lacked specific domains. It had 65 items, which made the survey cumbersome for nurses to complete. The NWI was revised by Aiken and Patrician (2000) and established that the presence of organizational traits, rather than perceived nurse satisfaction and productivity with the traits, results in improved patient care outcomes, decreased nurse burnout, and higher nurse retention rates. Value statements were eliminated and the survey was focused on the presence of traits that contribute to an excellent work environment. This Revised Nursing Work Index (NWI-R) has become the most widely used instrument to assess the nursing work environment (Lake, 2007).

Lake (2002) further refined the NWI and developed a Practice Environment Scale (PES-NWI) from which five subscales were identified. The hospital-level environment is reflected in the first two subscales of Nurse Participation in Hospital Affairs and Nursing Foundations for Quality of Care while the unit-level environment is captured in Nurse Manager Ability, Leadership, and Support; Staffing and Resource Adequacy; and Collegial Nurse-Physician Relations. The PES-NWI is used extensively to measure nursing practice environments (Warshawsky & Havens, 2011). The Staffing and Resource Adequacy subscale is comprised of four component items. The items with the highest factor loading (Lake, 2002, p. 182) were those that consider having enough nurses and staff to provide quality patient care. However, patient considerations such as acuity and complexity are not components of the tool.

There have been many changes in health care since the NWI was developed in the late 1980s. Namely, quality of care has increased overall through the growth of the Magnet

recognition program (Witkoski Stimpfel, Rosen, & McHugh, 2014). The ongoing generalizability of the data obtained using the PES-NWI could be diminished at this time. Warshawsky and Havens (2011) noted a growth in the use of primary data versus secondary analyses using the PES-NWI. Subscale and composite scores were reported in 22 studies (Warshawsky & Havens, 2011, p. 25). Several differences in the mean scores from the original study and the range of scores from more recently reported studies were noted. The lowest scoring subscale in the original study was “Nurse Participation in Hospital Affairs” as opposed to the “Staffing and Resource Adequacy” subscale from more recent studies. There is a wider range of scores reported in recent studies when analyzed against the original study that compared Magnet and non-magnet hospitals. There are many more Magnet hospitals in the U.S. today than when Lake’s study was conducted.

Another tool that measures nurses’ satisfaction with the practice environment is the “Essentials of Magnetism” (EOM). Developed by Kramer and Schmalenberg (2004) because the NWI had become outdated, the EOM measures aspects of the practice environment that nurses consider essential in delivering quality patient care. Nurses’ perception of staffing adequacy was measured by responses to a single-item indicator within the EOM. This single-item was the least discriminating factor because only 61% of nurses in Magnet facilities reported that they were adequately staffed (Kramer & Schmalenberg, 2005, p. 188).

In 2005, Schmalenberg and Kramer developed the “perceived adequacy of staffing” (PAS) subscale of the EOM. The PAS included six items that were derived from a delivery system survey added into the EOM study (Kramer & Schmalenberg, 2005). The PAS scale has been substituted by Schmalenberg and Kramer for the single-item indicator on the EOM tool to assess perception of staffing adequacy. Items on the PAS include the perception that there are

enough RNs to deliver quality care and that patient care is not delivered differently because of lack of sufficient staff. Although the degree of patient acuity was identified as an enabler of perceived adequacy of staffing, items related to the patient were not included on the PAS (Schmalenberg & Kramer, 2009).

Nurse Staffing and Patient Safety

Beginning in the early 1980s, Aiken and colleagues conducted research on factors that affect the supply and demand for nurses, nursing workload, and the relationships between nursing care and patient care outcomes. Aiken (1981) outlined nursing priorities for hospitals and nursing homes for that time period and reported on several studies that led to the 2002 landmark study she conducted on nurse staffing. Studies were cited that appeared to demonstrate the relationship between the quality of nursing care and patient outcomes (Aiken, 1981). As early as 1968, differences in postoperative death rates among hospitals appeared to be related to the quality of both the medical and nursing care (Moses & Mosteller, 1968). Factors such as nursing skill mix ratio and the qualifications of the nursing staff were found to be influences in the differences in postoperative mortality rates among hospitals. Aiken identified the need for nurses to practice with more autonomy, which she proposed could alleviate stress and burnout syndrome in nursing, an early identification of the importance of the workplace environment (Aiken, 1981).

During the late 1980s and early 1990s as hospitals were beginning reengineering efforts to streamline care and reduce costs, nursing personnel decreased nationally by 7.3 percent (Aiken, Sochalski, & Anderson, 1996, p. 89). Fewer caregivers per patient were available at that time compared to the prior decade. Nurses continued to report reduced staffing levels and

increased job stress (Aiken et al., 1996). Aiken stated that reengineering efforts could adversely affect patient safety and quality outcomes.

Research on the relationship between nurse staffing and selected nurse sensitive indicators among surgical patients was conducted by Kovner and Gergen (1998). An increase in nurse staffing (FTE RNs per adjusted inpatient day) was related to decreases in urinary tract infections, pneumonia, venous thrombosis, pulmonary embolism, and pulmonary compromise in post-operative surgical patients (Kovner & Gergen, 1998, p 317). Another study conducted by Kovner, Jones, Zhan, Gergen, and Basu (2002) on nurse staffing and postsurgical adverse events demonstrated similar findings. Three adverse post-operative events: urinary tract infection, venous thrombosis/pulmonary embolism, and pulmonary compromise were inversely related to RN staffing levels. There was a statistically significant inverse relationship between RN hours per adjusted inpatient day and post-operative pneumonia (Kovner et al., 2002). These studies were important during this time period in health care because they added to the growing body of research that supported a relationship between RN staffing and adverse patient events. During this time frame (1990-1996), many hospitals were undergoing workforce restructuring in order to contain costs. This restructuring resulted in reductions of nurses and nurse staffing levels. This research demonstrated that the evaluation of workforce redesign must include an analysis of the relationship between workforce redesign, nurse staffing, and adverse patient events.

Aiken and colleagues (2002) studied the relationship of nurse staffing to mortality rates of surgical patients and found that the risk of patient mortality within thirty days of admission increased by seven percent for each additional patient assigned to a nurse. Inadequate staffing was found to be a contributing factor in twenty-four percent of all unanticipated events that resulted in patient death, injury or permanent loss of function. The researchers concluded that a

lower number of patients assigned to each nurse is associated with better outcomes for hospitalized patients. These improved outcomes also translated into significant financial savings for hospitals, which was an important finding during the era of hospital reengineering and cost containment initiatives. During the early 2000s, there were few studies conducted that examined the relationships between nurse staffing, quality of care, and patient outcomes. The research that was available appeared to support the minimum nurse staffing legislation passed in California in 1999 and implemented in January 2004 (Aiken 2010). Aiken and colleagues (2002) stated that the study results “suggest that the California hospital nurse staffing legislation represents a credible approach to reducing mortality and increasing nurse retention in hospital practice, if it can be successfully implemented” (p. 1992).

Recognizing the important role that nurses serve in keeping patients safe, the Joint Commission introduced a “staffing effectiveness” standard in July 2002 and required that accredited organizations track clinical and human resource indicators to determine if there were any correlations between staffing and patient outcomes. Staffing effectiveness was described by the Joint Commission as ensuring the appropriate skill mix and numbers of staff to meet patients’ needs (Joint Commission Resources, 2007). In response to comments from organizations about the lack of correlation between these indicators, the Joint Commission revised this standard in 2010 and now requires hospitals to include the analysis of the adequacy of nurse staffing as a factor when negative trends in quality of patient care are identified (Joint Commission on Accreditation of Healthcare Organizations, 2010).

The 2004 IOM report, *Keeping Patients Safe: Transforming the Work Environment of Nurses*, stated that “how well we are cared for by nurses affects our health, and sometimes can be a matter of life or death” (Page, 2004, p. 2). This report built on two previous IOM reports,

To Err is Human: Building a Safer Health System (Kohn, Corrigan, & Donaldson, 2000) and *Crossing the Quality Chasm: A New Health System for the 21st Century* (Institute of Medicine, 2001). *Keeping Patients Safe: Transforming the Work Environment of Nurses* (Page, 2004) recognized the importance of nurses' work environment. It demonstrated that the average nursing work environment posed a threat to patient safety. Several recommendations were proposed to maximize workforce capability that would improve staffing levels and promote high quality, safe patient care.

Research on hospital nurse staffing levels demonstrated wide variations in practice even within individual hospitals. While tools such as patient classification systems (PCSs) were being used increasingly by hospitals to predict patient care needs, these systems had limitations (Page, 2004). Workload estimates were routinely established by vendors of PCS systems, which could differ from institution to institution. PCSs were not set up to consider essential indirect care or cognitive activities, such as collaboration with interdisciplinary team members or patient care assessments that are required for safe patient care. The routine practice of using the hospital midnight census as a number to estimate care requirements did not consider patient turnover during the 24-hour period or patients who stayed less than 23-hours for observation. Patient turnover and observation stay patients can both increase nurses' workload.

The report recommended establishing staffing principles or practices, similar to those developed by the ANA in 1999, to help organizations develop balanced staffing plans. The IOM report (Page, 2004) called for implementation of the following staffing practices to improve staffing levels and thereby patient safety: besides calculating the midnight census, incorporate an analysis of admission, discharges, and less than 24 hour patient stays into the estimation of patient volume. Nurses' scheduling must be flexible to accommodate for unpredictable

variations in patient volume and acuity, which affect nursing workload. Direct-care nurses must be involved in all aspects of staffing, from determining appropriate staffing levels by shift to regulating flow and setting criteria for unit closures as workload dictates.

An association between nurse staffing, burnout, and health care-associated infections such as urinary tract and surgical site infections was demonstrated by Cimiotti and colleagues (2012), who found that for every one patient increase in nurses' workload there was an associated increase in the risk of urinary tract and surgical site infections. For every 10% increase in job-related burnout reported on the Maslach Burnout Inventory-Human Services Survey, "the rate of urinary tract infections increased by nearly 1 per 1,000 patients and the rate of surgical site infections by more than 2 per 1,000 patients (Cimiotti et al., 2012, p. 488)." However, a study limitation was that a causal link could not be established since nurses were not linked to specific patients. Nurses' job satisfaction and burnout was also found to affect patient satisfaction levels in a study conducted by McHugh, Kutney-Lee, Cimiotti, Sloane, and Aiken (2011). For every ten percent increase in nurses who reported dissatisfaction with their jobs, there was a two percent decrease in patients who stated they would definitely recommend the hospital as measured by patient satisfaction surveys (McHugh, Kutney-Lee, et al., 2011).

Nursing Work Environment

Initiatives to stabilize the existing nursing workforce, reduce turnover and improve nursing recruitment and retention include the ANCC Magnet Recognition Program®. Approximately 7% of all 5,724 registered hospitals in the United States have achieved ANCC Magnet Recognition® status (American Nurses Credentialing Center, 2016). The original Magnet research study was conducted in 1983 by a task force appointed by the American Academy of Nursing to examine hospital nursing practice and workforce issues (McClure,

2005). Task force members noted that despite the nursing shortages of the 1970s and 1980s, some institutions were able to recruit and retain nurses. One of the characteristics noted in all Magnet hospitals is the longevity of employees at every level of the institution and the stability of the nursing workforce in these organizations (McClure, 2005). The ability of Magnet hospitals to retain nurses and create professional practice environments has been associated with improved patient outcomes and healthier nursing work environments (Witkoski Stimpfel et al., 2014).

The influence of the work environment, such as the effect of high nursing workload on nurses' job satisfaction, was studied by Aiken in addition to the influence of nurse staffing on the quality of patient care. Aiken, Clarke, Sloane, Sochalski, et al. (2002) found that nurses in hospitals with lower numbers of nurses assigned per patient were more than twice as likely to report job dissatisfaction and job-related burnout as nurses in hospitals with higher numbers of nurses. These results were similar to those previously described in a cross national study conducted in adult acute care hospitals in the U.S., Canada, England, Scotland, and Germany (Aiken et al., 2001). Aiken, Clarke, and Sloane (2002) demonstrated that nurses' reports of low quality care were up to three times as likely in hospitals with low nurse staffing levels. The same nurses also reported poor organizational support for nursing practice. The effects of organizational climate and nurse staffing were also demonstrated to increase the likelihood of sustaining needlestick injuries and near misses. Clarke, Sloane, and Aiken (2002) found that nurses in hospitals with lower staffing levels were more likely to report the presence of significant risk factors (i.e. staff carelessness and inexperience) that led to an increase in the report of needlestick injuries.

In addition to research on nurse staffing, Kovner has conducted studies on nursing work environment factors associated with work satisfaction (Kovner, Brewer, Wu, Cheng, & Suzuki, 2006), work attitudes of older nurses (Kovner, Brewer, Cheng, & Djukic, 2007), and mandatory overtime regulations (Bae, Brewer, & Kovner, 2012). Djukic, Kovner, Brewer, Fatehi, and Cline (2012) studied the association between RNs' rating of quality care and selected work environment factors and found a significant relationship between the RNs' ratings of quality and physical work environment, workgroup cohesion, nurse-physician relations, procedural justice, and job satisfaction. Nurses' ratings of perception of staffing adequacy were not associated with their ratings of quality. By 2012, Djukic and colleagues found that for each additional assigned patient, the odds of nurses reporting that patients were likely to receive high-quality care decreased by eight percent.

Aiken and colleagues have conducted research internationally on the effect of nurses and nursing care on the quality of patient care and outcomes through the Center for Health Outcomes and Policy Research at the University of Pennsylvania. The importance of the hospital work environment and adequate nurse staffing on nurse burnout and job dissatisfaction across many countries has been demonstrated in several studies (Aiken et al., 2011; Poghosyan, Clarke, Finlayson, & Aiken, 2010) with results similar to those seen in North America.

The relationship between the length of time worked by nurses and quality of care was demonstrated by Rogers, Hwang, Scott, Aiken, and Dinges (2004) who found that nurses who worked shifts longer than 12.5 hours had a three-fold likelihood of making an error. The relationship between errors or near misses and the time worked was not affected by other factors such as nurses' age or type of unit or hospital. In 2012, the relationship between nurses' shift length on burnout, job dissatisfaction, and intention to leave the job was studied by Witkoski-

Stimpfel, Sloane, and Aiken (2012) who found that the longer the work shift, the greater the likelihood that nurses would experience burnout. Patients were less satisfied with their care when there were higher proportions of nurses working 13 hours or more per day, as measured by Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) surveys.

Nurses' Education and Quality Care

Characteristics of nurses who deliver patient care are important to achieve quality patient outcomes. In a 1998 article, Kovner and Schore examined the relationship between nurses' practice, education, and experience across health care settings. The authors forecasted the potential for an increased demand for baccalaureate prepared RNs because baccalaureate-prepared nurses would be perceived as capable of delivering more complex nursing care. Kovner and Schore (1998) predicted the ability to deliver higher level care and improved nursing care quality could translate into increased hospital revenue.

Since 2003, when Aiken and colleagues found a statistically significant relationship between the proportion of nurses with bachelor's degrees and higher, and the risk of mortality and failure to rescue in surgical patients, controlling for other hospital and patient characteristics (Aiken, Clarke, Cheung, Sloane, & Silber, 2003), research has consistently demonstrated that hospitals with more nurses prepared at the baccalaureate level achieve better patient outcomes. Their results remain unchallenged. A longitudinal study conducted by Kutney-Lee, Sloane, and Aiken (2013) used cross-sectional samples of patients and nurses in acute care hospitals in Pennsylvania, compared at two different time periods (1999 and 2006). They found a 2.12 average reduction of deaths per 1,000 patients, associated with a ten point increase in the percentage of nurses with a baccalaureate degree.

Missed Nursing Care

Errors of omission or delays in nursing care, either in part or in whole, have been defined in the literature as “missed nursing care” (Kalisch, 2006) and as “rationing of nursing care” (Schubert, Glass, Aiken, Schaffert-Witvliet, Sloane, & DeGeest, 2008). Nurses’ perception of staffing adequacy can provide insight into nurses’ workload and the potential for missed nursing care. Kalisch (2006) conducted a qualitative study to determine what nursing care activities are reported by RNs as missed on medical-surgical acute care hospital units. Nine elements of regularly missed care activities (ambulation, turning and positioning, delayed or missed feedings, patient teaching, discharge planning, emotional support, hygiene, intake and output recording and patient surveillance) and seven themes as to why these activities were missed emerged from this study (Kalisch 2006). Kalisch and Aebersold (2006, p. 143) identified five major characteristics of an acute care hospital nursing unit that contribute to issues with patient safety: unclear unit values, fear of punishment for errors, lack of systematic analysis of mistakes, work complexity, and inadequate teamwork.

The effect of unmet nursing care needs and the variation of nursing care quality across hospitals was studied by Lucero, Lake, and Aiken (2009). Lucero and colleagues’ study sampled 10,184 nurses in 168 acute care hospitals in Pennsylvania about their work setting. Unmet nursing care needs, which were measured by nurses’ self-report of required nursing care that was missed was found to average two out of seven necessary nursing care activities missed during the nurses’ last shift. The authors found statistically significant variations in the quality of care across hospitals (Lucero et al., 2009). Another study conducted by Lucero, Lake, and Aiken (2010) examined the association between nurses’ reports of missed care and adverse events that included wrong medication or dose errors, nosocomial infections, and patient falls

with injury in acute care hospitals. They demonstrated a significant association between the quality of nursing care and adverse events in acute care hospitals (Lucero et al., 2010).

The actual quality of patient care is the result of the care provided and care that was *not* provided. Lucero and colleagues (2010) found in their study on nursing care quality and adverse events in U.S. hospitals that the proportion of missed nursing care “ranged from 26% for preparing patients and families for discharge to as high as 74% for developing or updating nursing care plans” (p. 2185). This same study reported an association between missed care and adverse patient events, but how much missed nursing care influences adverse effects is not known.

Patient Complexity Factors

The *ANA Principles for Nursing Staffing* (2012) describes the intricacy of nurse staffing. Staffing is both a noun and a verb, whereby there are sufficient nurses to provide patient care and the process for assigning that care has been appropriately factored into all the aspects of the patient, nurse, and environment (Weston et al, 2012). The ANA principles are organized into five sets applicable to stakeholders involved in patient care delivery: 1) healthcare consumer, 2) RNs and other staff, 3) organization and workplace culture, 4) practice environment, and 5) staffing evaluation. The principles related to healthcare consumers state that “staffing decisions should be based on the number and needs of the individual healthcare consumer, families, and population served” (ANA, 2012, p. 7). Several principles identified include age, functional ability, communication skills, cultural and linguistic diversities, transitional care, availability of social supports, continuity of care, and environmental turbulence (admissions, transfers, and/or discharges). Patient acuity is separated into several factors: severity, intensity, acuity, complexity, and stability of condition, multi-morbid conditions, and complexity of care needs.

Patient acuity is a widely used term in health care intended to describe the intensity of illness. The concept of patient acuity is believed to dictate the amount of nursing care needed. According to the concept analysis by Brennan and Daly (2009), patient acuity is a construct that lacks a clear definition, so measurement is also problematic. They applied Holzemer's Model for Health Care Research to the concept of patient acuity. Holzemer's (1994) model was developed to provide a framework for the complexities of health-related outcomes. In Holzemer's model, the horizontal axis represents Donabedian's system axis (inputs, processes, and outcomes) and the vertical axis is made up of components needed for health care outcomes research: client, provider, and setting (Holzemer, 1994, p. 6). This model expanded on Donabedian's work because it created nine cells that can be examined for "the interactions and linkages among structure, process, and outcomes at the levels of the client, the provider and the setting" (Holzemer & Reilly, 1995, p. 184). Holzemer (1994) used his Model for Health Care Research to analyze the effect of nursing care on patient outcomes in Latin America and the Caribbean.

Using Holzemer's model, Brennan and Daly (2009) showed that severity and intensity attributes of acuity are often used interchangeably. The main attribute of intensity fell under provider-related acuity and the severity attribute applied to the patient. The intensity category has three sub-categories: nursing care needs, workload, and complexity (Brennan & Daly, 2009, p. 1117). A gap in knowledge exists due to the lack of clarity in the concepts of acuity, severity, intensity, and complexity.

Finkler and colleague's (2013) definition of patient acuity is "the measurement of a patient's severity of illness related to the amount of nursing care resources required to care for the patient" (p. 375). Myny and colleagues (2012) acknowledge that while patient acuity may be

the most important factor affecting nurses' workload, the effect of other patient factors is not clear. Patient complexity was defined in this current study as the degree of difficulty of inter-related patient care needs resulting from specific patient-related factors. The patient complexity factors identified were: obesity, limited English proficiency requiring translation services, disruptive behavior, use of restraints, use of continuous observation, and family demands.

Obesity as a Patient Complexity Factor

Obesity in the United States is a major health problem. Obesity is defined by the Centers for Disease Control as a body mass index greater than or equal to 30 kg/m². Approximately one third or 35% of adults are classified as obese (Centers for Disease Control, 2016). Obese patients can increase the workload of nurses because additional workers may need to be assembled to provide care such as turning and positioning. Specialized equipment may also need to be used to accomplish these tasks. Myny and colleagues (2012) developed a tool to identify and measure the most significant factors, other than patient acuity, affecting nursing workload. Body mass index greater than 30 kg/m² (obesity) was identified as a potential patient complexity factor. The tool was administered to 864 participants and a factor analysis was conducted, which resulted in a three factor structure: work-fluency; amount of work; and admission, discharge, transfer activities (Myny, et al., 2012). Obesity loaded onto the "amount of work" factor, which was defined as determinants of work, both by the hospital and patient type.

Drake and colleagues (2008) conducted a study to identify the challenges nurses encounter when providing care to obese patients. The challenges were categorized as patient-nurse satisfaction, staffing issues, equipment challenges, patient safety considerations, and psychosocial/family issues. The study included nurses from several practice settings: inpatient acute care, outpatient sites, and community settings. Nurses from inpatient acute care settings

reported only 39% of satisfaction with the adequacy of staffing and identified nurse staffing as a barrier to care (Drake et al., 2008). Nurses from outpatient and community settings reported higher satisfaction with staffing adequacy when caring for obese patients.

Caring for obese patients and the workload consequences has been demonstrated to affect nurses' satisfaction. In a qualitative study to examine nurses' perception of nursing work and reasons for leaving nursing, Bogossian and colleagues (2014) identified four themes: workload, shift work, violence, and remuneration. The physical demands of nursing were noted under workload and included caring for obese patients. Study participants noted that "nursing is a physical role with increasing requirements with the comorbid and overweight population we are providing care for... this is underestimated" (Bogossian et al., 2014). Obese patients and the potential increased workload associated with their care can result in physical and mental fatigue in the nurse. Steege and colleagues (2015), in their study to develop a model to describe sources of fatigue in nurses' work, identified obesity as one of the patient factors that nurses acknowledged led to the most physically fatiguing tasks. Researchers concluded that consideration of patient obesity in staffing assignments can reduce physical fatigue in nurses.

In an integrative review of patient classification systems, Fasoli and Haddock (2010) identified variables that need consideration in developing a patient classification system model. Variables reported in the literature that were used in patient classification systems were grouped into three categories: patient, nurse/provider, and unit/organization. Patient care needs of obesity, psychosocial needs, and observational needs (Fasoli & Haddock, 2010, p. 308) were identified under the category of patient. While all three of these patient factors are included in the determination of patient acuity as measured by the acuity software system in this current study, a lack of nursing documentation in these areas affects the accuracy of measurement. For

example, obesity will only be factored into the acuity measurement if the patient is weighed daily, which does not always occur. Patients may not have been ordered to have daily weights performed or this may be an element of missed nursing care.

Limited English Proficiency

The ability to communicate effectively with patients and families is an important component in providing safe patient care. Patients with limited English proficiency provide communication challenges because the nurse must use qualified medical interpreters or technology such as mobile translation devices to communicate important information. Several authors have identified limited English proficiency as a factor that increases the complexity of the patient care.

Gran-Moravec and Hughes (2005) developed a self-report survey tool in their study to determine how nurses spend their time and to identify nurses' perceptions of how patient acuity and staffing should be determined. A mixed-methods study was conducted to gain a broad perspective of nurses' perceptions. In the qualitative study phase, two themes were identified: 1) communication, which focused on staff and 2) consideration for care, which referred to seeing the patient holistically. Personal factors such as language, patient behavior, and family considerations were identified (Gran-Moravec & Hughes, 2005, p. 130) as needing consideration in how patient care and workload can be measured. Language has been identified in patient complexity models as a potential barrier to communication, which can affect patient's ability to access and use care in outpatient settings (Safford, Allison, & Kiefe, 2007; Shippee, Shah, May, Mair, & Montori, 2012). Limited English proficiency was identified by de Raad et al. (2010) as a factor that increased the length of time for administering chemotherapy in an outpatient center. The time needed for patient communication was cited as the most difficult aspect of

administration time to estimate. Variations in time were influenced by patient's ability to speak English. Hemsley, Balandin, and Worrall (2011) investigated nurses' concept of time when communicating with patients with complex communication needs. Included in the definition of complex communication needs was the need for an interpreter or an alternate communication device. The study used a narrative inquiry technique. Researchers found that nurses identified time as both a barrier and a facilitator to effective communication. One of the barriers was the need to wait for an interpreter to communicate with the patient. A limitation of the study was the low use of interpreter services, which affected generalizability.

Researchers have included limited English proficiency in the development of tools to measure patient complexity. O'Brien and Bengert (2007) reported on the use of the Jones Dependency Tool, a validated measure of patient dependency in Emergency Departments, in their study to determine patterns of patient dependency to predict workload. The tool is comprised of six components of patient dependency, which are rated on a 3-point scale. The scores are then added to obtain a total score, which is used to determine the overall level of patient dependency. Communication is a component of the tool and patients with language barriers and behavioral problems are categorized as a "3," which indicates total patient dependency. Peek and colleagues (2009) created the "Minnesota Complexity Assessment Method," a checklist to identify patient and health system factors that can interfere with routine patient care. Complexity levels are assigned for each factor, higher numbers indicating more complexity. Under "resources for care" is the patient factor of shared language with providers. Patients who require translation services will receive higher level scores.

Disruptive Behavior

Patient confusion can lead to behavioral issues, which at times can be disruptive and difficult for nurses to manage. While behavioral issues can be the result of somatic illness and therefore be related to patient acuity, researchers have identified disruptive behavior as a complexity factor (Fasoli & Haddock, 2010; Gran-Moravec & Hughes, 2005). In the qualitative phase of Gran-Moravec and Hughes' (2005, p. 130) study, nurses said patient behaviors such as anxiety, confusion, and combativeness affect staffing and need to be considered when devising staffing plans. Psychiatric co-morbidities, which are common in patients on acute care units, increase the potential for disruptive behavior. De Jonge et al. (2001) examined the relationship between mental disturbances such as anxiety, depression, and alcohol abuse and nurses' perceived complexity of care at discharge. The study was conducted on internal medicine inpatient units with the aim of developing a screening tool to detect high complex-care patients on admission. Researchers found a relationship between nurses' perception of complexity of care and patients who scored high on the anxiety and depression scales.

Mental health co-morbidities and the behavioral issues that may arise for patients as a result of these co-morbidities have been identified as a complexity factor in the literature. Beglinger (2006) used an evidence-based approach to quantify patient demand in developing a staffing budget that would appropriately align staffing resources to patient needs. Three categories of "drivers of intensity" were identified by nurse leaders and include: length of stay, age of patients, and complexity of patients (Beglinger, 2006, p. 194). Confusion and disorientation were identified as factors under patient complexity. The Jones Dependency Tool that was used in O'Brien and Bengner's study (2007) as described above, identifies "environmental safety, health and social needs" (p. 2087) as a component. Patients will receive

higher ratings and be classified as more dependent, if they exhibit behavior that is dangerous to themselves or others or if they need extensive emotional support.

Grant and colleagues (2011) studied patients with complex health needs to develop a model to explain patient complexity from a primary care physician's perspective. Physician participants were asked to indicate their patients who were complex and identify the factors that influenced their choices. From this list of complex patients, complexity domains were developed. The five domains were: medical decision making, coordination of care, patient's personal characteristics, patient's diagnosed mental health issues, and patient's socioeconomic circumstance. Patient's personal characteristics were defined as "individual behaviors of the patient that increase the challenge of providing effective care" (Grant et al., 2011, p. 798). Mental health issues included psychiatric disorders that were different from patient's personal characteristics.

Restraint Use

Physical restraints are used as a final intervention to keep patients and other individuals, such as staff and visitors, safe. There are two types of behaviors that will necessitate the use of physical restraints: nonviolent and violent behaviors. Restraints for non-violent behaviors are commonly used to ensure that patients do not pull or remove medical devices such as tubes, drains, lines, or intravenous catheters. Restraints for violent behaviors are used as an intervention for patients who are violent, destructive, and threatening to harm themselves or others. Disruptive behavior may, or may not, result in the need for a physical restraint. Alternatives to restraints should always be attempted first and restraints should be a final alternative in order to keep patients safe. Restraint use has been linked with many risks such as aspiration, psychological trauma, suffocation, and death (Springer, 2015).

Beglinger (2006) identified the need for restraints as a driver of intensity, under the category of patient complexity. Like disruptive behavior, the need to restrain a patient may or may not be related to changing patient acuity. Unruh, Joseph, and Strickland (2007) found a significant relationship between high RN absenteeism, higher use of restraints, and high patient load, defined as patient days per RN hours.

Continuous Observation

Continuous observation of a confused or potentially violent, self-destructive patient is frequently used as an alternative to physical restraints. In addition to identifying confusion, disorientation, and the need for restraints as drivers of intensity, Beglinger (2006) included the need for employees assigned to continuously observe a patient under the category of patient complexity. Mittman, Seung, Pisterzi, Isogai, and Michaels (2008) studied nursing workload to determine times for nursing interventions in selected patient populations. The five types of patient populations included in the study were: people with acute myocardial infarction, diabetes mellitus, pneumonia, schizophrenia, and stroke. The most time consuming activity for four of the patient groups (people with diabetes, pneumonia, schizophrenia, and stroke) was close observation, or the need for a 1:1 companion.

In developing a new method to measure nursing workload and develop more effective staffing plans, Twigg and Duffield (2008) developed seven unit categories for public hospitals. Each category was allotted average nursing care hours per patient day and patient complexity criteria were identified for each category. High risk of harm to self and/or others and the need for close observation was identified as a complexity factor. Fasoli and Haddock (2010) also identified observational needs as a patient care need, a variable that needs consideration within patient classification systems.

Family Demands

The last patient complexity factor identified through the literature was family demands. This factor is unique in that it is not directly related to the patient, but is encompassed within the care of the patient. Fulton and Wilden (1998) developed an instrument, the “Components of Patient Requirements for Nursing Care,” to quantify nursing care needs of medical/surgical patients to determine appropriate nursing staff mix. There were five components of the tool: patient instability, nurses’ clinical judgment, educational needs of the patient, emotional support needs of the patient/family, and physical care needs. Support for family members is rated under the two components of educational needs and emotional support. Higher ratings are assigned in these categories when family members require extensive emotional support, counseling, or conferences to discuss the plan of care for the patient. Researchers found the highest scores, indicating more complex needs included the category of patient/family support (Fulton & Wilden, 1998).

Gran-Moravec and Hughes (2005) identified the factors of family issues and involvement under the theme of communication in the qualitative phase of their study. Family involvement, combative or troublesome families, and consideration of the time it takes to care for specific family members were mentioned by nurses in the study as factors that need consideration when determining staffing. Mittman and colleagues’ study (2008) reported family support and consultation greater than one hour were activities that required a significant amount of time for nurses to complete for patients with diabetes and pneumonia. Family support was also reported as an area where nurses spent a lot of time.

In a literature review conducted to identify non-direct patient care factors, which can influence nursing workload, Myny and colleagues (2011) included patient and family

characteristics as a category, but did not define family characteristics. The authors stated that most of the variables within the group of patient and family characteristics were related to the type or mix of patients most commonly treated in the hospital (Myny et al., 2011). The consideration of family demands has been noted in the literature as a factor that can affect nurses' workload and is an important component in nurse staffing. However, a knowledge gap exists between the amount of family involvement, the time required for nurses to meet family need, and the nurses' perception of staffing adequacy.

Conclusion

The contribution of nurse staffing to quality patient outcomes is well established in the literature. Many studies have demonstrated the relationship between higher numbers of RNs and lower levels of mortality and morbidity. Nurse staffing levels have also been linked to nurses' job satisfaction and work environment. However, knowledge gaps about patient-level factors that need consideration in nurse staffing plans and nurses' perception of the adequacy of staffing are evident.

Many terms have been used to describe patients and their needs for care. Terms such as acuity, complexity, and intensity have been used interchangeably in the literature. Further clarification of these terms is needed and a determination of how these factors influence nursing workload and staffing perception is an important consideration in nurse staffing. This current study identified patient complexity factors as being separate from patient acuity and examined the relationship between these factors and nurses' perception of staffing adequacy. Outcomes-driven acuity software systems are now available to predict staffing needs based upon patient acuity and environmental turbulence such as admissions, discharges, and transfers. However,

lack of documentation or missed nursing care can affect the accuracy of these predictions, which can affect nurses' perception of staffing adequacy.

Studies that have examined the relationship between structure and processes of nurse staffing and the effect on nurses' perception used large secondary data sets and were unable to link patients and their factors directly to nurses and their perceptions of staffing adequacy. The ability to determine the relationship between nurses' perception of staffing adequacy at the shift-level and selected patient factors is a unique contribution to the body of knowledge in nurse staffing.

CHAPTER 3: METHODS

The purpose of the current study was to determine the effect of patient complexity factors not captured consistently in the measurement of patient acuity by an automated workforce management system on nurses' perception of staffing adequacy. This chapter describes study design, variables, measures, data collection process, and data analysis plan for the current study.

Study Design

The current study employed a complex predictive correlational research design, which included repeated measures of patient data to examine the influence of patient complexity factors on nurses' perception of staffing adequacy where the main unit of analysis was the shift. For some analyses, the unit of analysis was the individual nurse or the individual patient. Previous research that examined relationships between the practice environment and staffing structures have focused on patient outcomes and have used a descriptive retrospective study design (Aiken et al., 2002; Kelly, Kutney-Lee, Lake, & Aiken, 2013; Kim, Capezuti, Boltz, & Fairchild, 2009; Lake & Friese, 2006; Park, Blegen, Spetz, Chapman, & DeGroot, 2012). Mark's (2002) secondary analysis of data from the Outcomes Research in Nursing Administration Project determined the effect of hospital, unit, nurse, and patient characteristics on nurses' perception of staffing adequacy. Recommendations for future research have included analyzing the relationship between perception of staffing adequacy, patient acuity, turnover, and nurse satisfaction (Mark, 2002). One of this current study's aims was to examine the relationship between nurses' perception of staffing adequacy and patient acuity. Previous studies have not accounted sufficiently for differences in patient demands for nursing care and have been unable to allocate staffing directly to individual patients. An assumption of this current study was that patient acuity and patient complexity are different constructs and therefore, should be considered

separately in developing staffing plans. The current study was unique in that it included certain patient factors that have not been previously studied for their effect, if any, on nurses' perception of staffing adequacy. The patient complexity factors that were recorded by nurses at the end of their shifts were: 1) obesity, 2) limited English proficiency requiring translation services, 3) disruptive behavior, 4) the need for continuous observation, 5) restraint use, and 6) family members who required significant psychosocial interaction and/or limit setting. RNs who worked on selected medical telemetry units were recruited and enrolled. Data from two similar units were selected for the current study to control for confounding factors. Nurses cared for many of the same patients over the course of the study so the data from the same patients was used as a repeated measure. However, the unit of analysis to answer the main research question was the shift worked, since nurses' perception of staffing adequacy was measured at the end of approximately 14 shifts per nurse.

Study Question

The research question was "what patient complexity factors predict the likelihood that nurses will report inadequate staffing?" The study aims were:

1. To determine patient complexity factors that predict nurses' perception of inadequate staffing on selected inpatient units.
2. To examine the effect of staffing based on the predicted staffing requirements made by an automated outcomes-driven acuity software system on nurses' perception of staffing adequacy.
3. To determine if uncaptured data about selected patient complexity factors affects the nurses' perception of staffing adequacy.

Procedures

Since the sample was to be made up of shift-level data, the first consideration was how many shifts of data would be needed to conduct multiple regression analysis with six predictors. A sample size of $N=329$ was recommended for 6 predictors if a small effect size was anticipated. The second consideration was how to control for differences among nurses supervised by different managers. Obtaining the required shifts of data on one or two units rather than across all six units was desired. The third consideration was related to “test burden.” Since RNs would record their perception of staffing adequacy at the end of a 12-hour shift, the principal investigator (PI) wanted to decrease test burden. Any data that could be retrieved from the electronic medical record (EMR) was not requested from the RNs. This decision meant that most data elements were extracted from the EMR by the PI. Although this decision was made to make volunteering to participate in the study more appealing, it created a great burden for the PI. Data extraction was labor intensive. This method would not be recommended to others.

Registered nurses ($N=54$) who provide direct care were recruited from six similar inpatient units at an academic medical center. There were approximately 195 RNs who were eligible to participate in the study, resulting in a participation rate of 28%. RNs had to meet the inclusion criteria: hold a license as a registered professional nurse and be able to work independently to provide direct patient care on the clinical unit. Exclusion criteria were: RNs on orientation or working on a permit (graduate nurses). There were no per-diem or travel nurses employed on the units during study recruitment.

Potential participants were notified passively about the study via flyers (Appendix E). A meeting was held at a neutral location for all interested potential participants, away from the clinical unit, where they were informed about the study. The recruitment flier served as an

informational handout and was provided to all interested participants at the meeting. The investigator presented the study to potential participants, explained the procedure for data collection, and discussed how to complete the data collection forms.

Nurses who volunteered were screened for eligibility. Those who met eligibility criteria, and wished to participate were enrolled in the study. Each volunteer completed the informed consent (Appendix F). Participants were told that the research study was covered by a certificate of confidentiality from the National Institute of Nursing Research due to the sensitive nature of the information that was collected during the course of the study. This certificate helped the PI avoid involuntary disclosure that could expose participants to adverse economic, legal, psychological, and social consequences. All participants received a packet that included the following study materials: a paper copy of the PES-NWI survey (Appendix A), an initial “Staffing Adequacy Perception - VAS” form (Appendix B), copies of the “Identification of Patient Complexity Factors/Staffing Adequacy Perception - VAS” form (Appendix C), and an RN demographic survey (Appendix D). All materials had a unique ID number created by the investigator. A locked box was placed on each unit in a secure location so participants could drop off completed forms after each shift. The packet also included the recruitment flier that explained the study. Upon consent, participants received a small honorarium of a \$10 Starbucks gift card and a certificate of study participation to acknowledge their time and effort.

Data were collected over a 60-day period from five data sources as described in Table 3.2 in order to quantify the key study variables. The accuracy of the staffing data was confirmed with the staffing coordinator for the time period of the study.

Table 3.1: Study Variables

Variable Name	Variable Definition	Measurement Level
<i>Patient Complexity Factors</i>		
Patient Obesity	BMI greater than 30	Nominal
Limited English Proficiency	Patient required translation services	Nominal
Patient disruptive behavior	Patient with disruptive and/or combative behavior	Nominal
Patient restraint usage	Patient's behavior required application of restraints	Nominal
Use of constant observation	Patient exhibited behavior that was a threat to self and/or others and required continuous observation by a worker	Nominal
Family demands	Patient with family members who require significant interaction and limit setting	Nominal
Total Factor Shift Score	Total number of patient complexity factors for the shift worked	Interval
<i>Patient Characteristics</i>		
Age	Patient's age in years at last birthday	Ratio
Gender	Male or Female	Nominal
Acuity Level Score	Patient's severity of illness	Ratio
<i>Nurse Characteristics</i>		
RN Education	RN educational preparation	Nominal
RN Experience	Years of RN experience	Ratio
RN Unit Tenure	Years of RN experience on the unit	Ratio
<i>Nurse Staffing</i>		
RN Skill Mix	Percentage of RNs to other direct care nursing personnel per shift	Interval
Nurse-to-Patient Ratio	Ratio of the number of patients assigned to the RN per shift	Interval
Assigned Care Hours	The hours of nursing care time required based upon patient demand as calculated per shift	Ratio
Percent of Assigned Care Hours	Percentage of hours worked to assigned care hours	Ratio
<i>Unit Characteristic</i>		
Inpatient Unit	Unit location of the patient	Nominal
<i>Perception of Staffing Adequacy</i>		
RN satisfaction with staffing adequacy	Score assigned by the RN to describe the adequacy of nurse staffing on the shift recently completed	Interval

Table 3.2: Data Sources, Study Variables, and Measurement

Data Source	Study Variable	Measurement
ClairVia© Outcomes-Driven Acuity Software System	<ul style="list-style-type: none"> • Nurse staffing by nurse-to-patient ratio • Assigned Care Hours • RN skill mix • Patient acuity level score 	<ul style="list-style-type: none"> • Ratio of the number of patients assigned to the RN per shift • The hours of nursing care time required based upon patient demand as calculated per current shift • Percentage of RNs to other direct care nursing personnel • Score assigned to the patient based upon NOC assessment scoring
RN demographic survey	<ul style="list-style-type: none"> • RN educational preparation • Extent of RN experience • RN unit experience 	<ul style="list-style-type: none"> • Proportion of RNs with a baccalaureate level degree or higher • Total number of years of RN experience • Number of years of RN experience on the unit
PES-NWI Survey	<ul style="list-style-type: none"> • Mean score on a composite of all subscale scores • Staffing and resource adequacy subscale 	<ul style="list-style-type: none"> • Subscale mean scores • Composite score
Staffing Adequacy Perception - VAS	<ul style="list-style-type: none"> • Perception of staffing adequacy for the recently completed shift 	<ul style="list-style-type: none"> • Interval level score
Patient Complexity Factors Form	<ul style="list-style-type: none"> • Patient complexity factors • Patient age • Patient gender 	<ul style="list-style-type: none"> • Investigator developed survey • Age in years at last birthday • Male/female

Independent Variables

The independent variables examined in the current study were grouped into five categories: 1) patient complexity factors, 2) patient characteristics, 3) nurse characteristics, 4) nurse staffing, and 5) unit characteristic. Six patient complexity factors were used that were grouped into three domains: personal, psycho-social, and social support domains. Two patient complexity factors in the personal domain were obesity and limited English proficiency. Three patient complexity factors in the psycho-social domain were patient behavioral issues such as disruptive behavior, which leads to restraint use or to constant observation for patient safety. The last patient complexity factor was in the social support domain, visitors who required significant RN interaction and/or limit setting. These six complexity factors were examined for their effect on nurses' perception of staffing adequacy. An additional variable that was called the "total shift factor score" was computed during the data analysis phase. This variable was created

by adding the total number of patient complexity factors present during the nurse's shift. The total shift factor score was used to examine the influence of the combination of patient complexity factors on the perception of staffing adequacy for that shift.

According to the Roy Adaptation Model (Roy, 2009), nurses' individual coping processes would be activated to meet their patients' needs. Individual coping is accomplished with regulator and cognator coping processes. Administrators' coping processes are activated to meet the work group's needs. At the group level, coping is accomplished through innovator or stabilizer processes. The physical adaptive mode describes how a work group adapts to resources allocated by the organization to achieve the work group's goals. Adjustment to staffing made by nurse administrators based on patient complexity factors would reflect effective organizational adaptation in this mode. The perception of staffing adequacy reflects nurses' beliefs that they are able to care effectively for patients, which in turn, reflects a healthy work environment. This perception illustrates Roy's group identity mode, which indicates interpersonal relationships and shared values within the group. If group level coping is effective, there is a greater chance that nurses' individual coping can be effective.

The second group of independent variables was patient characteristics. Patient characteristics were defined as age, gender, and acuity score. The third group of independent variables included nurse characteristics of RN educational preparation, total years of RN experience, and years of unit-based RN experience. Three types of calculations to determine how many nurses were needed to staff each unit for each shift were used for comparisons: nurse-to-patient ratio, assigned care hours, and RN skill mix. RN skill mix was calculated by determining the percentage of RNs to other direct care personnel. This variable was included to explore the relationship of the presence of nursing assistants available on the shift to nurses'

perception of staffing adequacy. The last independent variable group was unit characteristic. This was the type of inpatient unit in the current study. The two units were not different in characteristics, so this variable was not used in any tests.

Instruments

Two instruments were used to measure the perception of staffing adequacy. The Staffing Adequacy Perception - VAS was an investigator designed scale used by participants in rating the adequacy of staffing at the completion of their shift. The scale was 100 mm in length with two anchors at each end. Zero represented “completely inadequate staffing” and 100 represented “more than enough staff.” Demarcations at the 25, 50, and 75 mm intervals were provided for clarity.

Practice Environment of the Nursing Work Index (PES-NWI)

The thirty-one item PES-NWI (Appendix A) is a widely used instrument to measure the practice environment. It is used by NDNQI as a process indicator to measure RN job satisfaction (Warshawsky & Havens, 2011; NDNQI, 2014). The National Quality Forum (2014) has endorsed the use of the PES-NWI as a measurement of environmental structure for facilities. After study participants agreed to participate and signed the informed consent, they completed both instruments. The Staffing Adequacy Perception - VAS then was completed by participants after completion of each shift for 14 consecutive shifts. Convergent construct validity (Polit & Beck, 2012) was evaluated between the PES-NWI subscale of “Staffing and Resource Adequacy” and the Staffing Adequacy Perception - VAS by determining Pearson’s Correlation Coefficient.

The PES-NWI self-report instrument asks respondents to rate the extent to which they agree that an item is present in their current job on a 1-4 Likert scale. The instrument yields five

subscales and an overall composite score. Two of the subscales: Nurse Participation in Hospital Affairs and Nursing Foundations for Quality of Care, were used to assess the hospital environment. Three other subscales: Nurse Manager Ability, Leadership, and Support; Collegial Nurse-Physician Relationships; and Staffing and Resource Adequacy were used to assess unit level performance (Lake, 2002, p. 184).

The purpose of the PES-NWI development was to create a parsimonious scale to enable researchers to link the practice environment to nurses and patient outcomes (Lake, 2002).

Survey data for Lake's study was obtained from two different sources. The first sample was used by Kramer and Hafner in 1989 to develop the NWI. The second sample of 11,636 nurses working in Pennsylvania hospitals was a subset of a study conducted by Aiken and colleagues (2001). The survey was conducted in 1999 and contained 49 of the original 65 NWI items (Lake, 2002, p. 178). Lake developed and evaluated the PES-NWI scale in five stages.

Exploratory factor analysis was conducted in the second stage on the 1985-86 Magnet hospital nurse data to identify subscales that were representative of the domains of the practice environment. Five subscales were extracted using varimax rotation. Thirty-one of 48 items were retained based on factor loadings (Lake, 2002, p. 181). A mean of the subscales called the composite score was also created. The third stage of Lake's study involved examining individual and hospital level reliabilities of the subscales and composite score. The construct validity of the subscales and the composite score was determined by comparing Magnet and Nonmagnet data. In the last stage, the generalizability of the subscale structure was evaluated by principal components cluster analysis (Lake, 2002, p. 180).

Aiken and Patrician (2000) revised the NWI, retaining 55 items, modifying one item, and adding another item, which addressed team nursing. They conceptually derived three subscales

to measure organizational attributes based on a review of the literature and created a fourth subscale to measure organizational support for caregivers. The four subscales of the NWI-R are autonomy, control over the practice setting, nurse-physician relationships, and organizational support (Aiken & Patrician, 2000). These subscales are similar to, but do not correspond exactly to, the PES-NWI subscales. Excellent internal reliability of the tool was reported with Cronbach's alpha = 0.96 for the entire scale. Cronbach's alpha for the subscales were reported as: autonomy (0.85), control over practice, (0.91), nurse-physician relationships (0.84), and organizational support (0.84).

Staffing Adequacy Perception - VAS

A magnitude estimation scale (Appendices B and C) as described by Verran (1986) was designed by the PI and was used to determine nurses' perception of staffing adequacy at the beginning of the study and after completing each of 14 shifts. Magnitude estimation scaling is a way to measure the magnitude of a variable such as pain or work value (Waltz, Strickland, & Lenz, 2010). Polit and Beck (2012) use the term "visual analog scale" (VAS) to describe the process of magnitude estimation scaling and this term was used to name the instrument in the current study. The level of measurement for the instrument is ratio level because there is a zero anchor. In a study to evaluate the reliability of an instrument designed to measure complexity of care in the ambulatory care setting, Verran (1986, p. 282) used a modified magnitude estimation scale to estimate complexity of care required by the patient. Verran's technique was used to design this instrument, the "Staffing Adequacy Perception -VAS."

In the current study, participants were asked to rate their perception of staffing adequacy along a 100 mm scale that was anchored with zero at one end, labeled "completely inadequate" and 100 at the other end, labeled "more than enough staff." The ANA definition of appropriate

nurse staffing was provided on the form for construct clarification. The PES-NWI subscale of “Staffing and Resource Adequacy” was used for construct validation of the investigator developed tool the “Staffing Adequacy Perception - VAS” by performing a Pearson’s product-moment correlation.

Dependent Variable

Nurses’ perception of staffing adequacy is the dependent variable in the current study as measured by the “Staffing Adequacy Perception - VAS” and the “Staffing and Resource Adequacy” subscale of the PES-NWI.

Data for selected patient complexity factors were obtained with an investigator developed survey (Appendix C). It was completed by study participants at the end of each shift for a total of 14 consecutively worked shifts per nurse.

Other data (patient acuity scores and selected nurse staffing variables) were retrieved by the PI from the ClairVia® Outcomes-Driven Acuity software system. This acuity software program uses data from the electronic medical record to identify variation in patient care needs in real time (Pickard & Warner, 2007; Birmingham et al., 2011). The Outcomes-Driven Acuity system has two components: “patient outcome acuity assessment and the translation of outcome assessment data and other factors into staffing recommendations” (Birmingham et al., 2011). The source of the patient outcome acuity assessment for each patient is clinical data entered by the nurse into the patient’s electronic medical record. The software system links the data entered by the nurse with outcomes based upon the Nursing Outcomes Classification (NOC), developed and maintained at the University of Iowa’s College of Nursing. NOC provides a standardized language of clinical outcomes that has undergone extensive research testing and implementation since 1991 (Moorhead, Johnson, Maas, & Swanson, 2013). The software system merges patient

outcome acuity assessment and the translation of outcomes assessment data to provide staffing recommendations (Birmingham et al., 2011).

Patient outcomes are assessed for each patient by the nurse every shift on a Likert scale of 1-5. The Likert rating is weighted and then used by the software system to calculate each patient's acuity score. As patient events occur, such as admissions, discharges, and transfers, the nursing time required for these specific patient events are added to the workload of those patients. Changes in patient conditions are tracked through documentation in the electronic medical record. Inadequate or missing documentation can result in inadequate capture of the patient's acuity score.

Acuity levels are determined by the hospital according to the budgeted hours per patient day and the variability across the hospital among the patient populations. A unique feature of the Outcomes-Driven Acuity system is that it captures the amount of time a nurse spends in admitting, discharging, and transferring a patient. The capture of this time element encompasses more accurately the effect of these patient activities on nursing intensity as opposed to the traditional method of bundling that work into the budget category of hours per patient day. The number of acuity levels range from one to twelve, with twelve being the highest acuity. Staffing ratios are provided and loaded into the software system by unit to approximate the hours per patient day that are required for each patient per unit. The staffing ratios used are those designated by legislation in California (California State Department Of Health Services, 2003).

Data Collection

Data for the current study were collected by the following procedures. Patients who were admitted to the units where the sample was obtained during the time period of the study and cared for by the RN participants were included in data collection. The patient complexity factors

of constant observation, disruptive behavior, and family demands were recorded by the nurse participant in the investigator developed survey “Identification of Patient Complexity Factors/Staffing Adequacy Perception - VAS” form. Nurse participants were instructed to complete this form after the end of a shift for a total of 14 consecutive shifts worked on their home unit throughout the study time period. Overtime shifts were included as part of the data collection. Participants who were asked to float out of their home unit were directed to not record any data for a unit other than their home unit. This direction was given to control for confounding variables that could have been introduced by different work locations and conditions. Nurses were instructed to not record data for any shift that was not completed on the home unit due to floating or illness. With the exception of floating and not completing a shift, data were collected on consecutive shifts so participants would not self-select shifts to report perception of staffing adequacy. Completed forms were placed in a locked box in a secure location on each unit. Only the investigator had access to the boxes and they were checked daily for data.

The nurse staffing variables of staffing by nurse-to-patient ratio, RN skill mix, and assigned care hours were calculated by unit through the Clairvia® Outcomes-Driven Acuity software system. Patient acuity level scores were also obtained through this software system. The nurse staffing variables and patient acuity level scores were obtained and recorded by the investigator. The ratio between assigned care hours and hours actually worked was calculated as a new variable called “ratio of care hours.”

Each patient’s encounter number was recorded by the nurse on the “Identification of Patient Complexity Factors/Staffing Adequacy Perception - VAS” form. The encounter number is a unique patient identifier for that patient’s admission and the encounter number was used

retrospectively by the PI to obtain the patient's acuity level score from the Clairvia® Outcomes-Driven Acuity software system. Also collected retrospectively from the EMR were the patient complexity factors of patient obesity and Limited English Proficiency requiring translation services, and patient characteristics of age and gender. Patients' encounter numbers were coded and entered into a separate data file. Each patient was assigned a unique patient code by the investigator. The data file is being maintained separately from the survey forms to further protect the patients' privacy.

The variables of RN education, total years of RN experience, and years of unit-based RN experience (RN demographics) were collected with a survey (Appendix D) distributed to all RNs at the time of study enrollment. An RN demographic form was added to the packet of survey materials given to study participants at the time they consented to participate. The demographic data were collected by the investigator. A unique ID was assigned to each study participant that included the RNs' unit and sequence of enrollment of the RN. An instrument ID was assigned to each survey packet used in the study and was labeled sequentially. Data collection concluded at the end of the 60-day time period for each nurse participant.

Data Cleaning

All paper surveys and demographic forms were collected and examined for any errors in data entry, outliers, and missing data. The data were entered into a separate file that was kept on a secure lap top and accessible only by the PI. The files were password protected to ensure security and confidentiality. Once all data were entered, the file was cleaned by comparing a printed copy of the data file against the numbered sequential paper surveys and the electronic data file. Corrections were made to the electronic file as necessary. A password protected copy of this data file was created and was kept in a locked location separately from the hard drive. All

paper surveys, demographic forms, and paper copies of electronic files will be saved by the investigator in a locked filing box for seven years after publication. After the data were cleaned, the data were entered into the Statistical Package for the Social Sciences (SPSS) version 22.

Data Analysis

Univariate descriptive statistics were performed for the patient complexity factors, the patient characteristics, and nurse staffing characteristics. The frequency distributions were analyzed to determine any skewness or Kurtosis. The measures of central tendency and dispersion were analyzed for each variable as well as the measures of variability; range and standard deviation. Tables were constructed to display the data in summary (See chapter 4, pp. 83).

The dependent variable in the study, nurses' perception of staffing adequacy, was measured by the "Staffing and Resource Adequacy" subscale of the PES-NWI and the "Staffing Adequacy Perception - VAS" scale. To prepare the data for analysis, the scoring directions for the PES-NWI tool required reverse coding so that higher numbers indicate greater agreement. Reverse coding also brought the "Staffing and Resource Adequacy" subscale and the "Staffing Adequacy Perception - VAS" into directional alignment. Mean scores for each subscale and a composite mean score for all subscales were calculated for each participant.

The variables were examined to determine if they met the assumptions to perform parametric testing. These variables met the assumptions: patient acuity, average patient acuity, RN skill mix, shift total factor score, percent of assigned care hours, and perception of staffing adequacy. Bivariate analysis of the dependent variable and each of these independent variables was able to be performed by determining a Pearson's correlation coefficient. The variable of nurse-to-patient ratio did not meet the assumption of normal distribution so Spearman's rho was

performed. Correlation coefficients were also conducted to measure the relationship between perception of staffing adequacy and the other independent variables of patient characteristics and nurse staffing in order to achieve the study aims.

Multiple regression was performed to analyze the relationship between the sets of independent variables and the dependent variable. This method is widely used to analyze the relationship between the independent variables and a continuous dependent variable (Polit & Beck, 2012).

Human Subjects Protection

The research study received approval from the IRB committee at Molloy College (Appendix G) as well at the academic medical center where the study was conducted (Appendices H and I). Since sensitive information regarding nurses' perception of the practice environment was collected during the current study, a Certificate of Confidentiality (CoC) was obtained from the National Institute of Nursing Research (Appendix J). The CoC was needed to help the PI avoid involuntary disclosure that could expose participants to adverse consequences. It was prominently mentioned during recruitment so the nurses realized their anonymity was protected.

Since the PI held an administrative position at the study site, potential study participants were informed of the study passively through a recruitment flyer that announced a recruitment meeting. During the recruitment meeting, participants were informed that study participation was voluntary and that individual results would not be shared with anyone not directly involved in the study. Unit leadership nurses were not informed of any volunteer's participation in the study. Participants were told they could withdraw from the study at any time without penalty or retribution. Withdrawal from the study would not affect their employment. Benefits to nurses

included active participation in a research study and the opportunity to contribute to increased understanding of elements not currently considered when staffing decisions are made. A small honorarium was given upon enrollment to each participant to acknowledge their time.

Patient data were protected by the retrospective collection of patient acuity level scores and by the coding of encounter numbers, which are maintained in a separate data file, apart from the patient acuity level scores.

Chapter 4: FINDINGS

This chapter presents the statistical results of the current study. The results have been organized into the following sections: the characteristics and quality of the data collected and the psychometric analyses of the instruments including an exploratory factor analysis of the Practice Environment Scale of the Nursing Work Index (PES-NWI) tool. These preliminary findings will be followed by major study findings to answer the research question, to address specific study aims, and to test the proposition from the Roy Adaptation Model (RAM).

Quality of Data Collected

Descriptive statistics were conducted for all categorical and continuous variables for the current study. There were eight categorical variables: six patient complexity factors, inpatient unit, and patient gender. There were nine continuous variables: patient age, patient weight, patient acuity, average patient acuity per shift, Staffing Adequacy Perception– VAS, total factor shift score, RN skill mix, nurse-to-patient ratio, and percent assigned care hours. Data for 1,605 patients made up the data set for 328 shift observations that were entered into analysis. Table 4.1 presents the incidence of missing data, which did not influence the study results due to the random pattern. Observations of the missing data element of patient acuity, which was obtained from the automated software staffing system, were analyzed and categorized into the categorical variable of uncaptured data. The inability to capture the patient acuity affects the prediction of assigned care hours. This independent variable was used to achieve study aim 3, which was to determine if uncaptured data about the complexity factors affects nurses' perception of staffing adequacy.

Table 4.1: Missing Data: Categorical and Continuous Variables

Variable	Frequency Missing Data	N	Percent Missing Data
Patient Acuity	171	1605	11%
Percent Assigned Care Hours	32	328	10%
Average Patient Acuity	31	328	9%
Patient Obesity	28	1605	2%
Patient Age	1	1605	<1%
Patient Weight	4	1605	<1%
Patient Gender	1	1605	<1%
Family Demands	5	1605	<1%
Restraints	2	1605	<1%
Limited English Proficiency	1	1605	<1%
Staffing Adequacy Perception - VAS	2	328	<1%

The continuous variables were inspected for the presence of outliers by examination of the boxplots for each of the variables. There were no outliers for patient acuity and RN skill mix. There was one outlier (low values) for average acuity and patient age. There were several outliers (high and low) for the percentage of assigned care hours and nurse-to-patient ratio. High outlier values were present for total shift factor score and patient weight, while Staffing Adequacy Perception - VAS had low outlier values. Only two variables had extreme outliers: patient weight and nurse-to-patient ratio.

The distribution of the continuous variables was assessed by inspecting histograms and examining variables for skewness and kurtosis. Variables were normally distributed with skew values between -1 and 1 with the exception of nurse-to-patient ratio (3.95), patient weight (1.84), and Staffing Adequacy Perception - VAS (-1.29). Transformation of the skewed variables was attempted using the reflect and logarithm function in SPSS. Nurse-to-patient ratio could not be transformed. The dependent variable of Staffing Adequacy Perception - VAS was successfully transformed and achieved a normal distribution with a skew value of -1.03. After transformation, the transformed variable hindered data interpretation because the results indicated a positive relationship between the presence of patient complexity factors and perception of staffing adequacy. The transformed data set was not used for analysis.

Five percent of the outlier cases for each skewed variable were deleted to achieve a normal distribution. These trimmed data sets were used for analysis. The variable of nurse-to-patient ratio had little variability and a normal distribution was unable to be achieved. The nonparametric test of Spearman rho was used to test this variable.

Preliminary analyses were performed to determine if assumptions were met for the planned statistical techniques. The variables had linear relationships and were normally distributed once outliers were removed. There were no violations of the assumptions of homoscedasticity and multicollinearity among the independent variables.

Descriptive statistics were calculated for the continuous and categorical variables. The continuous dependent variable, the nurses' perception of staffing adequacy was measured each shift by the Staffing Adequacy Perception - VAS. The eight continuous independent variables were: a) patient age, b) patient weight, c) total factor shift score, d) patient acuity, e) average patient acuity, f) RN skill mix, g) nurse-to-patient ratio, and h) percent assigned care hours. Four of these variables, patient age, patient weight, acuity level score, and average patient acuity are patient characteristics. Total shift factor score was calculated from the presence of patient complexity factors. The remaining variables of RN skill mix, nurse-to-patient ratio, and percent assigned care hours are nurse staffing characteristics. The nine categorical independent variables were: 1) inpatient unit, 2) patient gender, 3) limited English proficiency, 4) restraint usage, 5) use of constant observation, 6) disruptive behavior, 7) family demands, 8) patient obesity, and 9) uncaptured patient acuity. The inpatient unit was a unit characteristic, patient gender was a patient characteristic and the remaining variables were patient complexity factors. Table 4.2 displays a descriptive analysis of the continuous dependent and independent variables.

Frequencies and statistics have been adjusted after outlier cases were deleted. Table 4.3 displays the descriptive analysis of the categorical independent variables.

Table 4.2: Descriptive Analysis of the Continuous Variables

Variable	Frequency	Mean	Standard Deviation	Min/Max
<i>Dependent Variable</i>	294	77.60	16.23	36-100
Staffing Adequacy Perception - VAS				
<i>Independent Variables</i>				
Patient Age	1604	65.75	17.22	18-102
Patient Weight (kg)	1441	77.78	17.46	48.6-128.37
Total Shift Factor Score	328	3.74	2.47	0-13
Acuity Level Score	1434	4.81	1.36	1-9
Average Patient Acuity	297	4.83	.78	2.65-6.56
RN Skill Mix	328	.61	.06	.45-.78
Nurse-to-Patient Ratio	296	.21	.02	.17-.25
Percent Assigned Care Hours	296	1.12	.24	.40-1.78

Table 4.3: Descriptive Analysis of the Categorical Variables (Bold percent = presence of factor)

Variable	Variable Level	Frequency	Percent
Inpatient Unit Shifts	Unit A	938	58.4
	Unit B	667	41.6
Patient Gender	Male	813	50.7
	Female	791	49.3
Patient Obesity	Yes	492	30.7
	No	1085	67.6
Limited English Proficiency	Yes	77	4.8
	No	1527	95.1
Disruptive Behavior	Yes	287	17.9
	No	1318	82.1
Restraint Usage	Yes	68	4.2
	No	1535	95.8
Use of Constant Observation	Yes	134	8.3
	No	1471	91.7
Family Demands	Yes	169	10.5
	No	1431	89.2
Uncaptured Acuity	Yes	58	17.7
	No	270	82.3

Descriptive Statistics

Sample of Nurse Participants

Baseline data were collected and used from 48 nurses upon study enrollment. Additional data from six nurses who were enrolled, but did not complete the study instruments were not used for psychometric analysis. The 48 sets of data were used to conduct psychometric analyses of two measures, the PES-NWI tool and the investigator developed tool, the “Staffing Adequacy Perception -VAS.” The PES-NWI tool was used in the current study to evaluate the convergent validity of the Staffing Adequacy Perception -VAS.

Most participants were from two units and worked 12-hour shifts (90%, n=43). Most participants (64%, n=31) reported a Bachelor’s degree as both their basic and highest level of education, but 31% (n=15) reported holding an Associate’s degree. The average length of nursing experience was 7 years with a range of 0.5 to 34 years. Unit based experience was slightly lower with a mean of 4.17 years and a range of 0.5 to 20 years.

Twenty-six nurses from two similar medical telemetry units comprise the sample that completed patient complexity factors and the Staffing Adequacy Perception - VAS. As this sample represented the majority of the sample used to determine the convergent construct validity of the PES-NWI subscale of “Staffing and Resource Adequacy” and the Staffing Adequacy Perception – VAS, the demographic characteristics are very similar to those of the entire group. Most participants worked 12-hour shifts (88%, n=23). Most participants reported a Bachelor’s degree (62%, n=16) while 35% reported an Associate degree (35%, n=9). The average length of nursing experience was 5.38 years with a range of 0.50 to 20 years. Unit based experience was lower with a mean of 3.17 years with a range of 0.50 to 11.5 years.

Psychometric Analyses

The internal reliability of the PES-NWI measure was determined with Cronbach's alpha. Cronbach's alpha for the PES-NWI tool, subscales and composite scores was obtained for the sample used in the current study and compared to Lake's (2002) original study. These results are displayed in Table 4.4.

Table 4.4: Reliability of the PES-NWI Tool

PES-NWI Measure	Cronbach's Alpha	
	Lake Study	Current Study
Sub-scale #1: Nurse Participation in Hospital Affairs	.83	.68
Sub-scale #2: Nursing Foundations for Quality of Care	.80	.72
Sub-scale #3: Nurse Manager Ability, Leadership, and Support of Nurses	.84	.63
Sub-scale #4: Staffing and Resource Adequacy	.80	.63
Sub-scale #5: Collegial Nurse-Physician Relations	.71	.81
Composite of Five Subscale Scores	.82	.70
31-item tool	Not Reported	.84

While the overall internal consistency of the PES-NWI tool was a Cronbach's Alpha of .84, there were differences between the subscale scores, particularly with the Staffing and Resource Adequacy subscale. A contributing factor is the significant difference in sample size between the current study (N=48) and Lake's study (N=2,299). Many of the studies using the PES-NWI tool report on the mean of the subscales. A comparison of the mean scores in the current study and Lake's is displayed in Table 4.5.

Table 4.5: Comparison of Mean PES-NWI Scores

Measure	Lake (2002)	Lake (2002)	Current Study
	Nonmagnet Hospitals	Magnet Hospitals	
Nurse Participation in Hospital Affairs	2.44	2.76	2.61
Staffing and Resource Adequacy	2.49	2.88	2.38
Collegial Nurse-Physician Relations	2.82	2.99	2.98
Nurse Manager Ability, Leadership, and Support of Nurses	2.68	3.00	2.88
Nursing Foundations for Quality Care	2.83	3.09	3.00
Composite of Five Subscale Scores	2.65	2.95	2.77

Subscale means and composite score of the current study are within range between Magnet and Nonmagnet facilities with the exception of the Staffing and Resource Adequacy subscale. In Lake's original study, the lowest scoring subscale was "Nurse Participation in Hospital Affairs" followed by "Staffing and Resource Adequacy." In a review of more recent studies (Warshawsky & Havens, 2011), the Staffing and Resource Adequacy subscale is now the lowest reported subscale as is the case with the current study. Table 4.6 presents a comparison of Lake's PES-NWI scores with more recently reported studies.

Table 4.6: Comparison of PES-NWI scores: Lake Research and PES-NWI reported scores

Measure	Lake (2002) Magnet Hospitals	Lake (2002) Nonmagnet Hospitals	Warshawsky & Havens (2011) Score Ranges (N=22)
Nurse Participation in Hospital Affairs	2.76	2.44	1.98 – 2.98
Nursing Foundations for Quality of Care	3.09	2.83	2.20 – 3.35
Nurse Manager Ability, Leadership, and Support of Nurses	3.00	2.68	2.08 – 3.42
Staffing and Resource Adequacy	2.88	2.49	1.87 – 2.90
Collegial Nurse-Physician Relations	2.99	2.82	2.32 – 3.26
Composite of Five Subscales	2.95	2.65	2.48 – 3.17

Exploratory Factor Analysis

The PES-NWI results for the current study were analyzed using the same methods as described by Lake (2002) to determine comparability of the current study's results with Lake's results. This exploratory factor analysis was conducted with a principal component analysis using a varimax rotation. The data were analyzed to determine suitability of the data for factor analysis. The correlation matrix was inspected to determine the presence of correlation coefficients above .30 and several exceeded this value. Bartlett's test of sphericity was

statistically significant with a $p < .001$, which indicates factor analysis would be appropriate. The Kaiser-Meyer-Olkin measure of sampling adequacy was .376, failing to reach a value of .60 which is needed for a good factor analysis. However, based on the high communalities of the test items, the strength of the intercorrelations, and Bartlett's test of sphericity, a principal component analysis was performed.

Lake's original principal component analysis resulted in a five factor structure: nurse participation in hospital affairs, nursing foundations for quality of care, nurse manager ability, leadership, and support of nurses, staffing and resource adequacy, and collegial nurse-physician relations. The principle component analysis with a varimax rotation on the data sample in the current study revealed the presence of eleven factor components with eigenvalues exceeding one, explaining a cumulative total of 77% of the variance. Based upon Lake's original analysis, the data were re-examined and five factors were forced. The five factors explained 51% of the variance, with component one contributing 12%, components two and three each contributing 10.5%, and components four and five each contributing 9%. An examination of the scree plot demonstrated a clear break after the fifth component. These five components were compared to the five factors from Lake's original study and the factor loadings from this sample did not correspond to the factor loading in the Lake study. Table 4.7, p. 88, presents the factor loading results of this sample. The five factors from the current study were examined and re-named as work collaboration, nursing resources, professional development, transformational leadership, and professional practice foundations. The four items that comprised Lake's original subscale of "Staffing and Resource Adequacy" subscale were contained in three of the factors in the current study: one item in collaboration, two items in nursing resources, and one item in professional development. Given the small sample size of the current study, it was decided to use Lake's

original “Staffing and Resource Adequacy” subscale items to determine the convergent validity of the baseline Staffing Adequacy Perception - VAS measure.

Table 4.7: Current Study Factor Loadings of the PES-NWI

Renamed Subscales	Item	Factor Loading
Collaboration	A lot of teamwork between nurses & physicians.	.85
	Physician & nurses have good working relationships.	.84
	Collaboration between nurses and physicians	.72
	Patient care assignments that foster continuity of care	.54
	Use of nursing diagnoses.	.48
	A preceptor program for newly hired RNs.	.37
	Enough time & opportunity to discuss pt. care problems with other nurses.	.32
Nursing Resources	A chief nursing officer who is highly visible and accessible to the staff.	.78
	Enough staff to get the work done.	.78
	Enough registered nurses to provide quality patient care.	.66
	Opportunity for staff nurses to participate in policy decisions.	.55
	Opportunities for advancement.	.48
	Nursing administrators consult with staff on daily problems and procedures.	.39
Professional Development	Active staff development or continuing education programs for nurses.	.79
	An active quality assurance program.	.73
	Career development/clinical ladder opportunity.	.57
	A supervisory staff that is supportive of nurses.	.46
	Nursing care is based on a nursing, rather than a medical, model.	.45
	Adequate support services allow me to spend time with my patients.	.44
	Staff nurses are involved in the internal governance of the hospital Praise and recognition for a job well done.	.43
Transformational Leadership	A nurse manager who is a good manager and leader.	.86
	A nurse manager who backs up the nursing staff in decision making, even if the conflict is with a physician.	.80
	Administration that listens and responds to employee concerns.	.64
Professional Practice Foundations	Written up-to-date care nursing care plans for all patients.	.62
	A CNO equal in power & authority to other top-level hospital executives.	.61
	Working with nurses who are clinically competent.	.56
	A clear philosophy of nursing that pervades the patient care environment.	.55
	High standards of nursing care are expected by administration.	.48
	Staff nurses have the opportunity to serve on hospital & nursing committees.	.46
	Supervisors use mistakes as learning opportunities, not criticism.	.37

Convergent Validity

Convergent validity between the “Staffing and Resource Adequacy” subscale (SS#4) of the PES-NWI and the initial Staffing Adequacy Perception – VAS measure was determined by the calculation of Pearson’s correlation coefficient. The data were analyzed to ensure that

assumptions were met prior to performing the correlation. There were no outliers in SS#4 and the initial Staffing Adequacy Perception - VAS had only one outlier. Histograms were inspected for normality and the variables were examined for skewness and kurtosis. Both variables had a normal distribution and had negative skew values of $-.25$ (SS#4) and $-.69$ (initial Staffing Adequacy Perception - VAS). The variables had linear relationships and homoscedasticity was not violated upon inspection of the scatterplot. There was a significant, positive correlation between the two variables ($r=.61, p<.001$).

Research Question

The research question was “What patient complexity factors predict the likelihood that nurses will report inadequate staffing?” The relationship between the patient complexity factors and the nurses’ perception of staffing adequacy was tested first by performing a correlation analysis. The 5% trimmed variable of Staffing Adequacy Perception – VAS was used for the correlation analysis. Only two of the factors, disruptive behavior and family demands, were observed to have a low negative correlation with nurses’ perception of staffing adequacy.

A stepwise multiple regression was conducted to evaluate the ability of the patient complexity factors of disruptive behavior and family demands to predict nurses’ perception of staffing adequacy. At Step 1 of the analysis, the variable called disruptive behavior was entered into the regression equation and explained 7.5% of the variance in nurses’ perception of staffing adequacy. After entry of the variable called family demands at Step 2, the total variance explained by the model as a whole was 10%, $F(2,285) = 15.65, p<.001$. In the final model, only the two factors of disruptive behavior and family demands were statistically significant, with the variable called disruptive behavior recording a higher beta value ($beta = -.256, p<.001$) than the variable called family demands ($beta = -.157, p<.001$). These findings suggest that while the

presence of the complexity factors explains 10% of the variance in nurses' perception of staffing adequacy, there are other factors outside this model that are contributing to perceptions of staffing adequacy.

Study Aim #1

The first study aim was to determine if the presence of individual patient complexity factors predict nurses' perception of staffing adequacy on selected inpatient units. The relationship of the independent variables of patient complexity factors to the dependent variable was analyzed to answer the research question. A correlation analysis between the Staffing Adequacy Perception - VAS and each of the patient complexity factors was conducted by determining a Pearson correlation coefficient to assess each relationship. The correlation analysis was conducted with the 5% trimmed variable of Staffing Adequacy Perception – VAS. There was a low negative correlation between the variables of disruptive behavior and family demands, and the Staffing Adequacy Perception - VAS. This finding indicates a decrease in nurses' perception of staffing adequacy when patients exhibit disruptive behavior or have family demands. No correlation was observed between the remaining patient complexity factors and Staffing Adequacy Perception - VAS. The Pearson's correlation coefficients are presented in Table 4.8 showing patient complexity factors and Staffing Adequacy Perception - VAS derived from the total number of patients in shifts observed for which data were available.

Table 4.8: Pearson's Correlation Coefficients between Patient Complexity Factors and Staffing Adequacy Perception - VAS

Variable	N	Pearson Correlation	Nonparametric Spearman's rho
Patient Obesity	287	-.101	-.099
LEP Patient	294	-.011	-.019
Restraints	294	-.002	.018
Constant Observation	294	-.007	-.006
Disruptive Behavior	294	-.274**	-.246**
Family Demands	293	-.186**	-.154**

** $p < .01$ level (2-tailed)

The relationship between the variable of total factor shift score, which is the total number of complexity factors present during the nurses' shift, and the Staffing Adequacy Perception – VAS was analyzed by performing a Pearson's correlation. There was a moderate negative correlation between these two variables with a Pearson's $r = -.418$, $p < .01$. This finding indicates a decrease in nurses' perception of staffing adequacy as the number of patient complexity factors increased for the shift worked.

Study Aim #2

The second study aim was to compare staffing based on the predicted staffing requirements made by an automated outcomes-driven acuity software system to nurses' perception of staffing adequacy. The relationship of the dependent variable, the Staffing Adequacy Perception - VAS to the independent variable of the percent of assigned care hours determined by the automated software system was analyzed. The patient characteristic of average patient acuity is calculated by the automated software system and reported for each nurse by shift. This variable was analyzed to determine if there was a relationship to the Staffing Adequacy Perception - VAS. The relationship of additional nurse staffing characteristics of RN skill mix and nurse-to-patient ratio to the percent of assigned care hours was also analyzed. A correlation procedure was used to analyze these variables. The variable of nurse-to-patient ratio violated the assumptions of Pearson's correlation. The non-parametric alternative of Spearman's rho was used to assess this relationship. No correlation was observed between the variables of percent of assigned care hours, average patient acuity, and RN skill mix and perception of staffing adequacy. No correlation was observed between nurse-to-patient ratio and Staffing Adequacy Perception - VAS with a Spearman's rho coefficient of .074. These findings indicate

no relationship between the prediction of staffing requirements made by an automated staffing system, including the determination of average patient acuity and nurse staffing characteristics of RN skill mix and nurse-to-patient ratio on nurses' perception of staffing adequacy.

Study Aim #3

The third study aim was to determine if uncaptured data from ClairVia© about selected patient complexity factors affects nurses' perception of staffing adequacy. The relationship between the independent variable of uncaptured data from the automated staffing system, which included instances of missing patient acuity, average patient acuity, and percentage of assigned care hours and Staffing Adequacy Perception - VAS was analyzed. A correlation analysis between the uncaptured data and Staffing Adequacy Perception - VAS was performed using Pearson's correlation coefficient. No correlation was observed with a Pearson's correlation coefficient of $-.083$ indicating there is no relationship between uncaptured data used to predict staffing requirements and nurses' perception of staffing adequacy.

Testing the Roy Adaptation Model Proposition

The proposition tested in the current study is "the organizational system develops priorities among internal and external influencing factors, which determine the intensity of the effect of a change on any one mode; these priorities, however, are fluid" (Roy & Anway, 1989, p. 82). The Roy Adaptation Model (RAM) group adaptive mode defines how groups adapt their operating resources to achieve their goals. In this conceptual model, (Figure 1, p. 23) the inputs examined were the patient complexity factors and selected patient characteristics such as patient acuity. The effects of these inputs and the staffing decisions made, as measured by variables such as RN skill mix, assigned care hours, and nurse-to-patient ratio were analyzed individually

for their relationship to nurses' perception of staffing adequacy. The RAMA interdependence adaptive mode is reflected in this demand for resources.

The findings of the current study supported the proposition. Changes in staffing levels as measured in the current study did not influence nurses' perception of the adequacy of staffing. These results indicate other factors beyond staffing variables influence nurses' perception of staffing adequacy. The presence of two patient complexity factors, disruptive behavior and family demands, negatively affected perception of staffing adequacy.

Summary

This chapter presented the results of the statistical analyses. A regression model explained ten percent of the variance in perception of staffing adequacy with the variables of disruptive behavior and family demands a statistically significant contribution. This finding suggests that there are other factors outside this model that are contributing to nurses' perceptions of staffing adequacy.

Forty eight nurses completed baseline data, which was used to conduct psychometric analyses of two measures, the PES-NWI tool and the investigator developed measure, the Staffing Adequacy Perception - VAS. Exploratory factor analysis was conducted with a principal component analysis using a varimax rotation to determine comparability of the current study's results with the original research study (Lake 2002). The internal consistency of the PES-NWI measure was established by determining Cronbach's alpha. Convergent validity of these measures was established by calculation of Pearson's correlation coefficient, which demonstrated a strong positive correlation.

The sample of participants who provided data on patient complexity factors and the Staffing Adequacy Perception -VAS was comprised of a subset of twenty-six nurses from the

baseline data collection. Since the unit of analysis was the shift, a trimmed sample (n=294) of shifts of data were analyzed. The relationship of the independent variables to the dependent variable was analyzed to answer the research question and achieve the study aims. A low negative correlation was demonstrated between the patient complexity factors of disruptive behavior and family demands, and the perception of staffing adequacy. There was a moderate negative correlation between the variable of total shift factor score, derived from the sum of patient complexity factors, and nurses' perception of staffing adequacy. This finding reflects the additive effect of the complexity factors on nurses' perception of staffing adequacy. There was no correlation between perception of staffing adequacy and any of the nurse staffing variables: percent of assigned care hours, RN skill mix, nurse-to-patient ratio, and average patient acuity.

Chapter 5: DISCUSSION AND RECOMMENDATIONS

The research question was to determine which patient complexity factors predict the likelihood that nurses will report inadequate staffing. Two factors, disruptive behavior and family demands, explained ten percent of the variance in perception of staffing adequacy. The other four factors did not contribute significantly to nurses' perception of staffing adequacy. In examining these results a few trends emerged. Nurses must work alone to care for patients with disruptive behavior or families who require significant interaction. These findings indicate that having to work alone in meeting patient needs with these complexity factors negatively influences nurses' perception of staffing adequacy.

The other four patient complexity factors require the nurse to obtain additional resources or assistance from team members to meet patients' needs. Professional nurse autonomy requires that nurses practice interdependently with members of the health care team to meet patient needs. Support received by nurses from interdisciplinary team members reflects the RAM interdependence group mode. A translator or translation services is needed for communication with the patient with limited English proficiency. Patients who require restraints need frequent monitoring, which the nurse may delegate to other staff and may require less direct nursing intervention than patients with disruptive behavior. Patients needing continuous observation have a staff member within arm's reach who is available to meet either meet the patient's needs and/or notify the nurse of the patient's needs. With obese patients, nurses may require the assistance of additional workers in order to deliver care such as positioning or ambulation. The RAM interdependent life process of relational adequacy is evident in these study results because nurses must rely on support from others to meet patient goals.

A seventh variable was calculated by the PI and was called the “total factor shift score.” This factor was the sum of all patient complexity factors present for the assigned patients for that nurses’ shift. This factor was used to determine whether there was a relationship between the number of factors present per shift and the nurses’ perception of staffing adequacy by shift. In the current study, a moderate negative correlation was found between the total factor shift score and nurses’ perception of staffing adequacy ($r = -.418$). This finding indicates that as the number of patient complexity factors increased for the shift, there was a decrease in nurses’ perception of staffing adequacy. Only two of the patient complexity factors correlated to the “Staffing Adequacy Perception – Visual Analogue Scale (VAS).” This finding indicates that there is an additive effect of the complexity factors on the influence of perception of staffing adequacy. The other four factors require additional resources or collaboration with, or direct assistance from, interdisciplinary team members in order to meet patient needs. The time required for this collaboration or seeking assistance with care are indirect care activities which can add to nurses’ workload (Myny et al., 2011). However, in this analysis, these four factors do not detract from the perception of staffing adequacy. The correlation between the “total factor shift score” and nurses’ perception of staffing adequacy is supported by Jones and Yoder’s (2010) production firm decision-making process. One of the assumptions of economic theory regarding administrative decision-making is that resources are fixed so the quality of care will be limited by available resources. Study findings indicate that the ability to effectively deliver care depends on availability of resources from other care team members.

The focus of the current study was patient complexity factors that might influence nurses’ perception of staffing adequacy. In the current study, nurses’ perception of staffing adequacy was measured at the end of completed work shifts. That perception was compared to selected

patient variables. Standard staffing variables were also compared to nurses' perception of staffing adequacy. Nurses' perception of staffing adequacy can vary from shift to shift. The overall impact of perception of staffing adequacy on job satisfaction remains unclear. When the current study was designed, nurse-to-patient staffing ratio legislation had been introduced in New York State. Staffing ratios were of interest. Nurse-to-patient staffing ratios in the current study had very little variability and did not contribute to nurses' perception of staffing adequacy. An advantage of the current study was the analysis of nurses' perception of staffing reported at the end of completed shifts. Perception of staffing adequacy was then examined using patient data that constituted six patient complexity factors.

Nurse leaders have recognized the need to more accurately capture changing patient needs and identify variability, so commercial predictive modeling software systems have been developed and are now being used. Unique to these systems is the ability to capture nurses' workload that escalates at times of patient admission, patient discharge, and transfer of patients. Previously, that additional work was not adequately considered during staffing. The site for the current study used the ClairVia© Outcomes-Driven Acuity Software System, a predictive modeling software system. Nurses had reported that there were patients with the same or similar acuity scores who had unequal actual needs for nursing care. Nurses' anecdotal reports pointed towards differences in the psycho-social and social support domains. Those anecdotes and a literature review helped shape the research question and study aims. The PI identified six patient complexity factors for the current study.

Patient Complexity Factors

The first study aim was to determine patient complexity factors that predict nurses' perception of staffing adequacy. Patient complexity in the current study was defined as the

degree of difficulty of inter-related patient care needs resulting from specific patient-related factors. Six patient complexity factors were selected and tested for their influence on nurses' perception of staffing adequacy: obesity, limited English proficiency requiring translation services, disruptive behavior, the need for continuous observation, the use of restraints, and family members who require substantial psychosocial interaction and/or limit setting. Only two of the complexity factors, disruptive behavior and family demands, contributed to nurses' perception of staffing adequacy.

Two of the complexity factors were in the personal domain: obesity and limited English proficiency. Obesity was defined as a body mass index (BMI) greater than 30 kg/m². This definition was selected because it is universally accepted as the parameter and level for obesity. According to the 2014 report from the Centers for Disease Control and Prevention (CDC), the prevalence of obesity in New York State was 27% (Centers for Disease Control & Prevention, 2014). The prevalence of obesity in the current study was slightly higher at 30.7%. Obesity was non-contributory to nurses' perception of staffing adequacy. It was determined based on the similarity in the prevalence between the current study and the CDC report that the sample was representative of the population on the obesity factor. Patient dependency was not tied to obesity in the definition so this is a study limitation.

Limited English proficiency was determined on initial assessment. Patients, who identified that English was not their preferred language to communicate, were categorized as having limited English proficiency. Translation services were needed for communication with such patients. Only 4.8% of patients in the current study were identified as having limited English proficiency that required translation services. The relationship between this factor and

nurses' perception of staffing adequacy was not statistically significant, but the low incidence of this factor may have led to insufficient power for an adequate statistical analysis.

Three of the patient complexity factors were in the psycho-social domain: disruptive behavior, restraint usage, and constant observation. Disruptive behavior was defined as patient behaviors such as confusion, disorientation, and combativeness that required substantial nursing intervention. Disruptive behavior could be episodic or continuous. This differed from constant observation, which was defined as the need for the continuous presence of a staff member to keep the patient safe. Constant observation is a status indicated for patients who are a threat to themselves or others and is used as an alternative to physical restraints. These factors are related because they are both interventions initiated to keep patients safe. However, restraints are used as a final intervention because it is the most restrictive to the patient and has the potential to result in patient harm. Restraint use was defined as the application of a physical restraint to restrict a patient's movement to prevent harm to self or others. Restraint use was only observed in 4.2% of patient observations. Similar to limited English proficiency, the low incidence of restraints is a consideration when evaluating the non-significant relationship to perception of staffing adequacy identified in the current study.

The last complexity factor, family demands, was in the social support domain. Family demands were defined as patients whose family members required a significant amount of nurse interaction and/or limit setting. Interaction with family members can be unpredictable based upon the time of day and the amount of time the family is spending with the patient. Nurses work independently when interacting with families and significant others, so support from interdisciplinary team members is minimal.

Patient Acuity

The current study defined patient complexity as different from patient acuity and used Finkler and colleagues' (2013) definition of patient acuity, which is "the measurement of a patient's severity of illness related to the amount of nursing care resources required to care for the patient" (p. 375). The data point used for patient acuity in the current study was measured by a computerized workforce management system for each patient and then that data point was averaged for the nurses' shift assignment. There was no significant relationship between average patient acuity and nurses' perception of staffing adequacy. An assumption of the current study was there would be no relationship between the variables of patient acuity and nurses' perception of staffing adequacy, which was upheld by the findings.

Mark (2002) conducted a secondary data analysis to examine the impact of the following characteristics on nurses' perception of staffing adequacy: hospital type such as bed size and teaching status, type of nursing unit, nurse characteristics such as age and years of nursing experience, and patient age. Perception of staffing adequacy was determined from a single-item, Likert scale response asking nurses to evaluate the adequacy of staffing on their units similar to the approach used in the current study. However, Mark's analysis did not link nurses' perception of staffing adequacy directly to the tasks of patient care. The amount of patient technology required by a patient was used as a proxy for patient acuity (Mark, 2002, p. 236) and was obtained from a survey of staff nurses using a 12-item scale with five categories, which indicated the nursing care needs. Mark found that higher levels of patient technology (or acuity) were associated with a decrease in perception of staffing adequacy. Mark's findings differ from the current study findings where the unit of analysis was the nurses' perceptions based on total shift data.

Nurse Staffing

Study aim #2 compared staffing based on predictions made by an automatic outcomes-driven acuity software system to nurses' perception of staffing adequacy. Nurse staffing variables of RN skill mix, nurse-to-patient ratio, and percent of assigned care hours were analyzed for their influence on perception of staffing adequacy. One of the study assumptions was that staffing variables such as RN skill mix, nurse-to-patient ratio, and percent of assigned care hours would not meaningfully contribute to perception of staffing adequacy because staffing changes rarely occur during nurses' shifts in response to ongoing changes in patient factors. The findings supported the assumption that the nurse staffing variables were not related to nurses' perception of staffing adequacy.

Further analysis of the prediction of nurse staffing by an automated software system was explored in study aim #3. Due to the timing of patient admissions, discharges, and transfers and potential delays in nurse documentation within the electronic medical record, there are uncaptured data within the automated system that affects the ability to predict patient acuity and required care hours. The relationship demonstrated between the instances of uncaptured data and the "Staffing Adequacy Perception - VAS" was not statistically significant. The automated software system enables nurse administrators to predict staffing requirements. The expectation following implementation of the electronic system was that any missing data would underestimate staffing requirements and therefore negatively influence nurses' perception of staffing adequacy. Study results do not support that expectation.

The lack of a relationship between the nurse staffing variables of RN skill mix, nurse-to-patient ratio, and percent of assigned care hours and nurses' perception of staffing adequacy is a meaningful study finding. The difference in the variable of nurse-to-patient ratio was small and

as such it precluded parametric testing during data analysis. Such lack of variation supports the economic theory assumption that staffing is more of a fixed resource and that changes to staffing assignments are not made based on patient acuity or workload factors. Nurses are consistently caring for the same number of patients without real-time consideration of other factors.

However, there was no impact of RN skill mix or percent of assigned care hours on nurses' perception of staffing adequacy, indicating there are other variables, not related to staffing that affect nurses' perception. This claim supports the anecdotes from nurses that the automated system does not adequately reflect the complexity of patient needs or make consistent and appropriate predictions for staffing. The insight of nurses on their perception of staffing adequacy on a shift-by-shift basis demonstrated that isolated categories of variables are insufficient measures to evaluate staffing adequacy.

Instrument

The perception of staffing adequacy was measured each shift by the "Staffing Adequacy Perception - VAS." Convergent construct validity was evaluated between the "Staffing and Resource Adequacy" subscale of the Practice Environment of the Nursing Work Index (PES-NWI) and the "Staffing Adequacy Perception - VAS." The exploratory factor analysis conducted in the current study did not result in the same factor loading as Lake's (2002) original study. Although five factors were examined and re-named, it was decided due to the current study's small sample size to retain the original "Staffing and Resource Adequacy" subscale to determine convergent validity of the baseline "Staffing Adequacy Perception – VAS" measure. The PES-NWI had been developed from two samples of nurses; one from 1985 and 1986 and the second from a 1999 study. The amount of time that has elapsed since the data were collected and the subsequent changes to the healthcare environment may have affected how nurses in the

current study responded to the items in the instrument. The decision to use the subscale as identified from the earlier research and the changes that have occurred in nursing and healthcare in the intervening years could have affected the study results.

Conceptual Framework

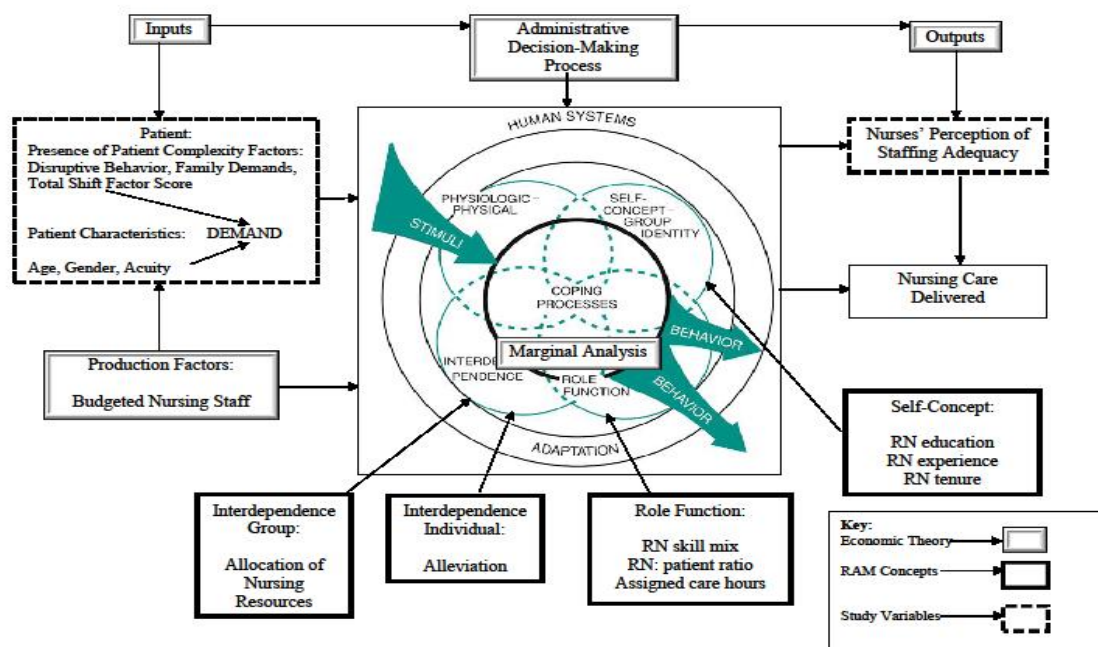
The conceptual framework used to answer the research question was a synthesis of the Roy Adaptation Model (RAM, 2009) and economic theory (Jones & Yoder, 2010). Roy and Anway's (1989) original work on theories for nursing administration were reviewed to gain a greater understanding of the RAM principles. Study results support the middle range theory of adaptation, production decision-making process, and nurses' perception of staffing adequacy (Figure 1, p. 23). The results have been incorporated into the model in Figure 2 (p. 104).

There are three levels of environmental stimuli within the RAM that individuals or groups encounter: focal, contextual, and residual. Contextual stimuli for nurses in this current study were changes in patient acuity and the presence of patient complexity factors. These dynamic stimuli were assumed to affect nurses' perception of staffing adequacy.

Adaptation in the RAM is observed by behaviors categorized into four adaptive modes. The physical adaptive mode for groups defines how groups adapt to operating resources such as human and fiscal resources to achieve operational goals. Fiscal resources represent organizational constraints because budgeted personnel can be a fixed cost. Allocation of human resources such as dividing work among nurses is an important part of staffing decisions. However, in the current study, nurses' perceptions of staffing adequacy were not influenced by changes in staffing variables. The findings of the current study support the need to improve decision-making around nurse staffing. Study results indicate that patient complexity factors of

disruptive behavior and family demands affect nurses' perception of staffing adequacy and therefore, need consideration when staffing decisions are made.

FIGURE 2: Middle Range Theory of Adaptation, Production Decision-Making Process, and Nurses' Perception of Staffing Adequacy



Several elements were not examined in the current study. The group identity mode gives a sense of purposefulness and unity and ideally allows groups to work together in a positive manner. Job satisfaction and the existence of a healthy work environment are part of the group identity mode but were not examined in the current study because this has been studied previously. The self-concept mode for individuals addresses the self-ideas and a moral-ethical-spiritual self. Psychic and spiritual integrity are the basic needs in this mode. The nursing characteristics of RN education, experience, and unit tenure that are part of the self-concept mode were collected originally but were not analyzed as part of the current study. The role function mode for groups defines how work is assigned in order to achieve the goals of the group

and is a basic need of this mode. Major findings of the current study are contained within this mode. The complexity factors of disruptive behavior and family demands share a similar trait: nurses are alone in their encounters when they meet increasing patient/family needs. These factors were found to negatively influence perception of staffing adequacy. These two factors appear to add a burden to nurses' workload that the other four factors do not add. An examination of the properties of complexity factors and amount of nurses' burden for the two significant complexity factors provides a rationale for this finding. Although this mode is designed for groups, how work is divided and staffing decisions made, has a substantial influence on the individual workload of the nurse. These findings have implications for nurse administrators and should be incorporated into staffing decisions.

Another valuable study finding was the negative correlation of the seventh patient complexity factor, "total factor shift score," to nurses' perception of staffing adequacy. The time that nurses need to collaborate with team members, which includes time to find available workers to help with care has been called indirect care activity. Upenieks and colleagues (2008) conducted a pilot study on three units and found RNs spent 17% - 37% of their work time in non-value-added care activities; included in these activities is the time nurses spend looking for people and retrieving equipment. However, Upenieks and colleagues did not examine the impact of non-value-added activities on nurses' job satisfaction or perception of staffing adequacy.

How work is divided and assigned as part of the role function mode for groups was measured in the current study by examining three different variables of nurse staffing and their influence on perception of staffing adequacy. There were no significant correlations between nurses' perception of staffing adequacy and RN skill mix, or with nurse-to-patient ratio, or with the percent of assigned care hours. These three staffing variables influence the use of marginal

analysis in making staffing decisions which reflects the interdependence group mode of this model. These findings indicate that staffing variables that have been used to make staffing decisions are not all encompassing as the variables were not meaningful to nurses' perception of staffing adequacy in the current study.

Testing the Roy Adaptation Model Proposition

The results of the current study supported the theoretical proposition that "the organizational system develops priorities among internal and external influencing factors, which determine the intensity of the effect of a change on any one mode; these priorities, however, are fluid" (Roy & Anway, 1989, p. 82). This current study used the RAM model synthesized with concepts from economic theory to assess nurses' perception of staffing adequacy based upon inputs of patient complexity factors and patient acuity along with production factors of budgeted nursing staff. The influencing contextual stimuli of the two meaningful complexity factors, disruptive behavior and family demands, have importance to nurse administrators who need to incorporate these factors into staffing decisions. The impact of the patient complexity factors of disruptive behavior and family demands on nurses' perception of staffing adequacy was an important study finding that supports the proposition. The reality that the nurse often works alone to meet patient needs with these two factors is contained within the self-concept mode and reflects the underlying need of psychic integrity. The finding that the total factor shift score had a negative correlation on nurses' perception of staffing adequacy is another important finding. The increasing number of complexity factors experienced by the nurse per shift determined the intensity of their perception of staffing adequacy as stated in the theoretical proposition.

Another meaningful study finding was the lack of a relationship between the nurse staffing variables within the role function group and nurses' perception of staffing adequacy.

The staffing variables of RN skill mix and nurse-to-patient ratio have been long standing benchmarks used by nurse administrators to determine adequacy of staffing. The implementation of a new predictive modeling software system at the study site produced another staffing variable, percent of assigned care hours, which can be used to assess staffing. None of these staffing variables influenced nurses' perception of staffing adequacy. These variables are commonly considered as priorities for staffing, however, the current study has demonstrated that these priorities need to be redefined and re-shaped.

RAM enables organizations to assess their work by integration of the adaptive modes with the coping processes of the innovator and stabilizer. These group coping processes can now be used to frame recommendations for nurse administrators and educators based upon the findings of the current study. Using the assumptions of decision-making and marginal analysis from economic theory and the coping process of the stabilizer, which refers to the organizational structures that strive for system maintenance, nurse administrators need to consider the presence and impact of complexity factors as part of staffing plans. Stabilizing staffing needs and promoting nurses' perception of staffing adequacy is important to the role of nurse administrators. The innovator coping process supports organizational growth and change and is used by nurse administrators when advocating for additional resources to meet staffing needs.

Patient Complexity Properties

In identifying patient complexity factors, terms used to describe patients' need for nursing care services were defined in Chapter 1, p. 4. Acuity, intensity, burden, and complexity have been used to categorize patient needs. These descriptors are present in the properties of patient complexity factors. The patient complexity factors share three properties: intensity, duration, and predictability. The properties are not present to the same degree for each of the

complexity factors. The differences in the properties for each factor and the effect on nurses' workload influences nurses' perception of staffing adequacy. Intensity is the strength or concentration of the factor. The intensity for each factor can vary based on patient condition. For example, one patient with disruptive behavior can be extremely confused, combative, or demonstrate threatening behavior, while another patient with disruptive behavior does not exhibit such extreme behavior as combativeness or threats, but requires close supervision to ensure patient safety. The need to obtain a translator for the patient with limited English proficiency can increase the intensity for effective communication.

Duration is the length of time the patient exhibits the complexity factor. A patient may be in restraints briefly during the nurses' shift or may need a physical restraint for the entire shift. But before restraints are used, alternatives to restraints may be attempted to reduce the potential for harm; this process can affect the nurses' workload and their perception of staffing adequacy. Duration will be increased for obese patients who are dependent and immobile because nurses will need more assistance from other workers and more time to meet patient care needs. Duration can be variable in patients whose family members require a substantial amount of interaction. The amount of time family members spend with a patient can fluctuate depending on the time of day and other circumstances.

Predictability is the capacity to plan. Limited English proficiency that requires translation services is more predictable for subsequent shifts. Once known, this factor can become part of the staffing plan. Obesity can be viewed as a predictable patient complexity factor because the patient's weight is known and functional status can be assessed. However changes in patient condition and procedures can reduce predictability for this factor.

The presence of patient complexity factors with their varying properties influences nurses' perception of staffing adequacy. However, nurses' perceptions have other inputs that have not been well defined. Nurses need different types of support to meet patient needs and help them deal with negative aspects of their workload. Different types of support alleviate nurses' burden as they work to meet patients' needs. The concept of alleviation helps to explain the interaction of the patient complexity properties and their effect on nurses' perception of staffing adequacy. Alleviation is defined as lessening the burden on workflow. Obese patients may be able to perform their own activities of daily living and may not require nursing assistance for repositioning and ambulation. However, other obese patients may be immobile and completely dependent and require assistance of many workers to meet needs such as positioning and ambulation. Assistance from co-workers with completely dependent obese patients results in alleviation of burden for the nurse and may not influence perception of staffing adequacy. Nurses caring for patients with limited English proficiency who require a translator receive assistance which lessens the communication burden.

Nurses caring for patients with disruptive behavior or significant family demands are working alone to meet patient/family needs. The independent nature of this work negatively influences perception of staffing adequacy because no support to alleviate the burden is available or requested. The additive effect of the patient complexity factors on nurses' perception of staffing adequacy also indicates an increase in the burden on workflow that is not being alleviated.

Limitations

There were several limitations in the data collection process. In order to reduce the burden of data collection on the participants, the PI retrospectively from chart review collected

the patient complexity factors of restraints, and BMI and the patient characteristics of age and weight. The study variables of RN skill mix, assigned care hours, and average patient acuity scores were obtained by the PI from the automated staffing system. Most participants worked 12-hour shifts but the maximum shift partition in the staffing system is an eight hour shift. This difference extended data collection since variables had to be hand calculated and recorded by the PI for 12-hour shift episodes. This was time consuming, labor intensive, and lengthened the data collection period.

An exploratory factor analysis for the PES-NWI tool was conducted to evaluate the current study's results with Lake's (2002) study. Sample size is an important consideration in factor analysis as small samples tend to have more variation and the correlation coefficients are less reliable. Tabachnick and Fidell (2013, p. 618) recommend 300 cases for factor analysis or a ratio of five cases per item which would be approximately 150 cases in the current study. This is a limitation with this sample $N = 48$.

The results of the current study were dependent upon participants' responses of their perception of staffing adequacy. The validity of the "Staffing Adequacy Perception – VAS" is affected by the potential of a social desirability response (Huang, Liao, & Chang, 1998). The PI held an administrative position at the study site during the duration of the data collection period. Participants may have altered their responses by overestimating staffing adequacy to conform to what they thought the PI wanted to hear or they could have provided underestimates with the intent of potentially obtaining future additional staffing resources based on study results. In retrospect, participants could have been screened by a social desirability scale, but since this was not anticipated, it is a limitation of the current study.

Data for the current study was derived mainly from two nursing care units in one academic medical center. This decision was made to reduce confounding variables. However, generalizability of these findings is limited by this decision. These results must be viewed with caution since findings with other populations and at different facilities might yield different findings.

Recommendations

The current study provides a unique examination of the presence of patient-related factors and their impact on nurses' perception of staffing adequacy. The meaningful finding that the two patient complexity factors that require nurses to work alone or unsupported has implications for nurse administrators and educators.

The transformation of health care that began approximately 30 years ago was in response to economic conditions of that era. The large scale efforts nationwide to reduce the nursing workforce to build in efficiencies of care, led quickly to a reduced quality of care. The concern for patient safety led to the 2000 Institute of Medicine's (IOM) report, *To Err is Human: Building a Safer Health System*. One of the principles recommended for designing safer systems in health care organizations was to promote effective team functioning and "train in teams those who are expected to work in teams" (Kohn et al., 2000, p. 173). Since then, interdisciplinary team training has been emphasized. The emphasis currently is on interprofessional teamwork. The recommendation based on these findings is to strengthen individual RN ability to manage patients and family members initially but to continue to develop their role on the healthcare team.

Future research in the area of nurses' perception of staffing should include use of a social desirability scale either to pre-screen potential participants or to detect and/or control for social

desirability during data analysis. Perception of staffing adequacy for a nurse can be considered a socially sensitive topic if the data are being provided to someone in the nurse's own institutional hierarchy. This point was mentioned as a limitation of the current study. Consideration of this point could improve the ability of the PI to interpret findings in future studies.

Future Research

In the current study, two patient complexity factors explained ten percent of the variance in nurses' perception of staffing adequacy using multiple regression. The findings indicate there are probably other factors that explain perception of staffing adequacy, which represents an opportunity for ongoing research. A qualitative study that explores patient complexity factors in depth would contribute to a deeper understanding of how each factor affects nurses' perception of staffing adequacy.

While the PES-NWI is a widely used scale to measure the nursing practice environment, further factor analysis of the subscales and scores with current samples is recommended. Health care organizations have changed dramatically since the 1980s and 1990s. Factor loadings and subscales could be confirmed with large and more recent samples. The use of the National Database of Nursing Quality Indicators (NDNQI) data, which uses the PES-NWI scale, might be explored for this type of study.

Nurses' perception of staffing inadequacy can result from increased patient demands and increases in nursing workload. As a result of this increased workload, delays in care or omissions can occur. These omissions and delays have been called "missed nursing care." The impact of missed nursing care on quality patient outcomes has been added to the NDNQI RN satisfaction survey. An area of future research is the relationship between reported episodes of missed nursing care and nurses' perception of staffing adequacy.

Another potential area for study is determining differences in nurses' perception of staffing adequacy based upon the characteristics of RN education and experience. Exploration of the RN characteristics through this type of study would enhance the middle range theory of adaption, production decision-making process, and nurses' perception of staffing adequacy that was tested during this research.

Conclusion

Before the current study began, much was known about nurse staffing. Research has shown that increased levels of nurse staffing lead to improved outcomes for patients as well as job satisfaction for nurses. California's effort to improve nurse staffing levels by using mandatory staffing ratios has shown that fixed staffing ratios decrease flexibility in staffing so that making staffing adjustments in real-time was undermined. Despite improved staffing levels, nurses continued to describe dissatisfaction with staffing.

All of the factors that impact nurses' perception of staffing adequacy need to be further investigated to promote better understanding. The findings show that patient complexity factors are different from traditional conceptualizations of patient acuity. Furthermore, nurses' perception of staffing adequacy has been found to be different from nurses' job satisfaction. Since patient acuity and nurses' job satisfaction have been the variables analyzed through large data sets, the current study shows that a limitation of those studies might be related to elements of job satisfaction that offset nurses' perception of staffing adequacy.

The current study identified patient complexity factors as being different from patient acuity. Several factors were identified and found to negatively influence nurses' perception of staffing adequacy. Although there were limitations to the study, the significant findings provide insight into individual nurses' perception of staffing adequacy at the shift level. The findings

inform the science of nurse staffing and contributes to the middle range theory of adaptation, production decision-making process, and nurses' perception of staffing adequacy.

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APPENDICES

Appendix A

The Practice Environment Scale of the Nursing Work Index

For each item, please indicate the extent to which you agree that the item is PRESENT IN YOUR CURRENT JOB. Indicate your degree of agreement by circling the appropriate number.

	Strongly Agree	Agree	Disagree	Strongly Disagree
1 Adequate support services allow me to spend time with my patients.	1	2	3	4
2 Physicians and nurses have good working relationships	1	2	3	4
3 A supervisory staff that is supportive of the nurses.	1	2	3	4
4 Active staff development or continuing education programs for nurses.	1	2	3	4
5 Career development/clinical ladder opportunity.	1	2	3	4
6 Opportunity for staff nurses to participate in policy decisions.	1	2	3	4
7 Supervisors use mistakes as learning opportunities, not criticism.	1	2	3	4
8 Enough time and opportunity to discuss patient care problems with other nurses	1	2	3	4
9 Enough registered nurses to provide quality patient care.	1	2	3	4
10 A nurse manager who is a good manager and leader.	1	2	3	4
11 A chief nursing officer who is highly visible and accessible to staff	1	2	3	4
12 Enough staff to get the work done	1	2	3	4
13 Praise and recognition for a job well done.	1	2	3	4
14 High standards of nursing care are expected by the administration	1	2	3	4
15 A chief nursing officer equal in power and authority to other top-level hospital executives	1	2	3	4
16 A lot of team work between nurses and physicians.	1	2	3	4
17 Opportunities for advancement.	1	2	3	4
18 A clear philosophy of nursing that pervades the patient care environment.	1	2	3	4
19 Working with nurses who are clinically competent.	1	2	3	4
20 A nurse manager who backs up the nursing staff in decision making, even if the conflict is with a physician.	1	2	3	4
21 Administration that listens and responds to employee concerns.	1	2	3	4

22	An active quality assurance program.	1	2	3	4
23	Staff nurses are involved in the internal governance of the hospital (e.g., practice and policy committees).	1	2	3	4
24	Collaboration (joint practice) between nurses and physicians.	1	2	3	4
25	A preceptor program for newly hired RNs	1	2	3	4
26	Nursing care is based on a nursing, rather than a medical, model.	1	2	3	4
27	Staff nurses have the opportunity to serve on hospital and nursing committees.	1	2	3	4
28	Nursing administrators consult with staff on daily problems and procedures	1	2	3	4
29	Written, up-to-date nursing care plans for all patients.	1	2	3	4
30	Patient care assignments that foster continuity of care, i.e., the same nurse cares for the patient from one day to the next.	1	2	3	4
31	Use of nursing diagnoses.	1	2	3	4

Source: Eileen T. Lake. "Development of the Practice Environment Scale of the Nursing Work Index." *Research in Nursing & Health*, May/June 2002; 25(3): 176-188.

Appendix B

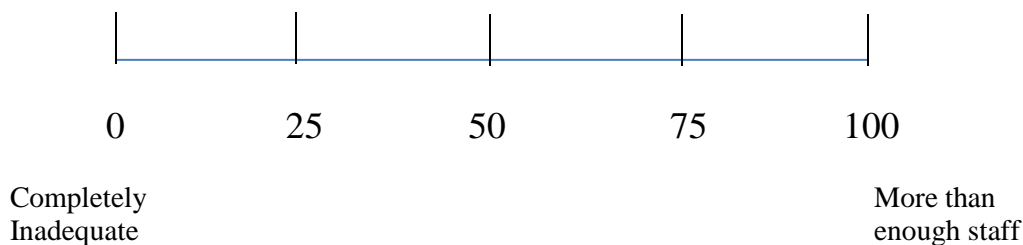
Staffing Adequacy Perception - VAS

Nurse ID#	Date	Shift	Unit
-----------	------	-------	------

Directions: Please read the following definition of staffing adequacy. Then draw a slash through the line under the question below asking you to rate your perception of the adequacy of staffing on the shift that you just completed.

Definition: Staffing adequacy is defined as a match of registered nurse expertise with the needs of the patient in the context of the practice setting and the situation. It describes the situation where there are enough nurses to deliver care factoring in all of the aspects of the care environment into the allocation of staff (ANA, 2012, p. 6.)

How would you rate the adequacy of staffing on the shift you just completed?



ANA (2012). *ANA's principles for nurse staffing* (2nd ed.) Silver Spring, MD: Nursebooks.org.

Appendix C

Identification of Patient Complexity Factors/Staffing Adequacy Perception - VAS

Nurse ID#

Date

Shift

Unit

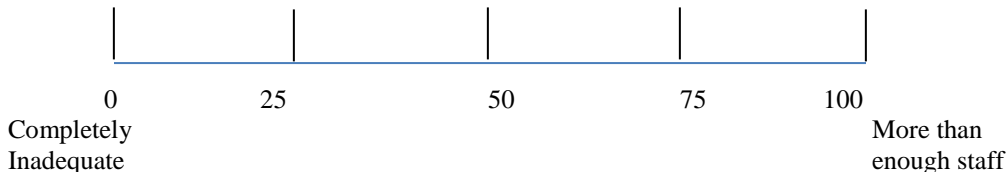
Directions: Please identify the following patient complexity factors that were present among the patients that were assigned to your care for the shift that you have just completed.

Complexity Factor	Patient #1	Patient #2	Patient #3	Patient #4	Patient #5	Patient #6	Patient #7	Patient #8
Encounter Number								
Requires a Safety Watch Sitter or 1:1 (Y/N)								
Displays disruptive and/or combative behavior (Y/N)								
Family members require significant interaction and limit setting (Y//N)								

Directions: Please read the following definition of staffing adequacy. Then draw a slash through the line under the question below asking you to rate your perception of the adequacy of staffing on the shift that you just completed.

Definition: Staffing adequacy is defined as a match of registered nurse expertise with the needs of the patient in the context of the practice setting and the situation. It describes the situation where there are enough nurses to deliver care factoring in all of the aspects of the care environment into the allocation of staff (ANA, 2012, p. 6.)

How would you rate the adequacy of staffing on the shift you just completed?



Appendix D

RN Demographic Survey

Nurse ID#

Date

Unit

Please answer the following questions by checking a response or filling in the blank.

1. What is your **basic level of educational preparation to become a nurse?**

- 1. Diploma in nursing
- 2. Associate Degree in nursing
- 3. Bachelor's Degree in nursing

2. What is your highest level of **nursing education?**

- 1. Diploma in nursing
- 2. Associate Degree in nursing
- 3. Bachelor's Degree in nursing
- 4. Master's Degree in nursing
- 5. Doctorate in nursing (PhD or DNP)

3. How long have you worked as a nurse?

_____ Years

4. How long have you worked on your current unit at this hospital?

_____ Years

Appendix E

Recruitment Flyer:

INVITATION TO PARTICIPATE IN A NURSING RESEARCH STUDY

Patient Complexity Factors and their Influence on Nurses' Perception of Staffing Adequacy

A research study is being conducted to examine nurses' perception of the adequacy of staffing based on the presence of selected patient complexity factors. Study findings might increase our knowledge regarding the factors that influence nurses' perception of staffing adequacy and might improve our ability to estimate patient requirements for nursing care.

Please consider volunteering if you:

- Are a registered professional nurse on 12 South, 15 South, 15 North, 9 South, 16 North, 13 North and
- Have completed orientation and provide direct patient care on your clinical unit, and
- Are willing to volunteer to be a participant.

Your participation involves:

- Completion of an initial survey packet (approximately 20 minutes)
- Completion of a survey at the end of each completed shift for a total number of 14 shifts (approximately 20 minutes per shift).

The research study is being conducted by Margaret Duffy, MS, RN, NEA-BC, a PhD candidate in nursing at Molloy College in Rockville Centre, NY. Study participants will receive a \$10 Starbucks gift card and a certificate of study completion to acknowledge their time and effort.

If you are interested in participating, please contact:

Margaret Duffy

631-834-2340

mduffy@lions.molloy.edu

Appendix F

Consent Form:



Stony Brook Research

Committees on Research Involving Human Subjects

Established 1971

RESEARCH CONSENT FORM

Project Title: *Patient Complexity Factors and Their Influence on Nurses' Perception of Staffing Adequacy*

Principal Investigator: Margaret Duffy, MS, RN, NEA-BC

You are being asked to volunteer in a research study. This study will examine your perception of the adequacy of nurse staffing based upon the presence of selected patient complexity factors. The *ANA Principles for Nurse Staffing* identify factors beyond patient acuity for consideration in nurse staffing such as complexity of care needs, cultural and linguistic diversities, communication skills, the existence and severity of multiple co-morbid conditions, and continuity of care needs. Capturing the acuity and complexity of the patient and translating that information into a realistic estimate of nursing care requirements that can be used by nurse managers to create staffing plans has been an ongoing challenge for nursing leaders. Study findings potentially might enhance our knowledge about factors that influence nurses' perception of staffing adequacy. This knowledge might improve our ability to estimate patient requirements for nursing care.

PURPOSE:

The purpose of this study is to determine the patient complexity factors not consistently captured in the measurement of patient acuity by an automated workforce management system and the influence those factors have on nurses' perception of staffing adequacy. Approximately fifty nurses will be recruited to participate in this study.

PROCEDURES:

If you decide to be in this study, you will receive a packet that includes survey materials. You will be asked to complete a survey packet which will take approximately 15 minutes to complete. Contained in the packet are an additional 14 sets of two instruments to document your perception of staffing adequacy after completion of a shift and the patient complexity factors present in your assignment for that shift. You will be asked to complete these instruments for each consecutive shift you work over the course of approximately a 60-day time period for a total of 14 shifts. Do not complete the forms if you work a partial shift since you won't have enough data to represent a full shift. Do not complete the forms for any shift that you are floated to another unit since floating involves other factors that are not being investigated in this study. Forms should be completed only for shifts worked on your unit in their entirety. The instruments will take approximately 20 minutes per shift to complete.

RISKS / DISCOMFORTS:

There are no known risks if you decide to participate other than the inconvenience of completing the forms.

BENEFITS:

There is no benefit expected as a result of you being in this study. However, potential study findings might enhance our knowledge regarding the factors that influence nurses' perception of staffing adequacy and might improve the ability to estimate patient requirements for nursing care.

PAYMENT TO YOU:

There is no compensation for participation in this study.

CONFIDENTIALITY: Protecting Your Privacy in this Study

We will take steps to help make sure that all the information we get about you is kept private. Your name will not be used wherever possible. We will use a code instead. All the study data that we get from you will be kept locked up. The code will be locked up too. If any papers and talks are given about this research, your name will not be used. Your decision on whether or not to participate will be made in the presence of the non-supervisory Principal Investigator in order to maintain a neutral environment. Your

results will not be shared with your direct supervisor, nor will they be made aware of your study participation.

We want to make sure that this study is being done correctly and that your rights and welfare are being protected. For this reason, we will share the data we get from you in this study with the study team, Stony Brook University's Committee on Research Involving Human Subjects, applicable Institutional officials, and certain federal offices. However, if you tell us you are going to hurt yourself, hurt someone else, or if we believe the safety of a child is at risk, we will have to report this.

We will do everything we can to keep others from learning about your participation in this study. This study requires that we collect very private information about you. To further help us protect your privacy, we have obtained a Certificate of Confidentiality (COC) from the United States Department of Health and Human Services (DHHS).

With this certificate, we cannot be forced (e.g. by court order or subpoena) to disclose information that may identify you in any federal, state, local, civil, criminal, legislative, administrative, or other proceedings. The researcher will use the Certificate to resist any demands for information that you identify you, except to prevent serious harm to you or others.

You should understand that a COC does not prevent you from voluntarily releasing information about yourself and your involvement in this study. If an insurer or employer learns about your participation, and obtains your consent to receive research information, then we may not use the COC to withhold this information. This means you must also actively protect your own privacy.

You should understand that we will in all cases, take the necessary action, including reporting to authorities, to prevent serious harm to yourself or others.

A COC does not represent an endorsement of the research study by the DHSS or the National Institutes of Health.

COSTS TO YOU:

There are no costs to you if you decide to participate in this study.

ALTERNATIVES:

Your alternative to being in this study is to simply not participate.

CONSEQUENCES OF WITHDRAWING:

Participation in this study is voluntary and you may leave the study at any time without penalty. As a courtesy, please notify the investigator if you do decide to leave the study.

YOUR RIGHTS AS A RESEARCH SUBJECT:

- Your participation in this study is voluntary. You do not have to be in this study if you don't want to be.
- You have the right to change your mind and leave the study at any time without giving any reason, and without penalty.
- Any new information that may make you change your mind about being in this study will be given to you.
- You will get a copy of this consent form to keep.
- You do not lose any of your legal rights by signing this consent form.

QUESTIONS ABOUT THE STUDY OR YOUR RIGHTS AS A RESEARCH SUBJECT:

- If you have any questions, concerns, or complaints about the study, you may contact Margaret Duffy, at telephone # (631-834-2340).
- If you have any questions about your rights as a research subject or if you would like to obtain information or offer input, you may contact Ms. Judy Matuk, Committee on Research Involving Human Subjects, (631) 632-9036, OR by e-mail, judy.matuk@stonybrook.edu.
- Visit Stony Brook University's Community Outreach page, <http://www.stonybrook.edu/research/orc/community.shtml> for more information about participating in research, frequently asked questions, and an opportunity to provide feedback, comments, or ask questions related to your experience as a research subject.

If you sign below, it means that you have read (or have had read to you) the information given in this consent form, and you would like to be a volunteer in this study.

Subject Name (Printed)

Subject Signature

Date

Name of Person Obtaining Consent
(printed)

Signature of Person Obtaining Consent Date

Appendix G

Approval Letter from Molloy College IRB



1000 Hempstead Avenue
Rockville Centre, NY 11571
www.molloy.edu

Tel. 516.323.3653
Tel. 516.323.3801

Date: December 3, 2014
To: Margaret Duffy
From: Kathleen Maurer Smith, PhD
Co-Chair, Molloy College Institutional Review Board
Veronica D. Feeg, PhD, RN, FAAN
Co-Chair, Molloy College Institutional Review Board

SUBJECT: MOLLOY IRB REVIEW AND DETERMINATION OF EXEMPT STATUS
Study Title: Patient Complexity Factors and Their Influence on Nurses' Perception of Staffing Adequacy
Approved: December 3, 2014

Dear Ms. Duffy:

The Institutional Review Board (IRB) of Molloy College has reviewed the above-mentioned research proposal and determined that this proposal is approved by the committee. With the approval you have received from the institution where the study will be conducted, it is EXEMPT from the requirements of Department of Health and Human Services (DHHS) regulations for the protection of human subjects as defined in 45CFR46.101(b) at the Molloy College IRB.

You may proceed with your research. Please submit a report to the committee at the conclusion of your project.

Changes to the Research: It is the responsibility of the Principal Investigator to inform the Molloy College IRB of any changes to this research. A change in the research may disqualify the project from exempt status.

Sincerely,

Kathleen Maurer Smith, PhD

Veronica D. Feeg, PhD, RN, FAAN

Appendix H

Approval Letter from Stony Brook University IRB



DATE: December 1, 2014

TO: Margaret Duffy

FROM: Stony Brook University IRB (CORIHS B)

SUBMISSION TYPE: New Project

STUDY TITLE: [623627-3] Patient Complexity Factors and Their Influence on Nurses' Perception of Staffing Adequacy

CORIHS#: 2014-2715-F

ACTION: APPROVED

SUBMISSION APPROVAL DATE: December 1, 2014

PROJECT EXPIRATION DATE: November 30, 2015

REVIEW TYPE: Expedited Review

EXPEDITED REVIEW CATEGORY: #7

Thank you for your submission of New Project materials for this research study. Stony Brook University IRB (CORIHS B) (FWA #00000125) has APPROVED your submission.

All research must be conducted in accordance with this approved submission. Any modifications to the study as approved must be reviewed and approved by CORIHS prior to initiation.

If this activity has components that require approval from additional compliance committees (e.g., IACUC, IRB, IBC, SCRO, COI) it is your responsibility to not commence with the study until these approvals have been secured as well.

Please note:

- Consent forms signed by subjects in this study must be kept by the investigator for 6 (six) years from study termination, or indefinitely (if so indicated in the consent form).
- Approval includes protocol, uploaded in package -2 and dated 9/28/2014.

FOR NEW STUDIES ONLY:

If your study involves University Hospital patients, facilities, personnel and/or services, your study must not commence until you receive documented approval from: Joseph Laver (all studies), Rhona Vainder (Chernoff) or Regina Rigoroso (all studies), Jay Bock (if your study involves Pathology/Laboratory Services), 'The Research Pharmacy' Group (if your study involves the Pharmacy), Mark Schweitzer (if your study requires Radiology services), and Stephanie Musso (if identifiable subject health information will be electronically transmitted outside of SBU).

You are reminded that you must apply for, undergo review, and be granted continued approval for this study before November 30, 2015 in order to be able to conduct your study in an uninterrupted manner. If you do not receive approval before this date, you must cease and desist all research involving human subjects, their tissue and their data until such time as approval is granted.

Where obtaining informed consent/permission/assent is required as a condition of approval, be sure to assess subject capacity in every case, and continue to monitor the subject's willingness to be in the study throughout his/her duration of participation. Only use current CORIHS-stamped forms in the consent process. Each subject must receive a copy of his/her signed consent/permission/assent document.

Unanticipated problems (including serious adverse events) must be reported to this office in accordance with SBU Policy at: <http://research.stonybrook.edu/human-subjects-standard-operating-procedures/unanticipated-problems-involving-risks-subjects-or>.

Any complaints or issues of non-compliance must be immediately reported to this office. If you have any questions or comments about this correspondence, please contact:

Office of Research Compliance
Division of Human Subject Protections
Stony Brook University
Stony Brook, NY 11794-3368.
Phone: 631-632-9036
Fax: 631-632-9839

Please include your study title and CORIHS # in all correspondence with this office.

We are interested in receiving feedback regarding your experience with the Office of Research Compliance, SBU's IRBs (CORIHS), or any other aspect of our Human Research Protection Program. Please feel free to e-mail Judy Matuk, Assistant Vice President for Research Compliance, at judy.matuk@stonybrook.edu, or if you'd like to submit feedback anonymously, you may do so at <http://www.tellmyirb.com>, choose the option 'Report a Problem', type in 'Stony Brook' as the site, click the radio button on the following screen, and then provide feedback!

Appendix I

Approval Letter from Stony Brook University IRB: Continuing Review



DATE:	November 13, 2015
TO:	Margaret Duffy
FROM:	Stony Brook University IRB (CORIHS B)
SUBMISSION TYPE:	Continuing Review/Progress Report
STUDY TITLE:	[623627-6] Patient Complexity Factors and Their Influence on Nurses' Perception of Staffing Adequacy
CORIHS#:	2014-2715-R1
ACTION:	APPROVED
MEETING DATE (IF FULL REVIEW):	
SUBMISSION APPROVAL DATE:	November 13, 2015
PROJECT EXPIRATION DATE:	November 12, 2016
REVIEW TYPE:	Expedited
EXPEDITED REVIEW CATEGORY:	#7

Thank you for your submission of Continuing Review/Progress Report materials for this research study. Stony Brook University IRB (CORIHS B) (FWA #00000125) has APPROVED your submission.

All research must be conducted in accordance with this approved submission. Any modifications to the study as approved must be reviewed and approved by CORIHS prior to initiation.

If this activity has components that require approval from additional compliance committees (e.g., IACUC, IRB, IBC, SCRO, COI) it is your responsibility to not commence with the study until these approvals have been secured as well.

Please note:

- Consent forms signed by subjects in this study must be kept by the investigator for 6 (six) years from study termination, or indefinitely (if so indicated in the consent form).

You are reminded that you must apply for, undergo review, and be granted continued approval for this study before November 12, 2016 in order to be able to conduct your study in an uninterrupted manner. If you do not receive approval before this date, you must cease and desist all research involving human subjects, their tissue and their data until such time as approval is granted.

Where obtaining informed consent/permission/assent is required as a condition of approval, be sure to assess subject capacity in every case, and continue to monitor the subject's willingness to be in the study throughout his/her duration of participation. Only use current CORIHS-stamped forms in the consent process. Each subject must receive a copy of his/her signed consent/permission/assent document.

Unanticipated problems (including serious adverse events) must be reported to this office in accordance with SBU Policy at: <http://research.stonybrook.edu/human-subjects-standard-operating-procedures/unanticipated-problems-involving-risks-subjects-or>.

Any complaints or issues of non-compliance must be immediately reported to this office. If you have any questions or comments about this correspondence, please contact:

Office of Research Compliance
Division of Human Subject Protections
Stony Brook University
Stony Brook, NY 11794-3368.
Phone: 631-632-9036
Fax: 631-632-9839

Please include your study title and CORIHS # in all correspondence with this office.

We are interested in receiving feedback regarding your experience with the Office of Research Compliance, SBU's IRBs (CORIHS), or any other aspect of our Human Research Protection Program. Please feel free to e-mail Judy Matuk, Assistant Vice President for Research Compliance, at judy.matuk@stonybrook.edu, or if you'd like to submit feedback anonymously, you may do so at <http://www.tellmyirb.com>, choose the option 'Report a Problem', type in 'Stony Brook' as the site, click the radio button on the following screen, and then provide feedback!

Appendix J

Certificate of Confidentiality from the National Institute of Nursing Research



DEPARTMENT OF HEALTH & HUMAN SERVICES

National Institutes of Health
National Institute of Nursing Research

31 Center Drive MSC 2178
Building 31, Room 5B05
Bethesda, MD 20892-2178

Tel: (301) 496-8230
Fax: (301) 594-3405

1/5/2015

Stony Brook University Hospital
Ms. Margaret Duffy
Nicolls Road
HSC, Level 5, Room 088
Stony Brook, NY 11794-841

Dear Ms. Duffy,

Enclosed is the Confidentiality Certificate protecting the identity of research subjects in your project entitled, 'Patient Complexity Factors and Their Influence on Nurses' Perception of Staffing Adequacy'. Please note that the Certificate expires on 12/01/2016.

Please be sure that the consent form given to research participants accurately states the intended uses of personally identifiable information (including matters subject to reporting) and the confidentiality protections, including the protection provided by the Certificate of Confidentiality with its limits and exceptions.

If you determine that the research project will not be completed by the expiration date, 12/01/2016, you must submit a written request for an extension of the Certificate three months prior to the expiration date. If you make any changes to the protocol for this study, you should contact me regarding modification of this Certificate. Any requests for modifications of this Certificate must include the reason for the request, documentation of the most recent IRB approval, and the expected date for completion of the research project.

Please advise me of any situation in which the Certificate is employed to resist disclosure of information in legal proceedings. Should attorneys for the project wish to discuss the use of the Certificate, they may contact the Office of the NIH Legal Advisor, National Institutes of Health, at (301) 496-6043.

Correspondence should be sent to:

Donna Jones
CoC Coordinator
National Institute of Nursing Research
6701 Rockledge Drive, Room 8135
Bethesda, MD 20892
Telephone: (301) 594-4734
Fax: (301) 480-5848

Sincerely,

Donna C. Jones -S
Donna Jones

Digitally signed by donna c. jones -S
DN: cn=Donna C. Jones, o=National Institutes of Health, ou=NIH, email=donna.jones@nih.gov, c=US

CERTIFICATE OF CONFIDENTIALITY

CC-NR-15-01

issued to

Stony Brook University Hospital

conducting research known as

Patient Complexity Factors and Their Influence on Nurses' Perception of Staffing Adequacy

In accordance with the provisions of section 301(d) of the Public Health Service Act 42 U.S.C. 241(d), this Certificate is issued in response to the request of the Principal Investigator, Ms. Margaret Duffy, to protect the privacy of research subjects by withholding their identities from all persons not connected with this research. Ms. Duffy is primarily responsible for the conduct of this research.

Under the authority vested in the Secretary of Health and Human Services by section 301(d), all persons who:

1. are enrolled in, employed by, or associated with the Stony Brook University Hospital and their contractors or cooperating agencies and
2. have in the course of their employment or association access to information that would identify individuals who are the subjects of the research pertaining to the project known as Patient Complexity Factors and Their Influence on Nurses' Perception of Staffing Adequacy

are hereby authorized to protect the privacy of the individuals who are the subjects of that research by withholding their names and other identifying characteristics from all persons not connected with the conduct of that research.

This study will examine nurses' perception of staffing adequacy based upon the presence of selected patient complexity factors. Approximately fifty RNs who provide direct patient care on six medical telemetry inpatient units will be recruited. Study participants will complete an investigator developed survey that will identify the presence of selected patient complexity factors and a magnitude estimation of perception of staffing adequacy at the end of each shift for a total of fourteen shifts per nurse.

A Certificate of Confidentiality is needed because sensitive information will be collected during the course of the study. The certificate will help researchers avoid involuntary disclosure that could expose subjects or their families to adverse economic, legal, psychological and social consequences.

All subjects will be assigned a code number and identifying information and records will be kept in locked files at the Institution.

This research is currently underway and is expected to end on 12/01/2016.

As provided in section 301 (d) of the Public Health Service Act 42 U.S.C. 241(d):

'Persons so authorized to protect the privacy of such individuals may not be compelled in any Federal, State, or local civil, criminal, administrative, legislative, or other proceedings to identify such individuals.'

This Certificate does not protect you from being compelled to make disclosures that: (1) have been consented to in writing by the research subject or the subject's legally authorized representative; (2) are required by the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.) or regulations issued under that Act; or (3) have been requested from a research project funded by the National Institutes of Health (NIH) or the Department of Health and Human Services (DHHS) by authorized representatives of those agencies for the purpose of audit or program review.

CERTIFICATE OF CONFIDENTIALITY**CC-NR-15-01**

issued to

Stony Brook University Hospital

conducting research known as

Patient Complexity Factors and Their Influence on Nurses' Perception of Staffing Adequacy

This Certificate does not represent an endorsement of the research project by the DHHS. This Certificate is now in effect and will expire on 12/01/2016. The protection afforded by this Confidentiality Certificate is permanent with respect to subjects who participate in the research during the time the Certificate is in effect.

Date: 1/5/2015

ann.knebel@nih.gov
OV

Digitally signed by
ann.knebel@nih.gov
DN: cn=ann.knebel@nih.gov
Date: 2015.01.05 16:19:52 -0500

Ann R. Knebel, PhD, RN, FAAN
Deputy Director
National Institute of Nursing Research