

THE RELATIONSHIP BETWEEN SYSTEM CHARACTERISTICS, PATIENT
SAFETY PRACTICES, AND PATIENT SAFETY OUTCOMES
IN JCAHO ACCREDITED ACUTE CARE HOSPITALS

by

Phyllis Morris-Griffith
A Dissertation
Submitted to the
Graduate Faculty
of
George Mason University
in Partial Fulfillment of
The Requirements for the Degree
of
Doctor of Philosophy
Nursing

Committee:

_____	Dr. P. J. Maddox, Chair
_____	Dr. Barbara Hatcher, 1 st Reader
_____	Dr. Margie Rodan, 2 nd Reader
_____	Dr. R. Kevin Mallinson, Assistant Dean, Doctoral Division and Research Development
_____	Dr. Thomas R. Prohaska, Dean, College of Health and Human Services

Date: _____ Summer Semester 2016
George Mason University
Fairfax, VA

The Relationship Between System Characteristics, Patient Safety Practices, and Patient
Safety Outcomes in JCAHO Accredited Acute Care Hospitals

A dissertation submitted in partial fulfillment of the requirements for the degree
Of Doctor of Philosophy at George Mason University

By

Phyllis Morris-Griffith
Master of Health Care Administration
Mississippi College, 1989
Bachelor of Science in Nursing
University of Southern Mississippi, 1985

Director: P. J. Maddox, Professor
Department of Health Administration and Policy

Summer Semester 2016
George Mason University
Fairfax, VA

Copyright 2016 Phyllis Morris-Griffith
All Rights Reserved

DEDICATION

This dissertation is dedicated to my grandmother, Ruby Barnes Sellers, who instilled in me the value of education. She taught me to live with purpose and determination, and believed that I could achieve anything. To my Aunt Janice, who inspired me as a young girl to strive for excellence, thank you for your constant encouragement. Finally, to LaVan—my husband, voice of reason, confidant, and best friend—thank you for always believing in me. I am so grateful for the constant support and sacrifice you made so that I could achieve my professional and academic goals. Your support was essential to my success.

ACKNOWLEDGEMENTS

I would like to convey my sincerest appreciation to many people who have supported my pursuit of this educational endeavor. My deepest gratitude is extended to my chair, Dr. P. J. Maddox, for her full support, expert guidance, patience, and encouragement throughout my study and research. Thank you for pushing me to see my work through a different lens. I have learned so much from you, and I am so appreciative for the opportunity to have worked with you. Your support and guidance were vital to my success. To my committee members, Dr. Margie Rodan and Dr. Barbara Hatcher, your indispensable advice, information, encouragement, and generosity of your time was so important to my achievement. To my children, Kayci Amanda and Benjamin LaVan, thank you for believing me. Your expectations motivated me to push forward towards completing this milestone. To Dr. Constance Bell, who encouraged me through continuous reminders that I could do this, I am so humbled by your faith in me. To all of the people who supported me through this achievement, I simply offer my heartfelt thanks. I am forever grateful for the love and support.

TABLE OF CONTENTS

List of Tables	viii
List of Figures	x
Abstract	xi
Chapter 1: Introduction	1
Background	2
Problem Statement	5
Conceptual Framework	12
Definition of Terms	15
Patient Safety Indicators	15
General Physiological Definitions of the Five Selected PSIs	16
National Patient Safety Goals	18
Teaching Status and Location	19
Bed Size	20
Registered Nurse Staff Hours per Average Patient Discharge	20
Geographic Region	20
Summary	21
Chapter 2: Literature Review	22
Rationale for Study	22
Conceptual Framework	25
Structure	25
Process	27
Outcomes	29
Patient Safety Movement	31
Patient Safety	34
Adverse Events	40
Organizational Characteristics and Patient Outcomes	43
Bed Size	45
Teaching and Location	47
Nurse Staffing	50
Outcome Measures	55
Patient Safety Practices	59
The Joint Commission Accreditation Process	66
Accreditation and Patient Outcomes	68
National Patient Safety Goals	72
Assessment Process	75

HCUP-NIS Data.....	76
Patient Safety Indicators	78
Summary	86
Chapter 3: Methodology	89
Research Design.....	89
Conceptual Model.....	90
Population and Sample	94
Population	94
Sample.....	95
Datasets	97
Hospital-Level Data	97
Group Size, Missing, and Outlier Data	102
Data Analysis	103
Data Analysis Plan.....	104
Research Question 1	104
Research Question 2	105
Research Question 3	106
Research Question 4	107
Human Subject Protection	108
Chapter 4: Results	110
Descriptive Analysis	110
Findings Reported by Research Questions	116
Research Question 1	116
Research Question 2	126
Research Question 3	127
Research Question 4	132
Chapter 5: Discussion and Recommendation	143
Question 1	144
Question 2	146
Question 3	148
Hospital Bed Size.....	149
Teaching Status and Location	150
RN Staffing	151
Geographic Region	152
Question 4	153
Teaching Status and Location	153
Geographic Region	156
Recommendations for Further Nursing Research.....	158
Implications for Nursing Practice	160
Strengths and Limitations	163
Strengths	163
Limitations	164
Conclusion	166

Appendix A.....	169
Appendix B.....	170
Appendix C.....	171
Appendix D.....	172
Appendix E.....	173
Appendix F.....	176
References.....	180

LIST OF TABLES

Table 1.	Operational Definitions of Patient Safety Indicators (PSIs)	17
Table 2.	Descriptions of 2011 Hospital National Patient Safety Goals (NPSGs)	19
Table 3.	Healthcare Cost and Utilization Project Bed Size Categories	20
Table 4.	Adverse Events and Hospitalization	41
Table 5.	Noncompliance Percentages for National Patient Safety Goals	74
Table 6.	Agency for Healthcare Research and Quality's Provider-level PSIs	81
Table 7.	Research Questions, Variables, Data Source, and Data Analysis	92
Table 8.	Hospital Discharges Per State for 2011 National Inpatient Sample	98
Table 9.	Variable Construction	101
Table 10.	Number and Accreditation Status of U.S. Hospitals in 2011 by State	111
Table 11.	Distribution of Hospitals by Region, Size, Teaching Status, and Location...	112
Table 12.	Healthcare Cost and Utilization Project-Participating Hospitals by States and Region	112
Table 13.	Mean Rate of Hospital-Reported Patient Safety Indicators	115
Table 14.	Hospital Patient Safety Indicator Frequency by National Patient Safety Goal Compliance	117
Table 15.	Patient Safety Indicator Rates by National Patient Safety Goal Compliance for Sample Hospitals Studied.....	118
Table 16.	Patient Safety Indicator Frequency by Hospital Geographic Region	119
Table 17.	Patient Safety Indicator Frequency by Teaching Status and Location	120
Table 18.	Frequency of Patient Safety Indicator by Registered Nurse Staffing Levels	121
Table 19.	Patient Safety Indicator Frequency by Hospital Bed Size.....	122
Table 20.	Relationship Between Hospital National Patient Safety Goal Compliance and Patient Safety Indicator Rate, Mann Whitney Results.....	124
Table 21.	Logistic Regression Coefficients for Hospitals by Bed Size, Region, and Teaching Status.....	125
Table 22.	Hospital Bed Size, Region, Location, and National Patient Safety Goal Compliance, Chi Square Results.....	127
Table 23.	Kruskal-Wallis Test Results for Hospital Characteristics and Patient Safety Indicator Outcomes Relationships	128
Table 24.	2011 National Inpatient Sample Patient Safety Indicator Rates Per Hospital Study Sample Characteristic	130
Table 25.	Logistic Regression Univariate and Multivariate–Decubitus Ulcer	135
Table 26.	Logistic Regression Univariate and Multivariate–Central Venous Line Bloodstream Infection.....	137

Table 27. Logistic Regression Univariate and Multivariate—Postoperative Sepsis	139
--	-----

LIST OF FIGURES

Figure 1. Donabedian's conceptual framework.....	30
--	----

ABSTRACT

THE RELATIONSHIP BETWEEN SYSTEM CHARACTERISTICS, PATIENT SAFETY PRACTICES, AND PATIENT SAFETY OUTCOMES IN JCAHO ACCREDITED ACUTE CARE HOSPITALS

Phyllis Morris-Griffith, Ph.D

George Mason University, 2016

Dissertation Chair: Dr. P. J. Maddox

This exploratory, descriptive study examined the relationship of patient safety practices as measured by compliance with The Joint Commission's national patient safety goals (NPSGs), hospital characteristics, and patient safety outcomes as defined by the Agency for Healthcare Research and Quality (AHRQ) patient safety indicators (PSIs) in accredited, acute care hospitals in the United States. It examined the relationship between the implementation of patient safety practices such NPSGs and outcomes as defined by the AHRQ's PSIs. It further examined the relationship between hospital characteristics such as teaching status, geographic location, and bed size with NPSGs. It used Donabedian's triad model (Donabedian, 1960) to examine the relationship between NPSGs and quality outcomes, and the influence of hospital characteristics on these variables. The findings provided objective information to guide hospital leaders regarding influences on patient safety outcomes and help them make decisions accordingly.

CHAPTER 1: INTRODUCTION

Concerns for quality in today's rapidly changing healthcare delivery system require healthcare policy makers to acknowledge the need for fundamental change (Institute of Medicine, 2001). Identifying influences that are associated with providing safe care in healthcare delivery is crucial. Many researchers contend that most medical errors or adverse events are preventable (Brennan, Hebert et al., 1991; Thomas et al., 2000b; Lehman, Puopolo, Shaykevich, & Brennan, 2005). As a result of medical errors, hospitalized patients face longer hospital stays and assume a greater financial burden (Nordgren, Johnson, Kirschbaum, & Peterson, 2004; Zhan & Miller, 2003b; Rojas, Silver, Llewellyn, & Ranees, 2005).

Hospitals struggle with the impact of organizational structure and process at the system level. As a result of the heightened attention toward improving patient safety over the past decade, healthcare leaders have turned to safety science literature to help explain patient safety and provide direction for creating safety management systems (Flin, 2007). Further, as federal and state compliance demands and production demands mount, providers are challenged to deliver healthcare with decreased staff, suboptimal working conditions, limited availability of suitable technology, and a shortage of nurses and physicians. It is the influence of these factors that lead to serious harm and

need to identify structures and processes that will influence the delivery of quality care (James, 2013).

Various safety practices have been implemented to address patient safety issues in healthcare. However, their impact on patient outcomes remains relatively unexplored (Shojana, Duncan, McDonald, & Wachter, 2001). The Joint Commission organization responded to the Institute of Medicine (IOM) reports on safety concerns in 2003 by issuing a group of standards and eventually national patient safety goals (NPSGs) to promote specific improvements. The goals serve as a national standardized performance measurement system of care delivered (The Joint Commission, 2013).

Despite widespread dissemination, there is significant variation in the application of the standards across hospitals (Fonarow, Yancy, & Haywood, 2005; Bradley et al., 2006; Peterson & Walker., 2006). Variability in the application of quality processes is complex, and researchers have suggested that reasons are associated with systems issues (Fonarow, Yancy, & Heywood, 2005). Although studies have found a correlation of specific outcome variables with hospital type, size, and location, no study specifically has examined patient outcome variables and their association with organizations' implementation of The Joint Commission's NPSGs.

Background

As early as 1964, Schimmel published evidence that supported the need for focus on patient safety in a study that revealed that 20% of 1,000 patients admitted to a university hospital suffered an adverse outcome, such as hospital-acquired infections and medication reactions, related to their hospitalization. Little activity ensued following

Schimmel's published report until the IOM, responding to public concern, published its now-renowned book, *To Err is Human: Building a Safer Healthcare System* (Kohn et al., 2000). The crusade to develop a quality improvement plan that would change the healthcare industry began with the formation of the IOM's Quality of Healthcare in America committee. Medical errors were number one on the agenda because errors easily were understood by the American public and the consequences of error created sizable financial and social burdens (Kohn et al., 2000).

The first estimates from the IOM report of medical errors received widespread attention (Kohn et al., 2000) and revealed that an estimated 1 million people are injured by errors during treatment at a healthcare facility each year. At the time of the report, 3% to 4% of hospitalizations had some adverse event, with 9% to 14% of those mistakes resulting in death. These numbers equate to approximately 44,000 to 98,000 annual deaths of hospitalized patients per year. According to the latest numbers noted in a study by Classen et al. (2011), adverse events in hospitals may be 10 times greater than previously thought.

Adverse events attributed to death in 13.6% of the subjects in one study (Brennan, Leape et al., 1991) and 6.6% in the other study (Thomas et al., 2000b). Medical errors are ranked as the eighth-leading cause of death in the United States. Further, the costs associated with medical errors in hospitals across the nation are estimated between \$17 billion and \$29 billion per year. Aside from these staggering statistics, the costs also impact intangible issues such as trust in the healthcare system and diminished satisfaction by both patients and health professionals (Kohn et al., 2000).

Fifteen years since the healthcare report from the IOM, *Crossing the Quality Chasm* (IOM, 2001), data show that the quality of delivery of healthcare in the United States remains at an unexpected low point, where efforts to improve patient safety in all dimensions is perilous (Hughes & Kelly, 2008). The United States is ranked last out of seven nations—including Australia, Canada, Germany, the Netherlands, New Zealand, and the United Kingdom—on dimensions of patient safety and access equity (Zhang, 2007). More than \$1.9 trillion is spent on healthcare in the United States—an amount that makes the United States' healthcare system the most expensive in the world. However, medical error costs in the United States totaled an estimated \$19.5 billion during 2008, according to the 2011 National Healthcare Quality Report. Indirect costs related to increased mortality rates total \$1.4 billion (Zhang, 2007). Despite the money spent, medical errors continue to plague the system.

There have been efforts from healthcare organizations, various associations, professional societies, health insurers, and regulatory and accrediting bodies to respond to the recommendations of the 1999 IOM report (Leape & Berwick, 2005). A sharp increase in new agencies focusing on healthcare improvements as well as a redirection to safety by established bodies such as the National Quality Forum (NQF), Leap Frog, Agency for Healthcare Research and Quality (AHRQ), The Joint Commission, National Foundation for Patient Safety, and Institute for Healthcare Improvement (IHI) have been noted. Experts agree that focused initiatives by these agencies should be preceded by a cultural change to fully reap the benefits of their efforts (Agency for Healthcare Research and Quality, 2012a).

The Joint Commission, the leading healthcare accrediting body in the nation, responded to the IOM report in 2003 with the issuance of patient safety accreditation standards known as NPSGs. The first set of six NPSGs was implemented in 2003 (The Joint Commission, 2012). The Joint Commission called for the implementation of these goals in healthcare organizations to direct healthcare improvement efforts to high-priority problem areas (Hyman, 2014) and to address patient safety issues being encountered and reported across the nation.

Problem Statement

As the 2001 IOM report *Crossing the Quality Chasm* made clear, estimated injuries were upward of 98,000 per year. Using a weighted average of four studies, James (2013) found a lower limit of 210,000 deaths per year to be associated with preventable adverse errors in hospitals. While this number is reflective of current estimates of preventable errors, it does not compensate for the known absence of evidence in medical records of errors, near misses, or verbalized patient complaints. Weissman et al. (2008) estimate a twofold increase in medical errors to account for undocumented evidence of serious adverse errors caused during hospitalizations. He estimates that preventable errors may contribute to the death of approximately 440,000 patients each year from care provided in hospitals. This number represents roughly one-sixth of all deaths that occur in the United States each year and is more than four times the original estimate of 98,000 from the IOM report (Kohn et al., 2000). Whether the number is 98,000, 210,000, or 440,000, an epidemic of patient harm in hospitals is undeniable. Additional research must be undertaken to identify causes and curtail these alarming numbers.

However, a significant gap exists in healthcare literature linking patient safety practices, patient outcomes, and selected hospital characteristics. The gap may be attributable in part to the lack of standardization of optimal indicators for the quality of patient care used in measuring outcomes and culture (Clarke, 2014). Before the implementation of NPSGs, organizations made attempts to use selected Joint Commission standards to improve the quality of care based on institutional data (Kizer & Blum, 2005; Leape, Berwick, & Bates, 2002). However, their attempts to gain valuable outcome information related to patient safety practices failed. Since the implementation of The Joint Commission's NPSGs in 2003, there has been an absence of studies to explore the relationship between NPSGs and the AHRQ's patient safety indicator (PSI) outcomes.

Despite widespread dissemination of The Joint Commission's NPSGs and the AHRQ's PSIs, there is significant variation in the implementation and compliance across hospitals (Fonarow et al., 2005; Bradley et al., 2006; Peterson & Walker, 2006; Masica, Richter, Convery, & Haydar, 2009). Reasons for the variation in the application of evidenced-based processes are complex. It has been suggested that differences are associated with systems issues (Fonarow et al., 2005). Brook, McGlynn, and Cleary (1996) assert that one factor contributing to the variation in compliance with national safety goals could be attributable to the lack of objective measures connecting the processes of care to patient outcomes. Though some studies have found a correlation between specific outcome variables with hospital type, size, and location, no work has specifically examined the relationship of hospital characteristics with NPSGs. This study

will examine characteristics of acute care hospitals, and the relationship between patient safety practices and patient safety outcomes.

Need for the Study

Despite marked efforts to improve patient safety, experts suggest that patient safety has not improved substantially, and that action and progress on patient safety are disturbingly slow (James, 2013; Rothschild et al., 2006). Efforts to improve safety have been encumbered, in part, by the difficulty in examining systemic failures that occur in complex, dynamic environments such as hospitals. The present estimate of more than 200,000 (James, 2013) deaths per year attributed to preventable errors is more than double the original estimates over a decade ago in the IOM report *To Err is Human: Building a Safer Health System* (Kohn et al., 2000). Loss of life and irreversible harm to patients in hospitals generates an urgency and increased vigilance to address the problem of harm to patients who seek safe, quality care.

The Joint Commission accreditation process is focused primarily on quality and safety of clinical care. As a result, hospitals spend a significant portion of their budgets to participate in The Joint Commission accreditation process and comply with its standards. Thornlow and Merwin (2009) assert that the relationship between utilization of patient safety practices, specifically NPSGs, has not been well studied, making it difficult for hospitals to understand and identify useful actions to solve problems that could improve patient outcomes.

Approximately 90% of all hospitals that are accredited in the United States are accredited by The Joint Commission (The Joint Commission, 2013). Further, compliance

with accreditation standards has been incentivized by the deemed relationship with the U.S. Department of Health and Human Service (HHS) Centers for Medicare & Medicaid Services (CMS), under which hospital licensure is affected by accreditation outcomes. Devers, Pham, and Liu (2004) conducted a study of administrators in 12 community hospitals and found that hospitals' major patient-safety initiatives primarily were intended to meet The Joint Commission's standards and requirements, leading to the conclusion that The Joint Commission's accreditation process is a principal driver of hospitals' patient safety initiatives.

However, the extent to which compliance with NPSGs truly is associated with safety and improved outcomes is relatively unknown (Miller et.al, 2005). To date, The Joint Commission has published limited research examining the relationship between the implementation of NPSGs and other quality-driven organizations' patient outcomes. Specifically, no research has been published that examines the influence of the implementation of The Joint Commission's NPSGs and use of standardized outcomes such as the AHRQ's PSIs. The Joint Commission introduced six original NPSGs in 2003, and over several years introduced 10 additional goals.

To evaluate its progress and how well hospitals were complying with the new goals, The Joint Commission released annual compliance data. The data reflect hospital compliance with the NPSGs to be low and inconsistent. It is noteworthy that as new goals were added, non-compliance percentages increased. A complete, in-depth discussion of noncompliance with the NPSGs can be found in Chapter 2. Given the growing emphasis on patient safety and the increasingly complex nature of healthcare, it is critical to

determine whether differences in preventable adverse events among Joint Commission accredited, acute care hospitals are reflective of differences in organizational systems and processes implemented in those hospitals.

Purpose

The purpose of this exploratory study is to examine the relationship between healthcare system characteristics and patient safety practices as measured by implementation of the NPSGs, and whether these variables are associated with the AHRQ's PSIs in Joint Commission accredited, acute care hospitals in the United States. The study also seeks to identify which hospital structural characteristics—such as teaching status, geographic location, and bed size—are related to implementation with NPSGs. For purposes of this study, four of 21 the AHRQ's PSIs will be used.

Donabedian's conceptual model will be used to guide the framework for examining quality and patient care safety in this study (Donabedian, 1997). His structure-process-outcome (SPO) paradigm long has served as a unifying framework for examining health services and assessing patient outcomes (Donabedian, 1980). Little evidence exists, however, that patient safety practices, as evaluated using accreditation criteria, are related to the achievement of patient safety outcomes (Thornlow & Merwin, 2009).

Significance and Projected Outcomes

Consequences of medical errors are both tangible and intangible. Tangible consequences are evidenced in the estimated \$19 billion spent per year due to errors. The tangible consequences of medical errors are reflected by loss of life, patient harm, and lack of public trust. The perception of quality and safe healthcare is affected by public

reporting, and it influences access and healthcare decisions. Results of The Joint Commission triennial accreditation survey is public and used by CMS to measure participation in Medicare.

Findings from this study contribute to understanding the predictors of patient safety outcomes. Such information may be used by healthcare leaders to improve patient outcomes in hospitals. Understanding the relationship between hospital system characteristics and implementation of NPSGs and the AHRQ's PSI outcomes will help advance the science of healthcare quality and safety measurements, and inform decisions on the use of healthcare resources.

Questions remain as to whether data currently collected by various safety agencies are sufficient to measure quality outcomes and help improve patient safety. Analysis of outcome data and understanding of the relationship between hospital systems and processes may be useful to healthcare executives in designing patient safety solutions. Since the use of data to influence operations and incorporating various safety practices comes from domains outside of healthcare such as the aviation industry, it is to be hoped that the study of adverse outcomes may influence an organization's learning environment (Shojana et al., 2001).

Findings from this study provided empirical data that may support healthcare organizations in efforts to improve quality and safety in healthcare.

The results of this study may contribute to what is known about successful quality improvement efforts in hospitals. Knowledge gained from this study may provide evidence about which systems or processes are related to quality patient outcomes and

the characteristics of acute care hospitals that utilize patient safety practices. It should have a far-reaching impact on the delivery of care and approaches to quality and safety measures.

Assumptions

Assumptions related to this study are the following: The use of secondary data sets provided by The Joint Commission accurately reflect implementation of NPSGs. The patient-level discharge data from the 2010 Nationwide Inpatient Sample (NIS), a subset of the Healthcare Cost and Utilization Project (HCUP), accurately reflect the patient conditions for each of the hospitals reported. Further, structural differences in the characteristics among Joint Commission accredited, acute care hospitals—their structures and processes—are representative of all U.S. hospitals, and the relationships observed in the study findings are generalizable to reflect adverse events in acute care hospitals. The independent variables are fixed and are measured without error, and a relationship exists between the independent variable (hospital characteristics) and dependent variables (patient outcomes and NPSGs) (Pedhazur, 1984).

Limitations

Limitations of this study include those related to study design and the sampling methodology known to affect the generalizability of study findings. The findings from this study may be limited to U. S. healthcare organizations with particular characteristics and locations. Some limitations are related to using secondary administrative data to study the quality of care delivered by healthcare providers. There also is an inherent potential for bias in self-reported, administrative data (Rantz & Connolly, 2004), outdated

data, coding inaccuracy or bias, missing data elements, under-reporting or incomplete reporting due to fear of reprisal, lack of clinical detail, or lack of event timing (Iezzoni, 1994; Lawthers et al., 2000; Miller, Elixhauser, Zhan, & Meyer, 2001; Weingart et al., 2000; Zhan & Miller, 2003a).

Research Questions

This study addresses the following specific research questions:

1. Is there a relationship between national patient safety goal (NPSG) compliance and the Agency for Healthcare Research and Quality (AHRQ) patient safety indicator (PSI), risk-adjusted hospital outcome rates for decubitus ulcer, postoperative sepsis, and central venous catheter bloodstream infection in acute care hospitals accredited by The Joint Commission?
2. What is the relationship between hospital characteristics and NPSG compliance in acute care hospitals?
3. What is the relationship between hospital characteristics and the AHRQ's PSI outcome rates of diabetes decubitus ulcer, postoperative sepsis, and central venous catheter bloodstream infection in accredited acute care hospitals?
4. What are the independent predictors of adverse hospital AHRQ's PSIs for decubitus ulcer, postoperative sepsis, and central venous catheter bloodstream infection in accredited acute care?

Conceptual Framework

There are numerous models to consider when exploring patient safety. According to the AHRQ (2012b), Donabedian's model is the standard for quality measurement in

healthcare. His SPO paradigm long has served as a unifying framework for examining health services and assessing patient outcomes (Donabedian, 1980). Donabedian (1980) was the first to introduce the SPO model, which is considered the foundation for modern healthcare quality research. His framework has influenced healthcare quality and has become the accepted archetype for outcomes research (Perrin, 2002). Donabedian's model was used to guide the framework for examining quality and patient care safety in this study.

Donabedian developed the SPO framework to assess and evaluate the quality of care from sciences. His model infers that three elements—structure, process, and outcome—are the rudimentary elements indicating the quality of care or lack thereof. Further, Donabedian's model draws causal linkages among structure, process, and outcome. Guidance from this approach can inform and infer conditions that either has salutary or adverse effects on patient outcomes (Donabedian, 1988).

Many researchers contend that Donabedian's framework continues to influence how the role of the nurse is viewed in relation to adverse patient outcomes (White & McGillis Hall, 2003), and that it remains relevant today for quality improvement studies linking structure and outcomes (Lee, Chang, Pearson, Kahn, & Rubenstein, 1999). Donabedian's work has been labeled the “precursor of modern outcomes research” (Moorhead, Johnson, Maas, & Swanson, 2008, p. 3). While many different types of quality measurements exist, nearly all fall into one of the three categories—structure, process, or outcome—in the Donabedian model. This model has set the framework for

most contemporary quality measurement and improvement activities (The Joint Commission, 2012).

Donabedian (1980) recognized that defining *quality* is particularly arduous and challenging because the quality is not a uniform property. Rather, it is comprised of a number of varying characteristics. Multiple formulations of definition are both possible and legitimate, depending on where the issues are located in the system of care, and the nature and extent of areas of responsibility. Two definitions related to his interpretations of quality have been offered. First, Donabedian defined quality as a reflection of values and goals current in the medical-care system and larger society. Second, he defined high-quality care as the delivery of services that are appropriate, efficient, and effective, resulting in the best outcomes for patients (Donabedian, 1980). Donabedian's definition of quality is congruent with a published definition of quality from the IOM, which noted that quality is the degree to which health services increase the likelihood of desired health for individuals and populations, and are consistent with current professional knowledge (Kohn et al., 2000).

Donabedian provided further insight into this three-part approach model to assessing quality by defining the components of the framework. *Structure* is defined as the characteristics of the care setting, which includes the organizational structure (Donabedian, 1980). Structure refers to a healthcare facility's organization and resources, such as hospital bed size and ownership. *Process* is defined as the detailed activities that constitute care delivery, such as preventive measures, treatment of illness, and patient education (Donabedian, 2003). Process refers to actual techniques used to treat patients

such as surgery and requirements outlined in The Joint Commission's NPSGs. *Outcome* is defined as the desirable or undesirable changes in individuals and populations that can be attributed to healthcare (Donabedian, 2003). Outcome refers to the consequences of a patient's interaction with the healthcare system or the desired result, such as postoperative sepsis rates, central venous catheter infection rates, and reduced rates of patient death.

Donabedian (1988) attributes the effectiveness of this approach to a causative linkage. He contends that to be effective, quality measures should be developed with a flow, maintaining the three prongs of the quality model. Quality is not a straight linear relationship, but an interchange between the effects of structure and process on outcome. Donabedian (1980) argues that a good organizational structure influences conditions for good or improved processes, and good processes subsequently cultivate better patient outcomes. His approach provides a solid underpinning and context in which to consider quality-improvement efforts. From the standpoint of patient safety, Donabedian's model fosters an examination of how risks and hazards are embedded within the structure of patient care and potentially lead to adverse outcomes (Donabedian, 1980).

Definition of Terms

Conceptual and operational definitions of terms used in this study, as reflected in Table 1, are:

Patient Safety Indicators

Operational definition: Twenty-one measures that screen for adverse events using administrative data found in the discharge record that patients experience as a result

of exposure to the healthcare system, such as teaching status, ownership, and size (Healthcare Cost and Utilization Project, 2011b).

Conceptual definition: A set of indicators providing information on potential in-hospital complications and adverse events following surgeries, procedures, and childbirth (AHRQ, 2010c).

General Physiological Definitions of the Five Selected PSIs

Selected infections due to medical care or surgical procedures: The rate of potentially preventable infections, primarily those related to intravenous lines and catheters, excluding patients who are immunocompromised and otherwise more susceptible to infection.

- **Central venous catheter bloodstream infection:** Patient has a fever, chills, or hypotension as well as positive laboratory cultures from two or more blood samples drawn on separate occasions that are not related to infection at another site and do not reflect contamination. (Gastmeier & Geffers, 2006).
- **Postoperative sepsis:** The body's systemic over-response to infection, disrupting homeostasis through an uncontrolled cascade of inflammation, coagulation, and impaired fibrinolysis (Sepsis Alliance, n.d.).

Decubitus ulcer: Any lesion caused by pressure, resulting in damage to underlying tissues (American Nurses Association, 2013).

Operational definitions for three AHRQ risk-adjusted PSIs in acute care hospitals applied throughout the study were derived from the AHRQ's technical definitions (AHRQ, 2013b):

Table 1

Operational Definitions of Patient Safety Indicators

	Description	Numerator	Denominator	Exclusions
PSI #7 Rate of Central Venous Catheter Bloodstream Infections	Central venous catheter-related bloodstream infections (secondary diagnosis) per 1,000 medical and surgical discharges for patients ages 18 years and older or obstetric cases.	Discharges, among cases meeting the inclusion and exclusion rules for the denominator, with any secondary ICD-9-CM diagnosis codes for selected infections.	Surgical and medical discharges for patients age 18 years and older or MDC 14 pregnancy, childbirth, and puerperium). Surgical and medical discharges are defined by specific DRG or MS-DRG codes.	Excludes cases with a principal diagnosis of a central venous catheter-related bloodstream infection, cases with a secondary diagnosis of a central venous catheter-related bloodstream infection present on admission, cases with stays fewer than two days, cases with an immunocompromised state, and cases of cancer.
PSI #13 Postoperative Sepsis Rate	Cases with secondary postoperative sepsis diagnosis per 1,000 elective surgical discharges of patients age 18 years and older.	Discharge cases meeting the inclusion and exclusion rules for the denominator, with any secondary ICD-9-CM diagnosis codes for sepsis.	Specific DRG or MS-DRG codes for elective surgical discharges including patients 18 years and older, ICD-9-CM procedure codes for an operating room procedure.	Cases excluded: principal dx of sepsis, secondary dx of sepsis on admission, principal dx of infection, secondary dx of infection present on admission, immunocompromised state, cancer, OB discharges, and cases with less than four-day stays.
PSI #3 Decubitus Ulcer	Cases of decubitus ulcer per 1,000 discharges with a length	Discharges with ICD-9-CM code of decubitus ulcer in any	All medical and surgical discharges age 18 years and older defined by	ICD-9-CM code of decubitus ulcer as principal diagnosis or if present on admission with a

Description	Numerator	Denominator	Exclusions
of stay more than four days.	secondary diagnosis field among cases meeting the inclusion and exclusion rules for the denominator.	specific DRGs, with the Agency for Healthcare Research and Quality's identified exclusions.	diagnosis of hemiplegia, paraplegia, quadriplegia, spina bifida, anoxic brain injury, debridement of a pedicle graft, admission from a long-term care facility, or transfer from an acute care facility, MDC 9 (skin, subcutaneous tissue, and breast) or MDC 14 (pregnancy, childbirth, and puerperium) and with a length of stay of less than four days.

Note. Definitions from Agency for Healthcare Research and Quality, 2012c. PSI = patient safety indicator. ICD-9-CM = International Classification of Diseases, 9th Revision, Clinical Modification. MDC = major diagnosis category. DRG = diagnosis related group. MS-DRG = Medicare severity diagnosis related group. Dx= diagnosis. OB = obstetrics.

National Patient Safety Goals

The operational and conceptual definitions, as reflected in Table 2, are:

Operational definition: The organization's decision report will reflect a check mark if the organization has met the applicable NPSG. An "x" is noted if the organization has not met the NPSGs (The Joint Commission, 2013).

Conceptual definition: A series of specific actions that accredited organizations are expected to take to prevent medical errors. Requirements of accredited healthcare organizations as part of The Joint Commission accreditation process to focus on a series of specific actions to prevent medical errors (The Joint Commission, 2013).

Table 2

Descriptions of 2011 Hospital National Patient Safety Goals (NPSGs)

NPSG	Description
Identify Patients Correctly NPSG.0.01.01 NPSG.01.03.01	Use at least two ways to identify patients. Make sure that the correct patient gets the correct blood when blood is administered.
Prevent Infection NPSG.07.01.01 NPSG.07.03.01 NPSG.07.04.01 NPSG.07.05.01	Use hand-cleaning guidelines from the Centers for Disease Control and Prevention or the World Health Organization. Set goals for improving hand cleaning. Use proven guidelines to prevent infections that are difficult to treat. Use proven guidelines to prevent infection of the blood from central lines. Use proven guidelines to prevent infection from surgery.
Prevent Mistakes in Surgery UP.01.01.01 UP.01.02.01 UP.01.03.01	Make sure that the correct surgery is done on the correct patient and at the correct place on the patient's body. Mark the correct place on the patient's body where the surgery is to be done. Pause before the surgery to make sure that a mistake is not being made.

Note. Definitions from The Joint Commission, 2013.

Teaching Status and Location

Operational definition: Defined as rural, urban teaching or urban nonteaching if hospital meets one of the following criteria: member of the Council of Teaching Hospitals of the Association of American Medical Colleges, approved residency by American Medical Association, or a ratio of full-time equivalent interns and residents to beds of 0.25 or greater (HCUP, 2013).

Conceptual definition: A hospital's teaching status and location as defined in the most recent Medicare Cost Report or as defined by the American Hospital Association (AHA).

Bed Size

Operational definition: Represents total inpatient hospital beds, categorized by HCUP as small, medium, or large specific to the region, location, and teaching status as shown in Table 3.

Conceptual definition: The number of beds that a hospital has been designed and constructed to contain or staff.

Registered Nurse Staff Hours per Average Patient Discharge

Operational definition: Registered nurse (RN) staffing includes all RN full-time equivalents (FTEs) multiplied by 2,080 annual work hours, then divided by the number of average patient discharge (APDs). This variable was computed using AHA variables of FTEs, RNs, and APDs (American Hospital Association, 2013).

Conceptual definition: A variable in the AHA data set computed from the number of RNs and the number of average hospital discharges. (AHA, 2013).

Geographic Region

Operational definition: The region variable was coded into four regions: Northeast, Midwest, South, and West.

Conceptual definition: The geographical location of a hospital concerning the geography of a particular region (AHRQ, 2012b).

Table 3

Healthcare Cost and Utilization Project Bed Size Categories

Geographic Region Location-Teaching Status	Hospital Bed Size Categories		

Geographic Region Location-Teaching Status	Hospital Bed Size Categories		
NORTHEAST	Small	Medium	Large
Rural	1-49	50-99	100+
Urban Nonteaching	1-124	125-199	200+
Urban Teaching	1-249	250-424	425+
MIDWEST			
Rural	1-29	30-49	50+
Urban Nonteaching	1-74	75-174	175+
Urban Teaching	1-249	250-374	375+
SOUTH			
Rural	1-39	40-74	75+
Urban Nonteaching	1-99	100-199	200+
Urban Teaching	1-249	250-449	450+
WEST			
Rural	1-24	25-44	45+
Urban Nonteaching	1-99	100-174	175+
Urban Teaching	1-199	200-324	325+

Note. Categories and descriptions from the Healthcare Cost and Utilization Project, 2013.

Summary

This chapter explored the beginning of the quality and patient safety movement in healthcare in the United States. It examined the ill effects and dangers that consumers seeking healthcare services continue to encounter, even after a call to action on the national front to address patient safety. Patient safety was elucidated, and conceptual and operational definitions were described. The background of patient safety efforts, need for the study, study's significance and purpose, and assumptions and limitations were discussed. Chapter 2 presents the current and relevant review of the literature related to structural elements and processes that have been shown to be associated with patient safety outcomes in acute care hospitals.

CHAPTER 2: LITERATURE REVIEW

Although studies have shown associations between characteristics of hospital systems, such as teaching status, ownership status, nurse staffing, and patient safety outcomes (Ayanian & Weissman, 2002; Devereaux et al., 2002; Kupersmith, 2005; Stanton, 2004), few have examined specifically how these characteristics influence the use of patient safety practices. Further, even fewer studies have examined the impact of patient safety practices on patient outcomes. Analysis and clear understanding of the association between structural characteristics, patient safety practices, and patient outcomes within hospital systems is a prerequisite to designing patient safety solutions (Shojana et al., 2001).

Rationale for Study

The purpose of this exploratory, descriptive, correlational study was to examine the relationship between healthcare system characteristics and implementation of national patient safety goals (NPSGs). It also examined whether patient safety practices are associated with patient safety outcomes in acute care hospitals in the United States. It sought to identify which characteristics of acute care organizations are linked more frequently to the implementation of NPSGs and whether there was an association with the Agency for Healthcare Research and Quality (AHRQ) patient safety indicator (PSI) outcomes and patient safety practices. Donabedian's (1980) conceptual model was used

to guide the theoretical framework for examining quality and patient care safety. His structure-process-outcome (SPO) paradigm has long served as a unifying framework for examining health services and assessing patient outcomes (Donabedian, 1980). Little evidence exists, however, that patient safety practices, as evaluated by using accreditation criteria, are related to the achievement of patient safety outcomes (Thornlow & Mervin, 2009).

A comprehensive literature search was conducted using the keywords “patient safety,” “patient safety indicators,” “adverse events,” “national patient safety goals,” “patient safety outcomes,” and other related keywords such as “patient safety culture.” Databases searched were Ovid OLDMEDLINE®, Ovid MEDLINE®, Cumulative to Nursing and Allied Health Literature, ProQuest, PsychINFO, Cochrane Database of Systemic Reviews, Health & Psychosocial Instruments, Dissertation Journals @Ovid, the AHA, Quality Interagency Coordination Task Force, Database of Abstracts of Reviews of Effects, and The Joint Commission. The following federal agency websites were reviewed: the U.S. Department of Veterans Affairs, CMS, U.S. Department of Defense (DOD), and AHRQ. Websites for grassroots lobbying organizations such as Leapfrog and Emergency Care Research Institute also were reviewed. In addition, general and related references in Google Scholar search engine were searched using the keywords “patient safety,” “patient safety outcomes,” “medical error,” and “medical adverse events.”

The search was limited to human subjects studies published from 1998 to 2014. However, classic studies related to patient safety and quality before 1998 also were included. Reference lists of articles were reviewed, and additional pertinent articles

retrieved. Inclusion criteria identified for the search included primary research, qualitative, mixed methods, and quantitative studies. Also included in the search was any article discussing patient safety, medical errors, leadership support, evidenced-based practice, communication, just culture, nurse-manager support, and patient safety climate. Articles were excluded based on three criteria: (1) lack of relevance to the field of patient safety in hospitals, (2) relevance to the field of patient safety, but lack sufficient information and detail, and (3) outdated information.

In total, 147 articles were found using the specified keyword boundaries. Duplications were identified and removed. Abstracts were scanned for relevance to the study. The result showed that there had been little research performed in the area of patient safety particularly exploring the relationship with patient safety practices and outcomes.

This chapter will synthesize the literature, specifically Donabedian's theoretical framework, and review relevant literature related to organizational characteristics and accreditation processes that influence patient outcomes in acute care hospitals. It is divided into three sections. First, the development and use of the theoretical framework, including constructs within the framework, will be explored. Second, the overall literature on patient safety practices, specifically The Joint Commission's NPSGs, will be reviewed. Finally, third, relevant literature related to structural elements and processes associated with patient safety outcomes in acute care hospitals, specifically the AHRQ's PSIs, will be reviewed.

Conceptual Framework

Donabedian (1980) attributes the effectiveness of his approach to measuring quality to a causative linkage. He contends that to be effective, quality measures should be developed with a flow, maintaining the three prongs of the quality model. Donabedian defined the quality prongs as follows (Donabedian, 1969; Donabedian, 1988). *Structure* consists of the organization of “instrumentalities” of care (Donabedian, 1969, p. 1833) or the attributes of the setting where care occurs. *Process* of care is the appraisal of care and the elements of care. *Outcomes* of care are the effects of care delivery on the patient.

Quality is not a straight linear relationship, but an interchange between the effects of structure and process on outcome. Donabedian (1980) argues that a good organizational structure influences conditions for good or improved processes, and good processes subsequently cultivate better patient outcomes. His approach provides a solid underpinning to consider quality-improvement efforts. Donabedian’s model fosters an examination of how risks and hazards are embedded within the structure of patient care and potentially lead to adverse outcomes (Donabedian, 1988). The three prongs to Donabedian’s framework are discussed in detail.

Structure

Structures incorporate the conditions and elements under which care is provided Donabedian’s (1988). It is the attributes of the setting where care is provided, and it is defined as the instrumentalities of the organization. It includes organizational characteristics such as ownership, bed size, and teaching status (Donabedian, 1969). Structure may also include “administrative and related processes that support and direct

the provision of care ... concerned with such things as ... the administrative structure and operations of programs and institutions providing care” (Donabedian, 1966, p. 695).

Structure within a hospital influences the occurrence of quality-related problems.

Structures of care within the conceptual model proposed in this study, shown in Figure 1, include organizational characteristics and administrative structural variables related to patient safety. They are based on Donabedian’s definition of structure.

Donabedian’s concept of structure encompasses stable characteristics of the system of care delivery, including staffing, equipment, and facilities and how those elements are organized to deliver care. Formalized organizational routines, such as the process of passing patient information across caregiver work shifts, are included in an organization’s structure. System improvements are considered a change in structure. Structure data are, therefore, essential to system-level organizational learning.

Structural variables in this study are (1) hospital bed size, (2) region, and (3) location and teaching status (teaching or nonteaching). Because of the potential impact or suggested relations found in patient safety literature, these variables will be considered confounding variables for this study. The selected variables directly affect patient safety, according to the model. However, they indirectly affect patient outcomes about the importance of healthcare structure. This relationship is in line with Donabedian, who conceived structure as a driving force for later care processes and ultimately for health outcomes (Donabedian, 1966).

Donabedian’s commentary on structure focused on physical structure, facilities, and provider qualifications. Most modern accreditation and quality organizations, such as

The Joint Commission, historically have viewed the structure largely from Donabedian's perspective (AHRQ, 2007). However, as the study of organizational characteristics and behavior has evolved, the understanding of organizational characteristics and management capabilities that drive quality improvement in healthcare remains underdeveloped. Organizational behavior—a multidisciplinary field including contributions from psychology, sociology, and economics studying individual and group dynamics within an organization—has demonstrated that people and organizational arrangements are key determinants of quality (AHRQ, 2007).

Process

The method in which healthcare providers deliver care—a series of actions, changes, or functions involved in the delivery of care and subjected to professional judgment that affects an outcome—is considered process (Donabedian, 1966; Stone et al., 2007). Process measures reflect common practices, apply to a variety of healthcare settings, and have proper inclusion and exclusion criteria. It refers to the actions involved in care delivery and the ways in which healthcare delivery is provided (Donabedian, 1966; Stone et al., 2007). Insertion of central intravenous catheters, timing of administration of antibiotic prophylaxis in surgical patients, vaccination rates for healthcare workers and patients and hand-washing protocols are all considered process measures (Stone et al., 2007).

Essentially, process is viewed as being under the control of the structure of an institution. Processes can be analyzed at various levels of an organization and readily observable. Donabedian (1966) asserts that processes are limited by the structures in

which they operate. Few healthcare organizations have effectively addressed the structures that hinder their progress toward assessing quality. However, healthcare organizations focus a copious amount of attention on improving care services, patient outcomes, and the safety and quality of the care provided. Process quality measures evaluate the method by which healthcare is provided. The measures reflect the procedures, tests, surgeries, and other actions provided for a patient during treatment (Donabedian, 1966).

To illustrate, The Joint Commission process measures, commonly called accreditation standards, require hospitals to conduct periodic risk assessments in timeframes defined by the hospital for multidrug-resistant organism acquisition and transmission, measure surgical-site infection rates for the first 30 or 90 days following surgical procedures based on National Healthcare Safety Network procedural codes, and perform a time-out immediately prior to an invasive procedure (The Joint Commission, 2009). NPSG compliance is required of Joint Commission accredited hospitals (Joint Commission, 2003). These measures, if followed, significantly improve patient outcomes.

A process measure required by CMS calls for facilities to track how often pneumonia patients receive blood cultures before receiving doses of antibiotic. This process affects the infection control rates of hospitals by preventing distortion of cultures and can improve patient outcomes (Centers for Medicare & Medicaid Services, 2010). Processes will be studied in the conceptual framework in for this by exploring compliance with the 2011 Joint Commission's NPSGs. The foundational quality elements

of Donabedian's SPO conceptual framework fit well with this research study.

Organizational characteristics such as accreditation status, hospital size, and teaching status represent structure implementation of NPSGs, which represent process. AHRQ's PSIs represent patient outcomes. Donabedian's organizational structure attributes will be applied in this study using a bivariate model to assess the relationship between organizational characteristics of accreditation status and four outcome variables.

Outcomes

The third component in Donabedian's (1988) framework is outcomes and refers to changes in health status that can be attributed to that care. Outcomes demonstrate the effects of care on the health status of patients and populations (Donabedian, 1988).

Outcomes of the provision of healthcare generally are used as an indicator of quality in health services research. However, there are several limitations to simply measuring outcomes (Donabedian, 1966). Outcomes reflect both the ability of healthcare providers to achieve certain results under any set of given conditions and the degree to which best-known practices have been applied. Outcomes also are affected by other extraneous factors that must be considered in making valid conclusions. Yet, outcomes remain the best validation for the measurement of the quality of healthcare (Donabedian, 1966).

Patient outcomes that were expected to be affected by structure and process variables in this study are postoperative sepsis rate, decubitus ulcer rates, and central venous catheter bloodstream infections. These outcome variables were chosen from among other outcomes of healthcare delivery because of their direct measures of patient safety practices congruencies with NPSGs. Outcome measures frequently are performed

by hospitals for internal quality improvement purposes. Further, outcome measures demonstrate the effect that structure and process measures have on patient care and measure the result of the entire care process.

Donabedian's framework (Donabedian, 1966) has guided more than five decades of quality research. The SPO model commonly has been used in healthcare quality assessment and research. However, adaptations have been made to the original model, particularly variations largely related to the process and outcomes realm by some researchers to take a closer look at outcomes (Mitchell, Ferketich, & Jennings, 1998; Aiken, Sochalski, & Lake, 1997). Mitchell et al. (1998) adapted Donabedian's conceptual framework with more focus on outcomes, called the Quality Health Outcomes Model. Aiken et al. (1997) adapted Donabedian's theoretical framework using conceptual elements of structure, process, and outcomes to study nursing outcomes.

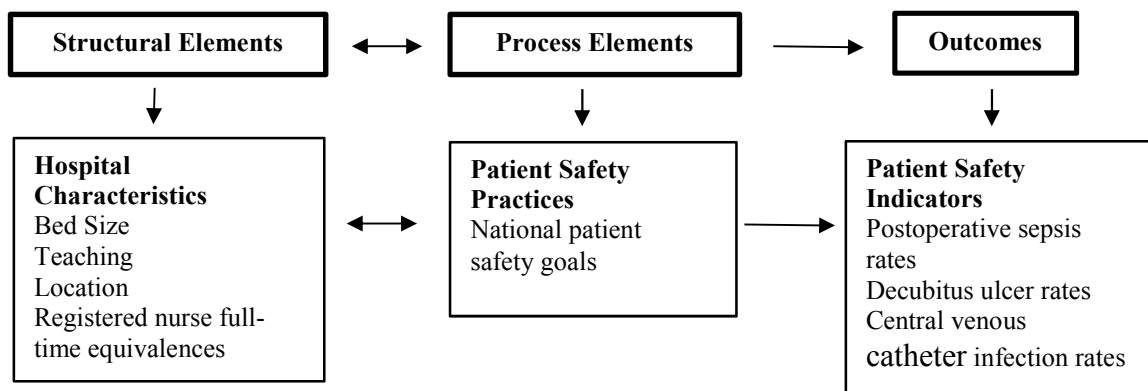


Figure 1. Donabedian's conceptual framework from Donabedian, 1966.

Experts contend that in selecting patient safety outcome measures, the event must be deemed preventable and measures must be clinically meaningful. The measures should

address inadequacies in structure, process, and outcomes of care with the ability to foster improvements (Zhan et al., 2005).

Patient Safety Movement

Examining how and why medical errors and adverse events occur historically has been focused on individual medical professionals. The tendency to blame individuals has perpetuated a culture of punishment and individual accountability among medical professionals (Hoff & Sutcliffe, 2006). Patient safety must be examined at the organizational level because of the growing belief that organizational culture shapes the facets of hospital performance, including safety. Organizational structure plays a critical role in the delivery of safe, quality healthcare.

More than 25 years ago, the Institute of Medicine (IOM) reports stimulated public debate surrounding patient safety and gave birth to an array of national and regional efforts to address the issue. A swelling of new agencies focusing on healthcare improvements was spawned, and a redirection to safety was seen at established bodies such as the AHRQ, The Joint Commission, IOM, CMS, The Leapfrog Group, Institute of Safe Medicine Practices, and the IHI. These organizations began gathering and analyzing data to develop measures to improve the quality and safety of healthcare (Leape & Berwick, 2005).

The Joint Commission, the leading healthcare accrediting body in the United States, responded to the report by issuing new patient safety accreditation standards, namely NPSGs, in 2003. The Joint Commission approved and implemented the first set of six NPSGs in 2003 (The Joint Commission, 2010b). In addition to developing NPSGs,

The Joint Commission demonstrated its commitment to patient safety with the revision of all its standards in 2003. More than 50% of the revised hospital accreditation standards focused on patient safety (The Joint Commission, 2010b). In each of the preceding years, new safety goals have been added annually to address significant safety issues (The Joint Commission, 2009). Continuing its focus on patient safety, The Joint Commission adds or revises NPSGs each year.

The National Quality Forum (NQF) responded to the IOM report in 1999 by revising its mission to develop and implement national strategies for healthcare quality measurement and reporting (National Quality Forum, 2010). Broad representation from a variety of partners—including national, state, regional, and local groups representing consumers, public and private purchasers, employers, healthcare professionals, provider organizations, health plans, accrediting bodies, labor unions, supporting industries, and organizations involved in healthcare research—support the effectiveness of its efforts. The NQF developed seven priority areas and goals in 1999. Improving safety of the U.S. healthcare delivery system, and creating and implementing a national strategy for healthcare quality reporting and measurement was a majority priority (NQF, 2010). In 2009, the NQF also created a list of never events and a requirement that hospitals that participate in the federal Medicare and Medicaid programs report their performance regarding this list. (NQF, 2010).

CMS also has participated in the safety movement. Initially, CMS responded by developing 27 quality measures for hospitals, 24 clinical process of care measures, and three clinical outcome measures (CMS, 2010). A new policy was implemented in 2008

that effects hospital reimbursement by denial of payment for admissions complicated by selected adverse events. Private healthcare payers are following suit by adopting similar policies (Wachter, Foster, & Dudley, 2008). Stakeholders such as CMS, individual providers, and healthcare insurers believe that nonpayment provides an incentive to prevent costly adverse events.

The AHRQ, formerly known as the Agency for Health Care Policy and Research, was developed as the health services research arm of the HHS with a focus on research, safety, and healthcare quality (AHRQ, 2012b). The research sciences have been heavily influenced by the AHRQ's contributions to healthcare quality and safety, including identification of a set of quality indicators. The AHRQ's 27 PSIs are a subset of quality indicators the agency has developed. Included in this set are 20 provider-level indicators (AHRQ, 2012b).

Even with efforts by numerous quality agencies, it is evident that there is room for improvement. Fourteen years after the IOM report, the data remains grim. According to the IHI (2010), 15 million adverse incidents occur in U.S. hospitals each year. One in 10 patients encounters an adverse event and dies because of the incident (Healthgrades, 2010). About 1 million patient safety incidents occurred from 2006 to 2008 among Medicare patients with an associated cost of \$8.9 billion. The financial burden and number of patients affected by adverse events remain virtually unchanged over the past 14 years.

Patient Safety

A fundamental principle of healthcare is patient safety. Patient safety is conceptualized as a set of practices affected by organizational leaders at various levels and caregivers focusing on the reduction of medical errors and the avoidance, prevention, and amelioration of adverse outcomes or injuries stemming from the processes of healthcare delivery (Cooper, Gaba, Liang, Woods, & Blum, 2000). Patient safety is not a policy, program, or procedure (Sammer, Lykens, Singh, Mains, & Lackan, 2010). Rather, it is a value within an organization that guides individuals as they solve problems, adjust to change, and deal with relationships (Choi, Bakken, Larson, Du, & Stone, 2004). It refers to the extent to which individuals and groups commit to personal responsibility for safety, act to preserve safety, actively strive to learn and adapt, and modify behavior based on lessons learned from mistakes (Sammer et al., 2010).

An organization driven by patient safety recognizes the inevitability of error, considers the impact of human factors on errors, and proactively seeks to identify and minimize latent threats (Reason, 1998). Reason's (1998) conceptual approach to examining errors is congruent with other findings about medical errors and contends that errors are not based solely on individual attributes, but also are influenced by systemic factors such as structural characteristics.

Kohn et al. (2000) declared in the 1999 IOM report that most medical errors do not result from individual recklessness or actions of a particular group. Rather errors are caused by faulty systems, processes, and conditions that lead people to make mistakes or fail to prevent them. Berntsen (2004) contends that individuals such as nurses who are in

direct contact with patients have been the focus of error reduction strategies. However, this is a serious flaw because the individual approach has no consideration of systemic contributions to errors. Reason (2000) contends that 95% of errors in an organization are due to systemic problems, and 5% are due to individuals. Reason's systems approach recognizes that individuals are fallible and errors are to be expected (Reason, 2000). Further, a systems approach actively seeks to identify how and why defenses failed within the system. Focus is placed on the structural elements under which individuals work, and errors are viewed as consequences rather than causes. However, the conditions under which humans work can be influenced and re-engineered (Etchells, Lester, Morgan, & Johnson, 2008). Shared accountability is critical in developing a patient safety culture that will affect patient outcomes.

Within healthcare institutions, several complex processes lend themselves to potential errors. However, numerous layers of protection exist to prevent errors. There are processes that are engineered and relied upon for error prevention such as alarms, the establishment of policies and procedures, AHRQ quality indicators such as PSIs, and regulatory requirements through The Joint Commission for error prevention.

There are also structural influences that affect errors, such as hospital bed size, teaching status, and geographic location. Ideally, all of these layers would be intact. In reality, there are weaknesses or gaps like slices of Swiss cheese (Reason, 1998). According to Reason's error theory (Reason, 1998), an organization's defenses against medical errors are modeled as a series of barriers with individual weaknesses in individual parts of a system that continually vary in size and position. The system as a

whole produces failures when individual weaknesses align, permitting a trajectory of accident opportunity so that a hazard passes through all of the holes and misses all defenses, leading to a medical error. The philosophical perspective of the systems approach calls for not readily blaming or penalizing an individual for an error, rather evaluating the system for failures.

As heightened attention is devoted to quality and patient safety, there is greater demand for data on quality and safety performance of individual providers and organizations healthcare (Kohn et al., 2000; Pronovost et al., 2003). Healthcare organizations have multiple aims for focusing on patient safety: 1) reducing the risk of injury or harm to patients from the structures or processes of care and 2) constructing operational systems designed to minimize the likelihood of errors by maximizing the likelihood of intercepting errors when or before they occur (IOM, 2001).

The provision of healthcare in the United States is vast, high risk, and complex. It consists of various clinical settings, procedures, conditions, and treatment interventions. Effectively measuring adverse events poses enormous challenges for healthcare organizations. Outcome measures at the systemic level, and other safety measures and initiatives currently in use vary considerably in the extent to which they have been validated, in the scope and consistency of their use in facilities and regions, and in the purposes that they were designed to serve (Zhan et al., 2005).

Medical errors have been shown to significantly affect the outcomes of hospitalized patients. Further, it has been suggested that adverse events can be categorized in areas of patient safety focus consistent with those safety initiatives of the

NPSGs implemented by The Joint Commission and PSIs supported by the AHRQ (Department of Health and Human Services, 2008). In one study, investigators examined medical records of 780 randomly selected patients, chosen to represent 1 million Medicare patients discharged from acute care hospitals. The study showed that 128 serious adverse events occurred that caused harm to patients and contributed to the deaths of 12 patients (HHS, 2008). Of the deaths, seven were medication related, two were from bloodstream infections, two were from aspiration, and one was linked to ventilator-associated pneumonia. All 12 deaths were related to areas of focus of The Joint Commission's NPSGs. Five deaths were related to events on the AHRQ's PSIs, and two events were on the NQF list. It was estimated that adverse events contributed to the deaths of 1.5 % or 15,000 per month of the 1 million Medicare patients hospitalized in October 2008 and 44% of adverse medical events were preventable (HHS, 2008; IHI, 2010).

In March 2011, Classen et al. (2011) examined the medical records of 795 patients treated in one of three tertiary hospitals recognized for their efforts to improve patient safety. Investigators found 167 adverse events. Nine adverse events, or 1.1%, attributed to the death of the patient. Nosocomial infection accounted for one event, postoperative pulmonary embolism/deep vein thrombosis accounted for two, and the others were unspecified. None of the deaths was explicitly associated with medication errors, which were the primary causes of death in Medicare patients studied by the Office of Inspector General (James, 2013). Errors involve a combination of sources—human and systemic (Etchells et al., 2005).

Organizations generally have formal reporting processes for internal event reporting (Kohn, Corrigan, & Donaldson, 1999). Written adverse event reporting was developed in the late 1940s and early 1950s (Flanagan, 1954) to identify and capture medical errors. The adverse-event reporting system used by healthcare organizations was fashioned after Flanagan's (1954) critical incident techniques. Flanagan's process involved collecting and analyzing significant facts related to a critical incident. Development of the event reporting system was twofold. It provided a means to identify, capture, verify that an event occurred, and offer a method for evaluating and developing strategies to decrease the risks of reoccurrence of similar events (Sharpe, 2003.)

According to Flanagan (1954) and an IOM report (2004b), medical errors are captured by an organization through two reporting means: written processes and surveillance. Surveillance methods are used to determine whether an adverse event occurred. Large, federal, healthcare systems have adopted a written process as their preferred method of capturing data (IOM, 2004b). However, no unified reporting method has been adopted by all healthcare systems.

Because of the federal government's response to the 1999 IOM report, the AHRQ was allocated \$50 million to spearhead patient safety efforts. The AHRQ and University of California of San Francisco-Stanford Evidenced-Based Practice Center developed PSIs that consisted of 20 hospital-based indicators for medical conditions and surgical procedures. Inpatient discharge data in conjunction with the HCUP is used to cultivate research examining patient safety outcomes, and support the identification of preventable problems and adverse events that are influenced by system-level changes (AHRQ,

2012a). Hospitals, health systems, and other organizations that monitor patient safety performance have increased their use of these indicators (Healthgrades, 2004; Miller et al., 2001; Romano et al., 2003; Rosen et al., 2005).

Research and regulatory agencies alongside the AHRQ are using administrative data to formulate research studies in patient safety. Administrative data sets provide perspectives on patient safety conditions and procedures, which show that adverse event rates vary substantially among institutions and may be linked to characteristics consistent with preventable errors (AHRQ, 2013b). However, additional research in the area of patient safety is warranted to evaluate the reliability and validity of the measures (Merwin & Thomlow, 2006). Analysis of data from the Hospital Quality Alliance national reporting system reveal that performance varies among indicators and hospitals (Jha, Li, Orav, & Epstein, 2005).

Stelfox, Palmisiani, Scurlock, Orav, and Bates (2006) evaluated the effects of the IOM (1999) reports on patient safety publications and research awards, and found a significant increase in the number of publications and awards since the reports' release. Stelfox et al. (2006) contend efforts must be made to shift from a retrospective aspect of accountability to a prospective view. Retrospective accountability is linked closely to practices of praising and blaming. Prospective accountability is a forward-looking, systems approach to the evaluation of medical errors. It emphasizes responsibility in taking preventive steps, represents goal-setting and moral deliberation, and offers shared accountability. Prospective accountability in patient safety suggests a high degree of transparency and analysis to determine the causes of errors (Sharpe, 2003).

While studies have addressed patient safety, overall research in the area largely has been descriptive, assessing the climate of patient care units and individual patient outcomes. Few studies incorporate assessments of organizations' structures and processes in investigating patient outcomes. A significant gap exists in healthcare literature linking patient safety outcomes and objective measurements of selected hospital and unit level characteristics. Progress appears to have been slow in developing an understanding the relationship between patient safety and outcomes. The reasons might be attributed, in part, to a lack of identification of optimal indicators of quality patient care and issues in measuring outcomes and culture (Clarke, 2014). Furthermore, various agencies' patient safety efforts are independent of the other. Therefore, there are no consistent measurements. Hence, there is a clear need for more research to examine the relationship between organizational characteristics and patient outcomes, and development of unified measurements across quality agencies.

Adverse Events

The findings of the 2000 IOM report (Kohn et al., 2000) revealed that 1 million people are injured by errors during treatment at healthcare facilities each year. The report showed that 3% to 4% of hospitalizations had an adverse event with 9% to 14% of those mistakes resulting in death. The study reported that of 30,195 patients, 1,133 adverse events occurred. Of the adverse events identified, 70% of the errors were preventable, 6% potentially were preventable, and 24% were not preventable. Nearly half of the adverse events identified were attributable to negligence (Brennan, Hebert et al., 1991; Brennan, Leape et al., 1991).

Researchers in the Harvard Medical Practice Study found that 18% of patients hospitalized are injured during their courses of stay. Adverse events account for 2.9% to 3.7% of deaths among hospitalized patients as shown in Table 4 (Kohn et al., 2000). Two additional studies (Brennan, Leape et al., 1991; Thomas et al., 2000a) examining medical errors found similar statistics. In a review of more than 15,000 medical records, 2.9% of patients experienced adverse events with 54% of them being preventable and 6% of the events resulting in death (Thomas et al., 2000b). It was revealed in another study by Brennan, Hebert et al. (1991) that 13% of adverse events contributed to the death of the patients while hospitalized (Brennan, Hebert et al., 1991). Further, the likelihood of experiencing an adverse event increases by 6% for each day of a hospital stay (Wachter, 2004).

Table 4

Adverse Events and Hospitalization

Event	Outcome Per Year
Number of Americans who die from medical errors	44,000 to 98,000
Percentage of adverse events for hospitalized patients	2.9% to 3.7%
Number of adverse drug reactions during hospital stays	1.9 million
Rate of adverse drug events among Medicare beneficiaries in ambulatory settings	50 per 1,000 persons
Cost attributable to medical errors	\$19.5 billion
Total cost per error	\$13,000
Annual cost attributable to surgical errors	\$1.5 billion

Note. Data from Kohn et al., 2000 and Shreve et al., 2010.

According to the IHI (2006), 15 million adverse incidents occur in U.S. hospitals each year. One in 10 patients who encounter adverse events dies because of the incidents (Healthgrades, 2010). In 2008, the cost of measurable hospital adverse events in the

United States was \$17.1 billion, constituting 0.72% of the \$2.39 trillion spent on healthcare delivered (Van Den Bos et al., 2011).

In 2010, there were 35.1 million discharges from hospitals. Lengths of stay averaged 4.8 days, and 2.2% of patients died while hospitalized. Hospital death rates declined overall from 2000 to 2010 but saw a 17% rise in the nosocomial infection rate (Hall, Levant, & DeFrances, 2013). Patients who died in hospitals had longer hospital stays than all patients.

Combining the findings and generalizing across 34 million hospitalizations, James (2013) concluded that preventable errors contribute to the deaths of 210,000 hospital patients annually. Weissman et al. (2008) estimate a two-fold increase in medical errors to account for undocumented evidence of adverse events, underreporting, and near misses during hospitalization. Weissman et al. contend that an accurate number of premature deaths associated with preventable adverse events is more than 400,000 per year (Weissman et al., 2008).

Data shows that consequences of adverse events most often include longer lengths of stay, increased costs, and poorer outcomes. In a study conducted by Healthgrades (2014), a convenience sample of 1.4 million patient records from 131 hospitals across 13 states was used. The study examined the relationship between direct hospital costs and patient outcomes for 32 mortality- and complication-based conditions and procedures. Findings showed a direct correlation between adverse patient outcomes and higher direct costs because of increased lengths of stays (Healthgrades, 2014). The findings were consistent with a previous study of 1,047 patients admitted to a large, urban teaching hospital where

17.7% of patients suffered at least one serious adverse event that led to longer hospital stays and increased costs (Andrews et al., 1997).

HHS' Office of the Inspector General found that one in seven Medicare patients are injured during hospital stays and adverse events during the courses of care contribute to the deaths of 180,000 patients every year (Landrigan et al., 2010). The authors of the report estimated that adverse events contributed to the deaths of 1.5 % of the 1 million Medicare patients hospitalized, equating to 15,000 deaths per month or 180,000 per year (Wachter, 2004).

In 2009, preventable medical errors ranked as the sixth-leading cause of death in the United States—an increase from its eighth-ranking in the 1999 IOM report (1999). That makes medical errors the third-leading cause of death in America, behind heart disease and cancer.

Finally, the financial impact of adverse events in 2010 totaled \$19.5 billion (Shreve et al., 2010), and the number of patients affected by adverse events virtually remain unchanged over the past 14 years (HHS, 2010). Therefore, there is an urgent need for continued research in this area.

Organizational Characteristics and Patient Outcomes

Numerous researchers consider adverse event data to be closely related to organizational characteristics, making it a sensitive indicator of the quality of care (Mitchell & Shortell, 1997; Vartak, Ward, & Vaughn, 2008; White & McGillis Hall, 2003). A retrospective review of a statewide database (Brennan, Hebert et al., 1991) examined the relationship of hospital organizational structure with adverse events. The

findings revealed higher complication rates associated with university teaching hospitals. However, ownership, location, size, and percentage of minority discharges were not significant. Further, adverse event rates were lower and occurred more often in rural and larger hospitals. However, the effects of organizational characteristics on patient outcomes vary.

Wan (1992) examined 10 hospital characteristics in relation to outcomes in 85 acute care hospitals in Virginia. Limited relationships with adverse patient outcomes were found. This finding is consistent with Donabedian's conceptual model of quality patient care used for this study (Donabedian, 1980). Donabedian contends that preventable, adverse events often result from process failures that may be related to structural characteristics such as teaching status (Duggirala, Chen, & Gergen, 2004; Romano et al., 2003; Kohn et al., 2000), bed size (Iezzoni et al., 1994), nurse staffing levels (Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2002; Person et al., 2004), or other organizational characteristics of hospitals. When investigating the relationship between hospital characteristics and PSI rates, it is important to account for structural characteristics that can affect processes and outcomes of care.

Hospitals provide structural component that influences the environment, physical setting, and resources for care delivery. Furthermore, the leadership of the organization determines how care will be carried out and is influenced by the overall hospital structure. Researchers have searched for links between hospital organizational structure and outcomes due to the differences in each hospital structure (Hartz et al., 1989). However, few studies illustrate work performed in this area. Various studies have found

that adverse event outcomes have been found to be indicative of variations in structural variables within the healthcare systems (Mitchell & Shortell, 1997; White & McGillis Hall, 2003).

Bed Size

Examining hospital size is an essential factor that provides meaningful data for the nation's smallest hospitals where resources, service volumes, and patient characteristics vary significantly from those of larger hospitals. Some studies have attributed variation in adherence to evidence-based guidelines and practice patterns the hospital size and location specifically, small and rural hospital settings (Goldman & Dudley, 2008).

Understanding how hospital bed size may influence implementation of patient safety practice and adherence to guides becomes critical to the examination outcomes. Most studies that have investigated the relationship between organizational characteristics and patient outcomes have use hospital size as a single unit. As a result, studies using hospital size as a single predictor of patient outcomes have reported varying findings, and have failed to establish a consistent association between hospital size and outcomes such as mortality (Al-Haider & Wan, 1991), preventable conditions, and adverse events (Silber, Williams, Krakauer, & Schwartz, 1992).

A meta-analysis of 16 studies conducted from 1980 to 2010 became the first systematic review of the literature evaluating hospital size and its impact on patient mortality outcomes. Results of this analysis indicate that large hospitals have lower odds of patient mortality compared to small hospitals (Fareed, 2012). Specifically, the

probability of patient mortality in a large hospital compared to a small hospital is approximately 11% less.

Studies with unadjusted mortality rates have even lower overall odds ratio of mortality compared to studies with adjusted mortality rates (Fareed, 2012). Fareed built his study upon a 2008 systemic review of structure-outcome studies of hospitals, and it indicated that structure-outcome variables provided a mixed set of findings that ranged from non-significant to positively significant to negatively significant relationships. In a national study of preventable adverse events, investigators found that large hospitals had the highest incidence of adverse patient safety events, although they had lower incident rates for such events as anesthesia complications, postoperative hip fracture, and abdominopelvic wound dehiscence (Romano et al., 2003).

Another study (Frankenfield, Sugarman, Presley, Helgersen, & Rocco, 2000) found increased effectiveness of hemodialysis, as measured by a greater potassium and urea reduction ratio, in hospitals with larger bed size. Mitchell and Shortell (1997) found the literature to be inconclusive when examining 81 research studies that associated organizational structure or process with mortality. They asserted that adverse events might be a more sensitive marker of healthcare quality than other measures. A similar association between outcomes and nursing was found by Pierce (1997) in a review of literature from 1974 to 1996 using Donabedian's framework. Similarly, in a national study using the 2000 HCUP-NIS data, 10 complex procedures in U.S. hospitals were studied. Elixhauser, Steiner, and Fraser (2003) found unadjusted mortality rates to be

significantly higher at low-volume hospitals for five selected procedures. Hospitals with low-volume also tended to have lower numbers of RNs, pointing to staffing as a factor.

Teaching and Location

There is evidence that suggests that quality of care generally is higher in teaching hospitals than in nonteaching hospitals. The evidence also shows that acute care hospital system characteristics, such as teaching status, influence preventable adverse event rates (Ayanian & Weissman, 2002; Kupersmith, 2005). A study conducted by Rivard et al. (2008) was among the first to compare teaching and nonteaching hospitals using a regression model that incorporated hospital structural characteristics similar to this study.

Using the AHRQ's PSIs and adult, male patient discharges from the Veterans Health Administration (VA) and non-federal hospitals, they examined the likelihood of incurring an event considered as a PSI. Their findings revealed higher PSI rates in major teaching hospitals than in nonteaching hospitals and that PSI events might more likely occur in teaching hospitals compared with nonteaching hospitals (Rivard et al., 2008). Further, results revealed that patients receiving care in non-federal teaching hospitals had higher incidence and higher stratified rates for developing decubitus ulcers and postoperative wound dehiscence (Rivard et al., 2008). In a study conducted by Thornlow and Stukenborg (2006), teaching hospitals had significantly higher rates of infection than rural and urban nonteaching hospitals. Urban nonteaching hospitals had significantly higher rates of infection than rural hospitals. Urban nonteaching hospitals reported statistically significant greater rates of infection than privately owned rural hospitals. Loux, Payne, and Knott (2005) conducted a study of 312 rural hospitals using the NIS

database exploring PSIs. The researchers asserted that small, rural hospitals had significantly lower rates of potential patient safety events than those of large, rural hospitals for three of the 19 patient safety indicators—iatrogenic pneumothorax, infection due to medical care, and postoperative hemorrhage or hematoma.

Two studies using administrative data found higher infection rates as a result of medical care in teaching hospitals compared to nonteaching facilities (Romano et al., 2003; Thornlow & Stukenborg, 2006).

Romano et al. (2003) also reported an association between teaching hospitals and patient safety outcomes in a national study. In that study, investigators found that PSIs were highest in urban teaching hospitals. Vartak et al. (2008) used the 2003 NIS database to assess the impact of teaching status on patient adverse events in a study that included 400 nonteaching, 207 minor teaching, and 39 major teaching hospitals. Findings suggest significantly higher incidence of postoperative deep vein thrombosis and pulmonary embolism as well as postoperative sepsis in teaching hospitals, while a lower probability of developing postoperative respiratory failure was found, demonstrating inconsistencies in the relationship between teaching status and various patient safety outcomes.

In 1991, Brennan, Hebert et al. (1991) examined the relationship of hospital organizational structure with adverse events using a retrospective review of a statewide database. Findings revealed higher complication rates associated with teaching hospitals. However, ownership, location, size were not significant. Thomas and Brennan (2000) contend that patients in major teaching hospitals were less likely to suffer preventable adverse drug events.

Results were varied in studies examining adverse event rates among teaching and nonteaching hospitals. Many investigators reported that nonteaching hospitals experienced lower incidences of adverse events (Brennan, Hebert et al., 1991; Duggirala et al., 2004; Sloan, Conover, & Provenziale, 2000). Patients in major teaching hospitals were more likely to experience adverse events than were those in nonteaching hospitals (Brennan, Hebert et al., 1991). Consistent with Brennan's study (Brennan, Hebert et al., 1991), Duggirala et al. (2004) found that rates of postoperative adverse events were higher in teaching hospitals than nonteaching hospitals. Higher reported postoperative complications were noted in surgical patients receiving care in teaching hospitals compared to nonteaching facilities (Sloan et al., 2000).

A relationship between teaching status and patient safety outcomes has been established through research. The direction of the association is challenging to establish due to empirical evidence related the influence of structural characteristics on patient outcomes being inconclusive. Conversely, the evidence is less clear on whether hospital teaching status affects patient safety. Several studies of potentially preventable adverse events reveal inconsistent findings in comparisons among teaching and nonteaching hospitals (Romano et al., 2003; Thornlow & Stukenborg, 2006; Thornlow & Merwin, 2009). Additional research on the relationship of structural characteristics to adverse events is warranted.

In a large study of 996 hospitals inpatients, Maynard, Every, Chapko, and Ritchie (2000) found that postangioplasty mortality rates were more abundant in rural hospitals among patients with acute myocardial infarction compared to other hospital types. In

addition, in-hospital mortality was lower in high-volume angioplasty in both rural and urban settings-

The finding revealed that patients in urban settings were more likely to receive beta-blockers and aspirin upon arrival and at discharge (Maynard et al., 2000).

Furthermore, it was significantly more likely that patients in urban hospitals have an assessment of the left ventricular function and smoking cessation education provided.

Overall, there were significant differences between care in acute care hospitals, and rural critical-access hospitals.

Conversely, rural critical-access hospitals' measured performance in four of the five pneumonia-related indicators was parallel or better than urban hospitals. Rural, critical-access hospitals were more likely to collect blood culture specimens before administering the first dose of antibiotics, assess oxygen levels, and administer antibiotics within the first four hours of arrival to the hospital (Park et al., 1990).

The quality of care provided in rural hospitals generally has been accepted as being congruent to care provided in urban hospitals. In 2006, the AHRQ examined the relationship between the effects of low service volumes and patient outcomes. The study found strong evidence of a volume-outcome effect, with low volumes being associated with poorer outcomes.

Nurse Staffing

Nurse staffing was related to lower infection rates in a number of studies examining the relationship between staffing and outcomes. Specifically, higher nurse staffing was related to lower nosocomial infection rates in multiple studies (American

Nurses Association, 2013; Kane, Shamliyan, Mueller, Duval, & Wilt, 2007; Lichting et al., 1999; Needleman et al., 2002). Lean nurse staffing was associated with increased urinary tract infections and postoperative infections in an evidence-based review of literature conducted by Seago (2001). Central venous bloodstream infections also were associated with higher nurse-to-patient ratio according to a 1996 study (Fridkin, Pear, Williamson, Gallgiani, & Jarvis, 1996). Higher staffing also has been associated with lower pressure ulcer development (Blegen, Goode, & Reed, 1998; Lichting, Knauf, & Milholland, 1999).

Lower staffing levels were associated with higher rates of general infections and urinary tract infections in a one-hospital study consisting of 497 patients (Flood & Diers, 1988). The IHI *100,000 Lives Campaign* related to the central-line infections prevented more than 120,000 deaths nationally during its first year of implementation in 2006 (IHI, 2006). The study focused on the implementation of evidence-based guidelines, or bundles of care, in acute care hospitals. The IHI noted decreases in bloodstream infection rates following the implementation of guidelines or protocols. Another study conducted in intensive care units in which central-line guidelines were implemented nearly eliminated catheter-related bloodstream infections (Behrenholtz, Pronovost, & Lipsett, 2004).

The American Nurses Association (2013) conducted a study with an all-payer sample of more than 9 million patients in 1,000 hospitals and a Medicare sample of more than 3.8 million patients in more than 1,500 hospitals, measuring outcomes deemed to be preventable adverse events. A significant relationship between nurse staffing and five outcomes—urinary tract infections, postoperative infections, pneumonia, pressure ulcers,

and length of stay—was found. Lang, Hodge, Olson, and Kravitz (2004) reviewed 43 studies meeting their inclusion criteria from 1980 to 2003. Their review showed that a rich skill mix of RNs resulted in lower mortality rates, failure to rescue, and shorter length of stays.

Another study found that the skill mix of RNs was associated with lower mortality in a one-hospital study spanning one fiscal year (Blegen et al., 1998). Kane et al. (2007) conducted an observational in the United States and Canada from 1990 to 2006 using meta-analysis to test the relationship between nurse staffing and patient outcomes. The researchers found that higher nurse staffing was associated with reduced hospital-related mortality, failure to rescue, cardiac arrest, hospital-associated pneumonia, and other adverse events. Tourangeau, Giovannetti, Tu, and Wood (2002) reported similar findings regarding the skill mix of RNs on mortality.

In a Midwestern hospital with a mix of 2,709 general, orthopedic, and vascular surgery patients, Halm, Lee, and Chassen (2002) found no relationship between RN skill mix and mortality. Needleman et al. (2002a, 2002b) examined administrative data, including 799 hospitals from 11 states with more than 6 million patient discharges. The researchers did not find an association between higher levels of staffing by RNs and mortality.

Decubitus ulcer. The prevalence of skin breakdown during hospitalization was studied. Lichting et al. (1999) measured nursing-sensitive, patient outcome indicators using an administrative data set for 1992 and 1994 for a study conducted in California and New York. Their findings revealed a relationship between nursing skill mix and

lower pressure ulcer rates. Other findings related to total hours of nursing care and the relationship to pressure ulcers, postoperative infections, and urinary tract infections were found in a study conducted by Blegen et al. (1998). This study using 1993 administrative data from a large university hospital with a large sample of more than 21,000 patients, found the higher the RN skill mix, the lower the incidence of adverse occurrences was on inpatient units, specifically decubitus ulcer development.

An association between nurse staffing mix and the development of decubitus ulcers was found (ANA, 2013; Blegen et al., 1998; Lichting et al., 1999). The ANA study (2013) used data from nine states, including more than 9 million patients in more than 1,000 hospitals, and a Medicare sample of 3.8 million patients in more than 1,500 hospitals. A statistically significant result was found between pressure ulcers and staffing levels. Although Blegen et al. (1998) used only one hospital, a large sample of more than 21,000 patients was included with total hours of care being associated with the rate of decubitus ulcer formation. In a literature review, White and McGillis Hall (2003) identified evidence of a relationship between nursing levels and mortality in a study using Donabedian's quality framework. They further concluded that nosocomial infections, falls, and pressure ulcers were significantly associated with nursing practice.

Infections. In a one-hospital study, two units and 497 patients were examined in relation to nosocomial infections (Flood & Diers, 1988). Lower staffing levels were associated with higher rates of general infections and urinary tract infections. Central venous bloodstream infections were associated with higher nurse-to-patient ratio (Fridkin et al., 1996).

In several studies, richer staffing mix of RNs and higher nurse staffing were related to lower nosocomial rates (ANA, 2013; Kane et al., 2007; Kovner & Gergen, 1998; Lichting et al., 1999; McGillis Hall, Irvine Doran, Baker et al., 2001; McGillis Hall, Irvine Doran, & Pink, 2004; Needleman et al., 2002a, 2002b). Seago (2001) conducted an evidence-based review of the literature. Seago's study showed strong evidence that increased urinary tract infections and postoperative infections were associated with lean nurse staffing. A study conducted by Vogel, Dombrovsky, Carson, Graham, and Lowry (2010) found that patients in large hospitals were more likely to develop sepsis after elective surgical procedures than patients in small hospitals. Urban, nonteaching hospitals were more likely to be complicated by postoperative sepsis compared to rural and teaching hospitals for elective surgical procedures. Small hospitals had higher rates for central venous catheter-related bloodstream infection and postoperative sepsis.

In contrast, Taunton, Kleinbeck, Stafford, Woods, and Bott (1994) conducted a study in four Midwestern acute care hospitals, collecting data from 1989 to 1990. The study included 65 units, using data from hospital documents and reports. The researchers did not find a relationship between nursing workload and urinary tract infections. However, the researchers found an association between RN absenteeism and nosocomial infections.

A literature review shows inconsistent findings about hospital structural characteristics and outcomes, providing no solid direction of correlation. Further research

is necessary to explicate a relationship between acute care hospital system characteristics, patient safety practices, and outcomes.

Outcome Measures

Outcome measurement in the healthcare industry has been at the forefront for decades, beginning with Nightingale's work during the Crimean War (Salive, Mayfield, & Weissman, 1990). Most of the earliest research focused on medical and nursing care (Pringle & Doran, 2003). Since then, defining and measuring outcomes of healthcare delivery increasingly has become a priority for healthcare researchers.

Measurement of patient outcomes not only consists of services provided within the acute care hospital, but also takes into account patients' clinical attributes, including severity of illness (Apolone, 2000). The effect of safety practices on patient outcomes has not been well studied beyond organizations such as The Joint Commission, which enforces implementation of patient safety practices. Likewise, a large-scale evaluation of influences on patient safety changes has not yet occurred nationally.

According to many researchers, outcome measures examine not only patient outcomes, but also include organizational outcomes (Stone et al., 2007; Van Doren, Bowman, Landstrom, & Graves, 2004). Outcome measures should be chosen based on frequency, severity, and preventability of the outcome events. Experts contend that the measures also should address inadequacies in structure, process, and outcomes that promote patient safety outcomes (Zhan et al., 2005). Examples of these measures are intravascular catheter-related bloodstream infection rates and surgical-site infections in selected operations. Although intravascular catheter-related bloodstream infections occur

at relatively low frequency, the severity is high. Furthermore, evidence-based prevention strategies exist, and they have proven to be effective.

Many safety measures and initiatives currently in use pertain to different aspects of complex healthcare systems. However, the measures vary considerably in the extent to which they have been validated, in the scope and consistency of their use across facilities and regions, and in the purposes that they were designed to serve (Zhan et al., 2005). Effectively measuring adverse events poses enormous challenges. However, patient outcomes at the individual level are elements that are present in all healthcare settings and can be understood as the occurrence of adverse events that harm patients. To establish good processes that improve healthcare outcomes, monitoring both process and outcome measures and assessing their correlation is considered a model approach (IOM, 2000, 2004b; Pronovost et al., 2003).

In 2003, 38,220,659 patients were discharged from U.S. hospitals. Of these patients, 2.2% died while hospitalized. Most of those who died received care in private, not-for-profit facilities (58%) and nonteaching hospitals (56%) with an average length of stay of 4.6 days (Merrill & Elixhauser, 2005). In 2005, the National Center for Health Statistics (2005) published the U.S. national death rates for selected causes and found that 1% of all hospitalized patients in 2003 died of complications from medical care. Using the 2000 HCUP-NIS and PSIs, Romano et al. (2003) found that 1.12 million potential safety-related events occurred in 1.07 million hospitalizations at nonfederal, acute care facilities. The national sample represented more than 36 million hospitalizations, and the

report found that 34% of the safety-related events occurred in surgical hospitalizations, 31% in obstetric hospitalizations, and 35% in medical hospitalizations.

PSIs are outcome measures that support best practices or evidence-based guidelines to prevent central-line associated bloodstream infections. Organizations have used selected standards of the hospital manual in The Joint Commission accreditation process in an attempt to create evidenced-based practices (Kizer & Blum, 2005; Leape, Berwick, & Bates, 2002; Shojania, Duncan, McDonald, & Watcher, 2002).

Yet, no studies have examined outcomes and the relationship of hospital system structure with the use of patient safety practices identified as NPSGs. Existing studies reveal an association between structural characteristics, such as teaching status and ownership status to patient outcomes (Ayanian & Weissman, 2002; Devereaux et al., 2002; Halm et al., 2002; Stanton, 2004; Kupersmith, 2005). Comprehensive literature reviews related to patient outcomes and adverse events were found identifying variations in structural variables within healthcare systems (Mitchell & Shortell, 1997; White & McGillis Hall, 2003).

Thornlow and Merwin (2009) assert that the relationship between use of patient safety practices, specifically NPSGs, has not been well studied. Therefore, it is difficult for hospitals to identify clearly actions and modifications necessary to improve patient outcomes. However, several researchers have attempted to examine relationships between The Joint Commission accreditation process and outcomes.

In 2009, two studies were published that examined the association between accreditation standards and patient outcomes (Masica et al., 2009; Thornlow & Merwin,

2009). Thornlow and Merwin (2009) investigated the relationship between patient safety practices using hospital accreditation standards and patient safety outcomes using the AHRQ's PSIs as measured by hospital infections, postoperative respiratory failure, decubitus ulcers, and failure to rescue. The researchers found that selected hospital accreditation standards significantly were related to higher decubitus rates and hospital infection rates. However, no association was found between postoperative respiratory failure and failure to rescue. It was also revealed that hospital system characteristics did not consistently explain patient outcomes, reverberating findings in other studies (Baker et al., 2002; Romano et al., 2003; Thornlow & Stukenborg, 2006).

In 2003, Chen, Rathore, Radford, and Krumholz (2003) studied the association between hospitals' quality of care, as measured by performance on three quality indicators, survival among Medicare patients hospitalized for acute myocardial infarction and compliance with Joint Commission hospital accreditation standards. Lower quality and higher 30-day mortality rates were found in hospitals not accredited by The Joint Commission.

In a 2005, study conducted by Miller et al. (2005) that examined the relationship between Joint Commission accreditation scores and PSIs from HCUP administrative data (n = 24 states and n = 2,116 hospitals) and Joint Commission accreditation data from 1997 to 1999. The study findings revealed that when there was little variation in The Joint Commission scores, wide variation existed in the PSI rates, resulting in the conclusion that there was no relationship between Joint Commission accreditation processes and the studied PSIs.

Further, Romano et al. (2003) investigated the relationship between hospital characteristics and PSIs. However, the study did not include patient safety practices such as The Joint Commission's NPSGs. The findings are consistent with conclusions of other research showing that Joint Commission accreditation levels had limited usefulness in differentiating individual performance among accredited hospitals.

A national study of preventable adverse events suggested mixed results, showing large hospitals with a higher prevalence of most patient safety events but lower incident rates for others (Romano et al., 2003). Al-Haider and Wan (1991) examined hospital mortality and noted that hospital size and specialization were not statistically significant with hospital mortality when controlling for the effects of other organizational factors.

Patient Safety Practices

Patient safety practices have been proposed to assist with generating meaningful data, process, and outcome measures. Process measures support patient safety initiatives by establishing common practices to diverse healthcare settings. They encompass appropriate inclusion and exclusion criteria. Identifying ways to improve outcomes and patient safety remain significant issues of healthcare leaders and researchers. Patient safety practices are considered process measures and have been incorporated into care delivery since the 1960s. The evidence-based practice center defined patient safety practice as a type of process in which application reduces the probability of an adverse event. Consistent with Donabedian's conceptual framework in patient safety, this definition declares that systemic changes are more effective and productive in reducing adverse events and medical error than targeting and punishing individual providers

(Shojana et al., 2001). The goal of systemic change is to prevent future problems and eliminate or reduce systems vulnerabilities.

As a result of regulatory requirements for reporting serious adverse events, organizations have a procedure to capture serious events known as sentinel events. A sentinel event is considered to be an unexpected occurrence involving death; severe physical or psychological injury or the risk thereof, including unanticipated death or major loss of functioning unrelated to the patient's condition; patient suicide; wrong-side surgery; infant abduction or discharge to the wrong family; rape; or hemolytic transfusion reactions (The Joint Commission, 2012). The Joint Commission (2002) initially proposed a sentinel event policy to learn about the frequencies and underlying causes of sentinel events, promote sharing of lessons learned with other healthcare organizations, and reduce the risk of future sentinel event occurrences.

In contrast to other error reporting systems found in other industries such as the aviation industry, the sentinel event policy excludes the reporting of near misses. According to The Joint Commission (2012), this exclusion causes organizations to miss opportunities to gain valuable teaching information from missed errors. Although healthcare organizations accredited by The Joint Commission are not required to report a sentinel event, mandated review of organizational responses to sentinel events is an active part of the standard accreditation process (The Joint Commission, 2012). The sentinel event policy requires accredited organizations to conduct an intensive, root cause analysis of all serious adverse events, and implement policies and procedures designed to reduce the likelihood of recurrence (Mello, Kelly, & Brennan, 2005). The Joint

Commission has required the reporting of sentinel events since 1996. Data does not yet exist to examine the impact of this reporting initiative on patient outcomes, nor is there data to research the degree and effectiveness to which hospitals carry out the root cause analysis process.

Future advancements in healthcare and patient safety are dependent upon the ability to learn from mistakes. To do that, an environment of trust and shared accountability must be created in which healthcare professionals feel safe to report errors and a concerted effort made to standardize the nomenclature used to define error. The focus of patient-safety-oriented organizations should be upon promoting an environment conducive to learning from errors and minimizing the effects of the error similar to what happens in the aviation industry (Nieva & Sorra, 2003).

Despite widespread dissemination, there is significant variation in the application of patient safety practices across hospitals (Bradley et al., 2006; Fonarow et al., 2005; Peterson & Walker, 2006). Reasons for variance in application of evidenced-based processes are complex. It has been suggested that differences are associated with systems' issues (Fonarow et al., 2005).

Elimination of variation in processes has helped improve performance and reliability over the past decades in the commercial aviation industry according to Chassin and Leob (2011). They contend that a comparable level of success has been attained in the fields of anesthetics and obstetrics.

Similarly, standardization of any process of care by using protocols and checklists can help achieve similar reductions in harmful events. These types of standardizations

should be recognized as guides to managing clinical situations or processes of care that apply to most patients. Thornlow and Merwin (2009), assert that the relationship between utilization of patient safety practices, specifically, NPSGs, has not been well studied, thus making it difficult for hospitals to identify clearly actions and modifications necessary to improve patient outcomes.

While studies have shown associations between hospital characteristics such as bed size, teaching status, and patient outcomes (Ayanian & Weissman, 2002; Devereaux et al., 2002; Kupersmith, 2005; Thornlow & Merwin, 2009), there is little evidence that examines how these structural characteristics effect utilization of patient safety practices in accredited hospitals. Moreover, none have examined the influence of patient safety practices such as NPSG compliance on patient safety outcomes. Past studies were limited to measuring Joint Commission accreditation scoring and the relationship with the AHRQ's PSIs (Miller et al., 2005; Masica et al., 2009; Thornlow & Merwin, 2009).

Two studies examined the association between The Joint Commission accreditation scores and quality measures and mortality (Chen et al., 2003) and inpatient quality and PSIs (Miller et al., 2005). No significant relationship between The Joint Commission accreditation decisions and performance were found in a 2003 study. Chen et al. (2003) examined the association between Joint Commission hospital accreditation, the hospitals' quality of care (using three quality indicators) and survival among Medicare patients hospitalized for acute myocardial infarction. Hospitals not surveyed by The Joint Commission revealed lower quality and higher 30-day mortality rates than those surveyed. Of those hospitals surveyed, patients admitted to hospitals accredited

with commendation had the highest use of beta-blockers on admission and during hospitalization, while patients admitted to hospitals with conditional accreditation had the lowest use. Hospitals accredited with commendation, 30-day mortality were higher on average in comparison to those conditionally accredited. Considerable hospital-level variation existed in the use of aspirin therapy, use of beta-blocker therapy, and 30-day mortality rates for the hospitals in the sample groups. The authors concluded that Joint Commission accreditation levels had limited usefulness in distinguishing performance among accredited hospitals as a result of wide heterogeneity in performance existed within each facility.

The Joint Commission Data

The Joint Commission is the leading healthcare accrediting body in the nation. Hospitals are accredited based on their compliance with a set of national standards, including the NPSG program. The first set of NPSGs was effective January 1, 2003. The NPSGs were developed by a panel of widely recognized patient safety experts identified as the Patient Safety Advisory Group. This group is comprised of nurses, physicians, pharmacists, and other health professionals who have hands-on experience in addressing patient safety issues in a variety of healthcare settings to help accredited organizations address specific areas of concern regarding patient safety.

The Patient Safety Advisory Group works with Joint Commission staff in identifying emerging patient safety issues, and advises on updates and changes using performance measures and other data. With input from practitioners, provider organizations, purchasers, consumer groups and other stakeholders, recommendations are

made to The Joint Commission to determine the highest priority patient safety issues and how best to address them. The Joint Commission also determines whether a goal applies to a specific accreditation program and, if so, tailors the goal to be program-specific.

NPSGs differ from standards and their corresponding elements of performance by requiring the surveyor to observe compliance of each goal applicable to hospitals. All accredited acute care hospitals are required to implement each recommendation surveyed for compliance during each survey. Each year, new goals or revisions are announced in July, and implementation is mandatory beginning January 1 of the following year. For example, the 2010 goals were announced in July 2010; implementation was not required until January 2011. Therefore, compliance data with 2010 NPSGs was examined in hospitals accredited in 2011 to ensure that organizations were given time to effectively address the goals. NIS patient safety indicator data also was compared for 2011.

In 2010, there were 15 NPSGs applicable to hospitals. Compliance with each of the 15 goals is measured through the triennial visit by Joint Commission surveyors. The Joint Commission survey process is data-driven, patient-centered, and focused on evaluating actual care processes. The Joint Commission on-site surveys are designed to be organization specific, consistent, and support the organization's efforts to improve performance.

Survey length is determined by information supplied on the application. Each accreditation report includes the healthcare organization's accreditation date and decision, areas with recommendations for improvement, compliance with NPSGs, and a display of how the individual healthcare organization compares to other organizations

nationally in each performance area (The Joint Commission, 2013). All hospital triennial and random performance reports for surveyed hospitals are housed on The Joint Commission's website. Information on a hospital's performance survey result can be retrieved for at least five previous encounters from the website. For this study, data for the 2011 accreditation performance reports were retrieved from the website.

When an organization's accreditation decision becomes official, it is publicly disclosed. The decision is posted to Quality Check® within one business day of being posted to the extranet. Using Quality Check®, results for all hospitals meeting inclusion criteria and evaluated for accreditation in 2011 were considered for this study. Results of hospitals surveyed in 2011 as part of The Joint Commission's unannounced process were included in the data collection. Quality Check® is the online guide to Joint Commission accredited and certified healthcare organizations in the United States (The Joint Commission Quality Check, 2013). The accreditation decisions are categorized as accredited, provisional accreditation, conditional accreditation, preliminary denial of accreditation, or denial of accreditation. For this study, the investigator considered accredited hospitals.

Compliance with NPSGs is noted on the Quality Check® report with symbols representing whether the hospital has met the goals, not met the goals, or the goals are not applicable. Only hospitals that meet the inclusion criteria set by HCUP-NIS and The Joint Commission were used in this study.

The Joint Commission Accreditation Process

The Joint Commission, founded in 1951, evaluates and accredits more than 20,500 U.S. healthcare organizations and programs. An independent, not-for-profit organization, The Joint Commission is the nation's oldest and largest standards-setting and accrediting body in the healthcare industry.

The Joint Commission Accreditation for Hospitals was established by the American College of Surgeons (ACS). The ACS developed the first national system to measure hospital performance related to patient safety. The first set of standards for patient safety was developed by ACS in 1917, and inspections of hospital compliance to these standards began in 1918. In 1952, The Joint Commission introduced published accreditation standards for hospitals and began accreditation surveys.

In 1966, Congress passed the Social Security Amendment Act of 1965 that deemed Joint Commission accredited hospitals as meeting the requirements for participation in the federal Medicare and Medicaid programs. While hospitals' participation in the accreditation process is voluntary, the federal government requires hospitals to meet The Joint Commission standards to receive reimbursement from Medicare and Medicaid. This requirement essentially mandates that hospitals participating in the accreditation process meet The Joint Commission standards.

An organization undergoes an on-site survey by a Joint Commission survey team at least every three years to earn and maintain The Joint Commission's Gold Seal of Approval™. The Joint Commission is governed by a 32-member Board of Commissioners that includes physicians, administrators, nurses, employers, a labor

representative, quality experts, a consumer advocate, and educators (The Joint Commission Quality Check, 2013).

To prevent a monopoly, Section 125 of the Medicare Improvements for Patients and Providers Act of 2008 removed The Joint Commission's statutorily guaranteed accreditation authority for hospitals. The Joint Commission's hospital accreditation program is now subject to the Centers for Medicare and Medicaid Services CMS requirements for organizations seeking accrediting authority. This action allows for governmental quality oversight of The Joint Commission's accreditation processes.

The scope of The Joint Commission accreditation services was expanded in 1987 to other healthcare organizations. The organization's name was changed to the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). The organization has undergone numerous name changes over the years, and it has continued its quest to address safety issues for healthcare organizations.

In 2007, JCAHO underwent a major rebranding and simplified its name to The Joint Commission. The Joint Commission's accreditation process supports organizations in the identification of functions and processes directed at continuously improving patient safety and increasing outcomes. There is a focus on organizational systems that are essential to providing safe, high quality of care, treatment, and services. The standards provide an objective evaluation method in which healthcare organizations measure, assess, and improve performance with the applicable standards in the hospital manual.

The Joint Commission annually accredits 4,067 acute care, children's, long-term acute, psychiatric, rehabilitation, and specialty hospitals. It also accredits 362 critical

access hospitals through a separate accreditation program. The Joint Commission accredits 90% of U.S. hospitals. More than 3,000 Joint Commission accredited hospitals provide data on 57 inpatient measures (The Joint Commission Quality Check, 2013).

Accreditation and Patient Outcomes

Devers et al. (2004) conducted a study of administrators in 12 community hospitals that indicated that hospitals' major patient safety initiatives were primarily intended to meet The Joint Commission's standards and requirements. The findings led researchers to conclude that The Joint Commission accreditation process is a principal driver of hospitals' patient safety initiatives. In 2004, Hibbard and Pawlson contended that improvement to the quality of care was achieved through compliance with Joint Commission accreditation standards and that accreditation played a major role in improving the quality of care delivered in hospitals. He argued that compliance with accreditation standards was incentivized by the deemed relationship with CMS in which hospital licensure is affected by the accreditation outcome.

In 2003, two studies examined the association between Joint Commission accreditation scores, quality measures, and mortality (Chen et al., 2003) and inpatient quality and PSIs (Miller et al., 2005). No significant association between The Joint Commission accreditation decisions and performance were found in either study.

Another study conducted by Devers et al. (2004) found that hospitals reported partial or full compliance with The Joint Commission's 2003 patient safety standards. One possible explanation provided for compliance was again related to the relationship between accreditation and the deemed status relationship with CMS, which influenced

hospitals' ability to received reimbursements for caring for Medicare patients. Medicare patients generated approximately 40% of revenue for hospitals participating in this study.

Jacott and Jacott (2003) contended that The Joint Commission's efforts to make patient safety a centerpiece of accreditation activity and the survey process play a significant role in driving improvement. However, the researchers concluded that substandard patterns of care unlikely were identifiable. Further, no evidence existed that these efforts have resulted in reducing medical errors.

Significant progress has been made in patient safety practices and process measurements since The Joint Commission took the lead in requiring healthcare organizations to report errors that harm patients, adopt systemic measures to improve patient safety, and reduce the potential for adverse events. Creating ways to improve outcomes, patient safety, and care delivery are priorities of healthcare leaders and researchers through the nation.

According to Lagasse (2002), improvements in patient care safety are not attributable to a singular action but, rather to a combination of regulatory requirements such as those imposed by The Joint Commission, and the use of multiple or bundled changes as proposed by the IOM. In 1996, The Joint Commission instituted a sentinel event reporting policy for accredited organizations. The policy requires accredited organizations to report adverse events that meet established criteria.

In July 2001, The Joint Commission propagated safety standards for organizations surveyed under its hospital standards manual. Initially, the safety standards were in response to the 1999 IOM report and affected hospital pharmacy practices by requiring

compliance processes to identify, track, and reduce the likelihood of errors. Later, the first set of the six NPSGs were approved and implemented (The Joint Commission, 2002). The NPSGs included clear, evidence-based recommendations to help healthcare organizations reduce specific types of errors.

Monitoring process and outcome measures, and assessing their correlation is a model approach to validating good processes that lead to good, safety, healthcare outcomes (The Joint Commission, 2009). In 2003, more than 17,000 Joint Commission accredited healthcare systems providing care relevant to the NPSGs began participation in the evaluation process for compliance with the requirements or implementation of acceptable alternatives. In each of the following years, new safety goals have been added to address significant safety issues (The Joint Commission, 2009).

Dennis S. O’Leary, M.D., president of The Joint Commission, contended that organizations possess the knowledge and tools to prevent errors, but must focus their concentration on measures that require healthcare organizations to implement preventive steps (The Joint Commission, 2002). The standards encouraged open dialogue among hospital staff about errors and urged a focus on patient safety issues during orientation. According to Henri R. Manasse Jr., Ph.D., chairperson of the Sentinel Event Advisory Group, the NPSGs selected by the advisory group are all high-impact, low-cost targets. These measures should significantly improve patient safety outcomes. (The Joint Commission, 2002).

Before the mandated implementation of NPSGs by The Joint Commission in 2003, there was limited evidence to support the notion that patient safety practices deliver

any benefit in acute care hospitals, especially on patient outcomes. Understating the effect of safety practices such as The Joint Commission's NPSGs on patient care is pivotal to improving patient safety. In 2003, two studies examined the association between The Joint Commission accreditation scores and quality measures and mortality (Chen et al., 2003), and inpatient quality and PSIs (Miller et al., 2005). No significant association between The Joint Commission accreditation decisions and performance were found in either study. A significant limitation of both studies was that data were captured before the incorporation of specific quality standards and the NPSGs into The Joint Commission accreditation process.

Romano et al. (2003) examined the relationship of hospital systems and PSIs, and found no relationship. However, the study was not inclusive of patient safety practices, specifically NPSGs. While some studies demonstrate a relationship between hospital system characteristics—such as teaching status and nurse staffing—with patient outcomes (Ayanian & Weissman, 2002; Devereaux et al. 2002; Halm et al., 2002; Stanton, 2004; Kupersmith, 2005), there are no studies that examine the relationship between hospital structure and the use of NPSGs.

Research shows that patient care, quality, and safety are influenced by organizational processes and structure (King & Byers, 2007). The step of connecting indicators of quality patient care with patient safety practices provides objective information in understanding how an organization's structure and process affect patient outcomes. This step is the next logical move toward improving patient safety. Examining the relationship between implementation of patient safety practices, organizational

characteristics, and outcomes will provide objective information to guide hospital leaders towards designing patient safety solutions. The examination also helps identify factors that may influence patient safety practices.

National Patient Safety Goals

In 2003, The Joint Commission, the leading healthcare accrediting body in the nation, responded to the IOM 2002 report by the issuance of new patient safety accreditation standards, namely NPSGs. NPSGs were introduced to direct healthcare improvement efforts to high priority problem areas (Hyman, 2014). The goals included improving the accuracy of patient identification, improving the effectiveness of communication among caregivers, improving the safety of high-alert medications, the safety of using infusion pumps, and the effectiveness of alarms used in the clinical setting. Organizations also were to develop processes to eliminate wrong-site, wrong-patient, and wrong-procedure surgery.

NPSGs have become a critical method by which The Joint Commission promotes and enforces major changes in patient safety. The criteria used for determining the value of these goals and required revisions are based on the merit of the goals' impact, cost, and effectiveness. Improvement in the safety of patients is the core of these goals. Recent changes have focused on preventing hospital-acquired infections and medication errors in addition to promoting surgical safety, correct patient identification, communication among staff, and identifying patients at risk for suicide.

The Joint Commission approved and implemented the first set of six NPSGs in 2003 (The Joint Commission, 2010b). Further demonstrating its commitment to safety,

the Joint Commission revised all of its standards in 2003. With this revision, more than 50% of hospital accreditation standards focused on patient safety (The Joint Commission, 2010b).

In 2009, 16 NPSGs were listed in the Joint Commission's hospital accreditation manual. While no new goals were added, the 2009 NPSGs contain the most significant revisions since the release of the 2003 original six requirements. Major changes for 2009 included three new hospital requirements related to preventing deadly healthcare-associated infections due to multiple drug resistant organisms, central venous catheter-associated bloodstream infections, and surgical-site infections. These changes enhanced the existing NPSGs for the reduction of healthcare-associated infections. The 2011 NPSGs for hospitals used in this study remain the same as the 2009 goals.

Beginning January 1, 2003, The Joint Commission on began to evaluate more than 17,000 healthcare organizations for compliance with the implementation of the NPSGs. Criteria used for determining the value of these goals and potential revisions are centered on the merit of their impact, cost, and effectiveness.

Mark R. Chassin, M.D., president of The Joint Commission, contends that by acting consistently to meet the goals, healthcare organizations can substantially improve patient safety and immediately benefit patients (The Joint Commission 2009). Dennis S. O'Leary, M.D., past president of The Joint Commission, stressed that the knowledge exists to prevent error, but the challenge before the industry was to develop processes and measures that prompt healthcare organizations to implement patient safety practices such as the NPSGs (The Joint Commission, 2002). Another leader in healthcare quality, Henri

R. Manasse Jr., Ph.D., chairperson of the Sentinel Event Advisory Group and past chairperson of the National Patient Safety Foundation, vowed that the NPSGs selected by the advisory group would make a substantial difference in improving patient safety as a result of the goals being low-cost and high-impact patient safety practice initiatives (The Joint Commission, 2002). The data from 2003 to 2009 indicate hospital noncompliance ranging from 0.6% in 2003 with the introduction of the initial six goals to a noncompliance rate of 29% in 2009 with 16 goals as shown in Table 5. Noncompliance data percentages with NPSGs indicate an urgent need for research in this area. The Joint Commission has published limited research examining the relationship between the implementation of the NPSGs and patient outcomes.

Table 5

Noncompliance Percentages for National Patient Safety Goals

National Patient Safety Goals	2003	2004	2005	2006	2007	2008 Q1, Q2	2009
1a. Two identifiers	3.8	4.1	3.9	8.1	2.9	5.0	n/a
1b. Time-out prior to surgery	8.9	8.0	17.1	25.8	7.7	n/a	29.0
2a. Read back verbal orders	7.4	8.2	11.6	15.7	3.4	2.2	n/a
2b. Standard Abbreviations	23.5	24.8	39.5	36.9	23.2	18.3	n/a
2c. Timeliness of reporting	n/a	n/a	7.6	26.9	33.8	41.4	27.0
3a. Concentrated electrolytes	3.0	1.95	1.3	n/a	n/a	n/a	n/a
3b. Limit concentrations	0.6	0.9	1.5	1.7	0.8	n/a	n/a
3c. Look-alike/sound-alike drugs	n/a	n/a	1.9	7.4	5.0	5.0	n/a
3d. Label meds and solutions	n/a	n/a	n/a	8.9	18.8	18.5	n/a
3e. Anticoagulation therapy	n/a	n/a	n/a	n/a	0.2		n/a
7a. CDC hand hygiene	n/a	1.2	3.6	8.8	9.8		n/a
7b. HC associated infection (include surgical site and CVL)	n/a	0.1	0.0	0.1	0.0	0.0	n/a
8a. Med. Reconciliation-list	n/a	n/a	0.0	33.9	15.4	22.4	n/a
8b. Med. Reconciliation-	n/a	n/a	0.3	27.5	10.9	15.5	n/a

National Patient Safety Goals	2003	2004	2005	2006	2007	2008 Q1, Q2	2009
reconcile							
9a. Fall assessment	n/a	n/a	3.0	n/a	n/a	n/a	n/a
9b. Fall prevention	n/a	n/a	n/a	6.5	4.2	4.4	n/a
13a. Active patient involvement	n/a	n/a	n/a	n/a	0 .2	0 .2	n/a
15a. Suicide risk assessment	n/a	n/a	n/a	n/a	1.9	1.9	n/a
16a. Changes in condition (failure to rescue)	n/a	n/a	n/a	n/a	n/a	0.2	2.0

Note. Data from The Joint Commission Perspectives 2003 to 2009. n/a = data not available. CVL = central venous line.

Assessment Process

Hospitals' compliance with accreditation standards and NPSGs are evaluated objectively through a process called tracer methodology. The process is an evaluation method in which surveyors select a patient, resident, or client, and use that individual's medical record as a roadmap to move through an organization. The goal is to assess and evaluate the organization's compliance with selected standards, and systems of providing care and services.

Surveyors retrace the specific care processes that an individual experienced by observing and talking to staff in areas where the individual received care (The Joint Commission Quality Check, 2013). Open dialogue about errors between hospital staff is encouraged, and focus is on patient safety issues during the survey process. To determine whether the goals and their requirements have been implemented and how consistently they are being performed, surveyors will do the following:

- Look at any relevant documentation an organization possesses.
- Trace the care of selected patients throughout the organization.

- Interview the organization's leaders and direct caregivers.
- Directly observe performance with respect to the goals to determine whether the requirements have been implemented and how consistently they are being performed.

Edmond and Eickhoff (2008) contend that The Joint Commission standards and NPSGs at times lack strong supporting evidence and do not provide a mandate for hospitals to report outcomes associated with NPSGs to ensure that interventions actually are improving outcomes. The Joint Commission accreditation process attempts to ensure that scoring and evaluation processes are congruent with the organization's performance standards, transparent and easily understood by all involved, and based on the criticality of the standards (The Joint Commission, 2012).

HCUP-NIS Data

The AHRQ's PSIs originally were developed in 1994 using data from the HCUP-NIS as a method for screening inpatient administrative discharge data to identify potential patient safety problems. Yet, they increasingly are being used for quality measurement and hospital comparison purposes (Romano et al., 2009.) In 1998, the AHRQ revised and updated the indicators with input from users and advances in the sciences (AHRQ, 2010a). The PSIs were developed to minimize false positives at the expense of false negatives and maximize the likelihood that flagged events are preventable (AHRQ, 2007; Romano et al., 2003). The PSIs have good face validity, and studies suggest that several PSIs have good construct validity (Duggirala et al., 2004; Romano et al., 2003; Rosen et al., 2005; Rosen et al., 2006).

The NIS is part of the HCUP, an all payer healthcare database developed through a federal-state-industry partnership and sponsored by the AHRQ. Currently, NIS is the largest all-payer, inpatient, hospital care database in the United States. It is used by policymakers and researchers to analyze and track national trends in healthcare utilization, charges, quality, and outcomes (AHRQ, 2011). The HCUP-NIS contains “the unit of analysis is the hospital stay rather than the patient” (Levit et al., 2007, p. 56). The HCUP database currently provides clinical and nonclinical variables from hospital discharge abstracts from 1988 to 2011 for states participating in HCUP. For 2011, more than 97% of the U.S. population is included in the database. Databases contain clinical patient-level discharge information, and resource information is included in a typical discharge abstract.

The AHRQ’s PSI data is being used in a variety of ways to foster safety (CMS, 2010). For example, evidence-based indicators are being amassed through reports such as the AHRQ’s National Healthcare Quality Report and National Healthcare Disparities Report, which integrates patient safety indicator information to perform assessments of national performance on quality and patient safety in the United States (AHRQ, 2012a).

Furthermore, many states along with HCUP are facilitating electronic PSI data availability so that hospitals quickly can access their own quarterly PSI rates for a more just-in-time view of their performance (Savitz, Sorensen, & Bernard, 2004).

Hospitals have the ability to query their individual PSI rates, compare their results, analyze differences in individual discharge data, and develop strategies to address areas of need (Savitz et al., 2004).

Patient Safety Indicators

To use PSIs effectively, researchers must generate a solid and integrated overview of various quality dimensions. Donabedian (1966) first presented a conceptual framework to classify indicators to fulfill this requirement. His quality assessment theory contains a relatively simple model, particularly applicable in healthcare, called the SPO or Donabedian's triad model in which the PSIs fit (Donabedian, 1980).

In his theory, Donabedian describes three quality elements: structure, process, and outcome. The first two elements contain indirect measures that influence the third, direct element. All elements are linked with each other. Therefore, insight into one of the three is insufficient to measure and evaluate integral quality. Indicators can provide a structural and specific view of various quality properties (Donabedian, 1980).

PSIs are a set of quality measures used to help hospitals identify potential adverse events that may require further study. They provide an opportunity to assess the incidence of adverse events using administrative inpatient hospital and discharge data. Specifically, PSIs provide a method for identifying preventable adverse events that patients experience through contact with the healthcare system and that are likely amenable to prevention by implementing system level changes (AHRQ, 2002). With information available from secondary diagnoses reported in discharge abstracts, PSIs provide information on in-hospital adverse events after surgeries, procedures, and childbirth using the International Classification of

Diseases 9 (ICD) and Revision Clinical Modification (RCM) codes present in hospital administrative data (AHRQ, 2002).

A model for risk adjustment is incorporated into the PSI algorithms, which are available through the AHRQ's comorbidity software (Elixhauser, Steiner, Harris, & Coffey, 2006) and include patient-level predictors such as age, sex, age-sex interactions, modified DRGs, and modified comorbidity categories (Rosen et al., 2005). Risk-adjusted rates were used for this study. The risk-adjusted rate answers the converse question: "What rate of adverse events would we see in this provider (or area) if they provided the locally observed quality of care to patients whose distribution of characteristics matched those in the reference population?" Risk-adjusted rates are useful in comparisons between providers or areas. They are evaluated on an identical mix of patients, so calculating them is an attempt to remove the confounding influence of patient mix from the comparison. A total of 30 comorbidities are generated automatically by the PSI software and used as risk adjusters in the administrative data set (Zhan & Miller, 2003a). This risk adjustment at the patient level strengthens the internal validity of the study's findings (Tourangeau & Tu, 2003).

The use of point of admission fields uniformly can impact PSI and patient discharge indicators rates by reducing the times that false positives occur—diagnoses being identified as complications from the current hospitalization instead of a prior hospitalization or pre-existing comorbidities. The PSIs are organized into three categories of measures: prevention quality

indicators, inpatient quality indicators, and PSIs (AHRQ, 2007). They are deemed amenable to detection using administrative data, adequately coded in previous studies, and sensitive to the quality of care (Romano et al., 2003).

Twenty PSIs exist as shown in Table 6 for medical conditions and surgical procedures that represent a selective list of potential safety-related events believed amenable to discovery using administrative data and sensitive to the quality of care (Romano et al., 2003). For the interest of this study, hospital provider level PSIs were used to examine outcomes of which three are of interest for this study. Evidence suggests that adverse event rates have been shown to vary substantially across institutions and that these indicators may link to deficiencies in the provision of care (AHRQ, 2012b).

Since the release of the AHRQ's PSIs in 2003, several studies have been conducted by researchers using the indicators to examine associations between selected variables and adverse patient outcomes. These studies offer a considerable contribution to established empirical evidence about patient safety outcomes. In 2001, using the AHRQ's PSI data from 1997 and more than 2 million patients in the New York inpatient database, Miller et al. (2001) investigated the association between patient safety events and variables such as length of stay, inpatient mortality, and hospital charges. Because of their work, PSI algorithms were created along, and an association was made between patient safety events, age, and hospitals with higher inpatient surgeries and intensive care beds.

Table 6

Agency for Healthcare Research and Quality's Provider-level PSIs

Provider-level Patient Safety Indicators	PSI Number
Complications of anesthesia	1
Death in low-mortality	2
Decubitus ulcer	3
Failure to rescue	4
Foreign body left during procedure	5
Iatrogenic pneumothorax	6
Selected infections due to medical care	7
Postoperative hip fracture	8
Postoperative hemorrhage or hematoma	9
Postoperative physiologic and metabolic derangements	10
Postoperative respiratory failure	11
Postoperative pulmonary embolism or deep vein thrombosis	12
Postoperative sepsis	13
Postoperative wound dehiscence	14
Accidental puncture or laceration	15
Transfusion reaction	16
Birth trauma - injury to neonate	17
Obstetric trauma - vaginal with instrument	18
Obstetric trauma - caesarean delivery	19
Obstetric trauma - vaginal without instrument	20

Note. Data from the Agency for Healthcare Research and Quality, 2007.

In 2002, Kovner et al. (2002) conducted a study utilizing HCUP-NIS inpatient data from six to 14 states from 1990 to 1996. The researchers aimed to examine indicators for hospital-level adverse events. They examined four postoperative events—pneumonia, deep vein thrombosis and pulmonary embolism, pulmonary compromise after surgery, and urinary tract infections. The findings identified a significant relationship between RN staffing hours per average patient discharge and pneumonia.

Using the AHRQ's PSIs, Romano et al. (2003) identified 1.12 million potential safety-related events in 1.07 million hospitalizations at nongovernmental

acute care hospitals in a 2000 HCUP study. Further, the researchers established face and consensual validity of these indicators, and identified an association with patient and hospital characteristics. Their findings revealed that PSIs were highest in urban teaching hospitals, increased with age, and were higher in African Americans when adjusted.

In a 2005 study by Miller et al. (2005) that examined the relationship between Joint Commission accreditation scores and PSIs from HCUP administrative data, and Joint Commission accreditation data from 1997 to 1999. The study findings revealed that when there was little variation in Joint Commission scores, wide variation existed in the PSI rates, resulting in the conclusion that there was no relationship between Joint Commission accreditation processes and the studied PSIs.

Romano et al. (2003) used HCUP-NIS data to establish face and consensual validity of PSIs and presented national data on the AHRQ's PSIs. This data included events over time and their association with patient and hospital characteristics. More than 1.12 million potential, safety-related events in 1.07 million hospitalizations at nongovernmental acute care hospitals in 2000 were identified. When adjusted, the frequency of PSIs was highest in urban teaching hospitals.

In 2005, Savitz et al. (2004) investigated the relationship between PSIs, the NQF indicators, and ANA indicators. The researchers found an association with two indicators: failure to rescue and rate of decubitus ulcers. An additional

PSI–infections due to medical care—also was found to overlap with the NQF indicators. Three indicators from these findings were used in this study: development of decubitus ulcer and infections due to medical care that include postoperative sepsis and central venous catheter bloodstream infection. The three selected PSIs represent both medical conditions and surgical procedures that are amenable to detection using HCUP-NIS administrative data and are potentially nursing sensitive to measuring the quality of care (Romano et al., 2003).

Supporting evidence of PSI construct validity was provided in a study using VA data from 2000 to 2001 (Rosen et al., 2005). Researchers applied the AHRQ’s PSIs to VA data, examined differences in actual and risk-adjusted VA data, and compared the VA data to non-VA data sources. Results revealed that the most frequent PSI complications were failure to rescue, decubitus ulcer, and deep vein thrombosis and pulmonary embolism. Researchers found the VA risk-adjusted rates to be significantly lower than both HCUP-NIS and Medicare event rates for decubitus ulcer, infection due to medical care, postoperative respiratory failure, and postoperative sepsis in the comparison of VA and non-VA data.

Three studies (Isaac & Jha, 2008; Rivard et al., 2008; Vartak et al., 2008) were conducted in 2008 with significant findings related to the AHRQ’s PSIs. The first was a follow-up study performed by Rivard et al. (2008) to work performed by Rosen et al. (2005) using nine of the AHRQ’s PSIs from October 2000 to September 2001. Rivard et al. 2008 found all nine selected PSIs to be associated with increased cost, the length of stay, and mortality. In comparing VA

data and non-VA data, outcomes were consistent with the study by Rosen et al. (2005).

In 2008, Isaac and Jha used specified PSIs to examine a relationship with other measures of hospital quality using 2003 MedPAR data and scores from the Hospital Quality Alliance Program. Only one indicator—failure to rescue—was consistently associated with better performance on the quality measures. Other PSIs selected—death in low mortality diagnosis-related groups (DRGs), decubitus ulcer, and infections due to medical care—were not associated with quality measures. Vartak et al. (2008) found higher rates of complications at teaching hospitals in their study of six postoperative PSIs—postoperative sepsis, postoperative deep vein thrombosis and pulmonary embolism, postoperative hip fracture, postoperative respiratory failure, postoperative metabolic derangement, and postoperative hemorrhage.

Thornlow and Merwin (2009) investigated the relationships among hospital systems, use of patient safety practices as measured by hospital accreditation overall scores, and patient safety outcomes in acute care hospitals to determine if the use of patient safety practices influenced the rates of four PSIs—the AHRQ’s PSI infections, postoperative respiratory failure, decubitus ulcers, and failure to rescue. The researchers found that selected hospital accreditation standards significantly overlapped in two of the four measures—higher decubitus rates and hospital infection rates. Hospitals considered lower-performing in the accreditation standard of assessing patient needs had

higher rates of infection than those with higher scores. Hospitals with poor performance under the accreditation standard of care procedure had higher rates of decubitus ulcers than did hospitals with better performance. Use of patient safety practices was not associated with hospital rates of postoperative respiratory failure or failure to rescue.

The three PSIs selected for investigation in this study have been shown to be influenced by organizational characteristics (AHRQ, 2007; Romano et al., 2003; Miller et al., 2001) and care processes (Lake & Freise, 2006; Gastmeier & Geffers, 2006; Kovner & Gergen, 1998). Further, the medical conditions and surgical procedures represented in the data set are sensitive to the indicators selected (Romano et al., 2003) and the quality indicators are amenable to detection. Therefore, there is significant support for the selection of the three indicators chosen for analysis in this study. Further explanation and detail of the selected indicators are defined more completely in Chapter 3.

American Hospital Association

The AHA annual survey database, through the services of Health Forum L.L.C., collects survey data in the fall of each year for 6,000 U.S. hospitals. The 2011 survey database consisted of 6,317 hospitals. An enormous amount of data has been collected annually since 1946 and is widely deemed as the healthcare industry's most comprehensive source of data for profiling and categorizing hospitals (AHA, 2013). Hospitals choose to complete the voluntary survey either online or via mailed questionnaire. The survey generally has an excellent response

rate. However, response rates vary by question. For nonreporting hospitals or instances when data elements are omitted, data estimations are created by statistical modeling or data is derived from similar hospital facilities using the most recently available hospital data (AHA, 2013).

Variables pertinent to hospital systems such as teaching status, location, and size are available in both the AHA dataset and NIS inpatient data set. Considered the most significant information for this study is the provision of demographic and hospital identification data provided in the data set. This data was used to crosslink hospital information for HCUP-NIS and The Joint Commission. According to the AHA user agreement, it can be readily linked with the HCUP-NIS dataset.

Summary

This chapter described several efforts to improve safety that have been encumbered, in part, by the difficulty in examining systemic failures that routinely occur in complex and dynamic environments such as hospitals. Despite marked efforts, experts suggest that patient safety has not substantially improved (Rothschild et al., 2006). Given the growing emphasis on patient safety and increasingly complex nature of healthcare, it becomes exceedingly important to determine if differences in preventable adverse events among acute care hospitals are reflective of differences in organizational systems and processes implemented in accredited hospitals.

Clinicians and healthcare leaders are compelled to examine how patient safety practice is operationalized and how organizational characteristics of acute care hospitals

affect patient safety outcomes in order to significantly improve patient safety. Without a commitment to use collected data on patient safety practices to identify and correct systemic issues, the safety of patients will continue to be jeopardized.

The Joint Commission accreditation process is tantamount with quality and safety of clinical care. As a result, hospitals spend a significant portion of their budgets to participate in The Joint Commission accreditation process. However, the extent that the accreditation process, specifically implementation of NPSGs, truly is associated with safety and improved outcomes is relatively unknown (Miller et al., 2005). Examining the relationship of healthcare system characteristics and patient safety practices in acute care hospitals is key to identifying system failures and influences that lead to potentially preventable medical errors. At this time, there is little to no published research examining the relationship between the implementation of NPSGs and patient outcomes.

Research related to The Joint Commission process has focused on the relationship between accreditation and compliance scores and core measure variables such as heart failure and ventilator-associated pneumonia (Masica et al., 2009). There is a significant gap in the literature examining the impact of the 2003 NPSG implementation and evidenced-linked outcomes such as the AHRQ's PSIs. PSIs are considered as the state-of-the-art measure for safe hospital care.

The AHRQ emphasized that improving patient safety is critical to improving healthcare quality in the United States (AHRQ, 2007). There are many unanswered questions regarding the relationship between acute hospital characteristics and compliance with The Joint Commission's NPSGs on preventable, adverse events,

specifically on the AHRQ's PSIs. Chapter Three will describe this study's methodological properties.

CHAPTER 3: METHODOLOGY

Previous chapters presented an overview of this study; conceptual framework used to examine relationships among acute care hospital systems, patient safety practices, and patient outcomes; and a review of existing literature. This chapter introduces the study's research design, questions to be answered, theoretical model, population and sample, constructs measured, and data analyses to be used to answer the research questions. Additionally, human subject confidentiality and data protection methods are also disclosed.

Research Design

A descriptive, correlational research design was used in this study to examine the relationships between hospital characteristics and NPSGs, and to explore their relationship to selected patient safety outcomes in Joint Commission accredited hospitals in the United States. Secondary data from a probability sample representing approximately 20% U.S. community hospitals (AHRQ, 2011) and the 2011 Joint Commission accreditation performance reports derived from 2011 HCUP-NIS participating hospitals from across the United States were used to explore the relationships among hospital systems, patient safety practices, and patient outcomes.

Conceptual Model

The study was based on the Donabedian conceptual model depicted in Figure 1. The aims of this study were three-pronged. First, the study examined the strength and direction of the relationship between organizational characteristics (structural elements) of acute care hospitals such as teaching status, hospital location, and bed size, and implementation of patient safety practices (process elements), specifically The Joint Commission's NPSGs. Second, the relationship between patient safety practice implementation (process elements) and patient safety indicator outcomes for selected PSIs was examined. PSIs are defined as potentially preventable complications resulting from care. Indicators were measured for each hospital using criteria in an AHRQ software specifically designed to identify PSIs found in the hospital-based discharge database (AHRQ, 2011). Third, patient safety outcomes were risk-adjusted via the AHRQ software formula to account for patient characteristics. This formula also was used to examine hospital structural variables associated with patient outcome variables among the acute care hospitals of interest.

Creation of the Analytic Data File

The research database was composed of data obtained from multiple sources, including the 2011 AHA crosswalk file, the 2011 HCUP-NIS hospital file, and The Joint Commission, in which files were retrieved online from The Joint Commission Quality Check® site for hospital compliance with NPSGs. Secondary data were procured at two levels of analysis for patients and hospitals. Hospital-level data include the 2011 AHA annual survey data and the 2011 Joint Commission accreditation performance reports.

Patient-level data were obtained from the 2011 NIS discharge dataset, which is a subset of the HCUP databases. A description of each dataset follows.

The AHA database, through the services of Health Forum LLC, collects survey data in the fall of each year for approximately 6,000 hospitals in the United States. The 2011 AHA survey database consisted of data from 6,317 U.S. hospitals representing all sizes, locations, and teaching status. It provided all nurse staffing values for all hospitals throughout the United States. Accreditation status and hospital demographics such as hospital identification and location also were provided by this source. The HCUP-NIS hospital file was linked to the 2011 AHA file using identifiers present in both the AHA crosswalk file and the HCUP-NIS file. The information on The Joint Commission Quality Check® website provided sufficient hospital identifiers to link each hospital to the AHA and HCUP-NIS files. The 149 HCUP-NIS hospitals participating in the accreditation process in 2011 represented 3.5% of the total hospitals in the United States accredited by The Joint Commission, according to AHA records. Only one Joint Commission accredited hospital was unable to be linked due to insufficient identification information (Health Forum, LLC, 2008).

The AHRQ WinQI software reported expected rates, risk-adjusted PSI rates, and smoothed rates from the NIS data file for the variables of interest in this research. A total of three PSI files were merged with selected AHA data, HCUP-NIS data, and The Joint Commission survey results to create a file for data analysis. The sample of hospitals was selected after the construction of the study sample datasets. Graduate Statistical Package for the Social Sciences® 23 was used to analyze the resulting data set.

Research Questions

This study addresses the following research questions shown in Table 7. Included in the table are study variables, data sources, and the proposed data analyses.

Table 7

Research Questions, Variables, Data Source, and Data Analysis

Research Question (RQ)	Variables	Data Source	Data Analysis
RQ1: Is there a relationship between The Joint Commission's NPSGs and AHRQ's PSI outcome rates of risk-adjusted, postoperative sepsis and decubitus ulcer, and central venous catheter bloodstream infection in accredited acute care hospitals?	<u>Categorical</u> NPSGs - (D) <u>Continuous</u> <ul style="list-style-type: none"> PSI #3 - Cases of decubitus ulcer per 1,000 discharges with a length of stay more than four days PSI #7 - Central catheter venous bloodstream infection rate per 1000 discharges of infections due to medical care, primarily those related to intravenous lines and catheters PSI #13 - Post-operative sepsis; cases of sepsis per 1,000 elective surgery patients with an operating room procedure and length of stay of four days or more 	<ul style="list-style-type: none"> HCUP-NIS AHA The Joint Commission database 	<ul style="list-style-type: none"> Descriptive statistics: mean and standard deviation, and frequency of the continuous variables Frequency distribution for categorical variables and ordinal data Chi-square test Mann-Whitney U Tests
RQ2: What is the relationship between hospital characteristics and implementation of National Patient Safety Goals in acute care hospitals?	<u>Categorical</u> <ul style="list-style-type: none"> Bed Size - (O) Region - (N) Teaching Status and Location -(N) NPSG - (D) 	<ul style="list-style-type: none"> HCUP AHA The Joint Commission database 	Logistic regression conducted to determine whether hospital system characteristics correlate with the adoption of patient

Research Question (RQ)	Variables	Data Source	Data Analysis
			safety practices
RQ3: What is the relationship between hospital characteristics and AHRQ patient safety indicators outcome rates of risk-adjusted diabetes, postoperative sepsis, and central venous catheter bloodstream infection in accredited acute care hospitals?	<u>Categorical</u> <ul style="list-style-type: none"> • RN FTE APD - (O) • LPN FTE APD - (O) • Total Licensed APD - (O) <u>Continuous</u> <p>HCUP-NIS indicators risk-adjusted PSIs</p> <ul style="list-style-type: none"> • PSI #3 - Cases of decubitus ulcer per 1,000 discharges with length of stay more than four days • PSI #7 - Central catheter venous bloodstream infection rate per 1000 discharges of infections due to medical care, primarily those related to intravenous lines and catheters • PSI #13 - Post-operative sepsis; cases of sepsis per 1,000 elective surgery patients with an operating room procedure and length of stay of four days or more 	<ul style="list-style-type: none"> • HCUP-NIS • AHA • The Joint Commission database 	<ul style="list-style-type: none"> • Kruskal-Wallis • Descriptive statistics: mean and standard deviation, and frequency of the continuous variables frequency distribution for categorical variables and ordinal data • Chi-square test
RQ4: What are the independent predictors of AHRQ risk-adjusted PSIs for decubitus ulcer, postoperative sepsis, and central venous catheter bloodstream infection in	<u>Categorical</u> <ul style="list-style-type: none"> • NPSGs - (D) • Bed size - (O) • Region - (N) • Teaching-Location status - (N) • RN FTE APD - (O) • LPN FTE APD - 	<ul style="list-style-type: none"> • HCUP-NIS • AHA • The Joint Commission database 	<ul style="list-style-type: none"> • Multiple logistic regression conducted to determine which hospital characteristics are predictors AHRQ PSIs in accredited

Research Question (RQ)	Variables	Data Source	Data Analysis
accredited acute care hospitals?	(O) • Total Licensed APD - (O) <u>Dichotomous</u> HCUP-NIS indicators risk-adjusted PSIs • PSI #3 - Cases of decubitus ulcer • PSI #7 - Central catheter venous bloodstream infection rate • PSI #13 - Post-operative sepsis; cases of sepsis		acute care hospitals • Descriptive statistics: mean and standard deviation, and frequency of the continuous variables

Note. NPSG = national patient safety goals. AHRQ = Agency for Healthcare Research and Quality. PSI = patient safety indicator. HCUP-NIS = Healthcare Cost and Utilization Project-Nationwide Inpatient Sample. AHA = American Hospital Association. O = ordinal. N = nominal. D = dichotomous. RN = registered nurse. FTE = full-time equivalency. APD = adjusted patient discharge.

Population and Sample

Population

The population for this study was nongovernmental, acute care community hospitals across the United States, as classified by the AHA, that were included in the HCUP-NIS database. The hospital population of the AHRQ NIS database was drawn from states participating in HCUP. The HCUP database includes more than 95% of the inpatient hospitalized U.S. population. It is derived from a 20% stratified sample of discharges from all U.S. community hospitals, excluding rehabilitation and long-term, acute care hospitals. Hospitals excluded from this study are children's hospitals and specialty hospitals because the study PSIs do not apply.

Sample

The sample for this study was derived from two secondary datasets. First, the 2011 HCUP-NIS administrative dataset was used to identify acute care community hospitals in the 46 states that participated in the HCUP from across the United States. There were 1,049 hospitals with 8,023,590 discharges during this period. Of the 1,049 hospitals that participated in the NIS sample, 446 met the inclusion criteria as being accredited by The Joint Commission. An additional hospital inclusion criterion was that the hospital must have participated in the accreditation process in 2011. As a result, the study sample was limited to 28 states and consisted of 149 acute care community hospitals. The excluded hospitals were located in Alabama, Delaware, the District of Columbia, and Idaho. New Hampshire participated in HCUP-NIS but did not submit data in time to be included in the database. The number of hospitals per state in the 2011 NIS sample ranged from two to 90.

Secondly, the NPSG implementation was taken from a 2011 Joint Commission dataset. The 2011 AHA list shows that 6,320 hospitals were reviewed to identify a sample of hospitals that participated in The Joint Commission accreditation process in 2011.

Of the 46 states in the NIS sample, four restricted the identification of hospital structural characteristics, and 19 prohibited the release of hospital identifiers, which are one of the variables for the study. Stratified data elements identifying control, ownership, location, teaching status, and bed size were excluded for 18 states. However, those

elements were obtained from the AHA dataset. Further reductions occurred through the elimination of hospitals that did not seek accreditation from The Joint Commission.

Data from the AHA for 2011 included hospitals that completed The Joint Commission accreditation survey in that year. Therefore, data analysis was matched in the same year.

Data validation and duplication were done by linking the AHA crosswalk file—using hospital identifiers, address, city, state, and zip code—to the HCUP-NIS hospital identification number using the name, address, city, state, and zip code. As a result, the sample included 149 acute care hospitals in 21 states.

Determination of the appropriate sample size was a crucial part of the study design. The required sample size for regression analysis depends on various issues, including the desired power, alpha level of significance, and the expected effect size (DuPont & Plummer, 1998). NQueryadvisor7.0® study planning software (Elashoff, 2007) was used to determine the required sample size for this study. A sample size of at least 100 hospitals was recommended to achieve a significance level with $p = 0.05$ and 80% power. Power is defined as the likelihood of rejecting the null hypothesis and avoiding a Type 2 error (Munro, 2005). Power of 80% generally is viewed as adequate.

Significance was achieved at $R^2 = .0913$. Tabachnik and Fidell (2001) were used as a cross-reference. The suggested sample size equation for testing the multiple correlation is $N \geq 50 + 8m$ (where m = number of independent variables) and for testing individual predictors $N \geq 104 + m$. A medium-size relationship is assumed between the independent variables. Therefore, a power of 80%, significance level of 0.05,

and an effect size of .20 was used. Based on these suggested equations to test the considered seven variables, the example equation would be $50 + 8(7) = 106$ and the equation to test regression formula of the individual variables is $104 + 7 = 111$.

Datasets

The HCUP-NIS is a stratified probability sample of U.S. hospitals, where the universe of community hospitals across the United States is divided into strata using five hospital characteristics: ownership and control, bed size, teaching status, urban or rural location, and U.S. region having sampling probabilities proportional to the number of U.S. community hospitals in each stratum (AHRQ, 2010c).

The sampling procedure used in this study is adequate to ensure representation in the HCUP-NIS sample (AHRQ, 2010d). The procedure is multi-tiered. First, hospitals are stratified by geographic location. Next, hospitals are sorted by zip code stratum. Finally, a systematic random sample of up to 20% of the total number of hospitals within each stratum is drawn. All hospitals within that stratum are selected for inclusion only if a sufficient number of hospitals are found in the frame. A minimum of two hospitals within each stratum frame is required for inclusion in the HCUP-NIS sample.

Hospital-Level Data

The number of hospitals identified by NIS in each state ranged from 11 to 486. As noted in Table 8, hospital discharges per state ranged from 235 to 638,000. Excluded from consideration were VA hospitals and other federal facilities such as those of the DOD and HHS's Indian Health Service; short-term rehabilitation hospitals; long-term, non-acute- care hospitals; psychiatric hospitals; and alcoholism and chemical dependency

treatment facilities. However, 94% of the excluded states previously were excluded. Of the stratified listing exclusions and hospital identifier exclusions, one state was not included on both lists. Of the four states restricting hospital structural identification, the restrictions were not pertinent to the study. Therefore, they did not affect the sample size. Overall, 43% of the total population of hospitals was excluded from the study. Twenty-seven states with 149 accredited general medical/surgical hospitals remain.

Table 8

Hospital Discharges Per State for 2011 National Inpatient Sample

State	Discharges	State	Discharges
Alaska	3,796	Nevada	58,015
Arizona	168,667	New Jersey	207,319
Arkansas	87,095	New Mexico	46,313
California	834,410	New York	598,902
Colorado	136,934	North Carolina	250,166
Connecticut	99,594	North Dakota	13,916
Florida	584,887	Ohio	326,764
Georgia	205,583	Oklahoma	95,997
Hawaii	235	Oregon	81,472
Illinois	349,835	Pennsylvania	400,938
Indiana	230,634	Rhode Island	35,921
Iowa	61,618	South Carolina	118,814
Kansas	75,570	South Dakota	28,714
Kentucky	128,410	Tennessee	205,619
Louisiana	137,103	Texas	638,165
Maine	16,660	Utah	69,054
Maryland	220,059	Vermont	25,278
Massachusetts	153,881	Virginia	251,779
Michigan	200,895	Washington	109,487
Minnesota	142,629	West Virginia	70,698
Mississippi	105,108	Wisconsin	153,115
Missouri	249,518	Wyoming	10,356
Montana	9,145		
Nebraska	24,522	Total	8,023,590

Note. Data from Healthcare Cost and Utilization Project, 2013.

Study Variables

PSIs were designed to compare risk-adjusted hospital rates for several types of preventable complications and adverse events in studies using administrative data from discharge abstracts in conjunction with HCUP-NIS data (Elixhauser et al., 2006). The AHRQ-designed PSI software version 5.0a was run on the combined file (core + NIS hospital) to identify patient safety outcome variables of interest to this study.

The software generated an algorithm to calculate rates that used the date of procedure, ICD-9-CM diagnosis and procedure codes, and patient characteristics, including age, gender, and DRG to flag potentially preventable complications. Each of the PSIs was analyzed in three forms, as recommended by the software: unadjusted ratio, risk-adjusted ratio, and risk-adjusted ratio with smoothing. The unadjusted ratio is the number of observed encounters divided by the number of discharges. The program calculated observed PSI rates regardless of the number of cases available (numerator or denominator). The numerators consist of the complications of interest, and denominators consist of the population at risk (AHRQ, 2010a).

Patient risk adjustment was controlled for by application of the AHRQ comorbidity software (HCUP, 2011c). Because NIS is a stratified sample, proper statistical techniques were used to calculate standard errors and confidence intervals. The outcome variables' validation of the AHRQ's PSIs is still in its early stages. PSI rates were risk-adjusted for case mix, age, gender, age-gender interactions, comorbid conditions specific to each indicator, and DRGs specific to each indicator (Elixhauser et al., 2006).

Elements in the combined file were renamed or recoded in the AHRQ data dictionary prior to running the program to conform to the PSI software requirements: (1) gender: “female” was renamed and recoded to “sex,” (2) admission source: “source” was renamed and recoded as “point of originub04,” and (3) patient state and county code “hfipsstco” was renamed “fips.”

Risk-adjusted rates for three PSIs were used in this study. The software applied pre-calculated coefficient adjustments using the HCUP-NIS database and computed risk-adjusted PSI rates for 149 selected hospitals in 28 states for the three selected PSIs (HCUP, 2011c).

PSI rates for the three selected indicators were merged into the hospital-level HCUP-NIS analytic file using the HCUP identifier to create the patient safety outcome variables selected for this study as shown in Table 9. The output file was re-combined with the NIS hospital-level file to identify individual AHA hospitals. Successful file merging was validated by comparing the initial file data for discharge abstracts on hospital identity, teaching status, ownership, and others identifiers with the final hospital-level file. Beginning October 1, 2007, the UB-04 data (point of admission) may affect the prevalence of the outcome of interest and the risk-adjusted rates by excluding secondary diagnoses coded as complications from the identification of covariates in the database.

In summary, the combined risk-adjustment approach at the patient level enhances the reliability and internal validity of the instruments used for identifying potentially preventable adverse events in hospital discharge data. This approach is done while taking

into account the specificity of the PSI definitions and variables of age, sex, and diagnosis in the PSI software (Tourangeau & Tu, 2003).

Table 9

Variable Construction

Variable	Variable Construction
Region	The region variable originally was coded into four regions: Northeast, Midwest, South, and West. Since there were four levels, dummy coding was performed. Each level was defined uniquely by the assignment of values “1” and “0” to reflect the presence or absence for binary logistic regression analysis. These values became the predictors of the regression model. Region was recoded into dichotomous variables (1 = yes; 0 = no).
Bed Size	Categorical variable that classified hospitals into three categories: (1) small, (2) medium, or (3) large, depending on a hospital’s region as well as and location and teaching status.
Teaching and Location	Defined as (1) rural, (2) urban nonteaching, and (3) urban teaching based on Metropolitan Statistical Area population standards for classifying localities. Teaching hospital was assigned if a hospital met one of the following criteria: American Medical Association approved residency program, member of the Council of Teaching Hospitals of the Association of American Medical Colleges, or ratio of FTE interns and residents to beds of 0.25 or greater.
RN Staffing	A continuous variable measured as a ratio of RN FTEs to adjusted average patient day variable. It was recoded to reflect three categories. Categories were developed (1) low, (2) medium, (3) or high as a result of examination the frequencies of RN FTEs and the data from the American Hospital Association for 2011 denoting RN FTEs per average patient discharge. The categorical variable was dummy coded.
National Patient Safety Goals (NPSGs)	Measured by data obtained from The Joint Commission site of Quality Check®, which provides data that denotes if the hospital met NPSGs during survey or failed to meet goals. If goal not met (0) and goal met (1).

Note. RN = registered nurse. FTE = full-time equivalent. Data from the Agency for Healthcare Research and Quality, 2011.

Group Size, Missing, and Outlier Data

Treatment of missing values was contingent upon whether the missing value was hospital- or patient-level data. Missing values for hospital-level data such as hospital teaching status, ownership, size, location, and Quality Check® data provided by The Joint Commission was addressed first by attempting to replace the value by searching alternative datasets or other sources for prior year's data, especially AHA data. Patient-level missing data for variables such as age, sex, or DRG resulted in the exclusion of that case from the PSI software analysis (AHRQ, 2012a).

There was no missing data in the descriptive hospital characteristics for The Joint Commission accredited hospitals group. In addition, missing data were examined for the PSI dataset. Missing data were a concern in the staffing variables, specifically the RN FTE ($n = 14$), LPN FTE ($n = 13$), and the total license FTE ($n = 14$). The cases were not excluded. Missing was included as a category when examining PSI data to determine if there were significant relationships in the outcome PSIs. Missing RN staffing cases were excluded when analysis of variables other than PSIs was performed.

The data were examined for outliers using Mahalanobis distance. This distance is the multivariate measure of distance from the centroid (mean of all the variables). Mahalanobis distance reported the highest and lowest five cases for the each of the PSI variables selected. Only the cases with the greatest value from the mean were examined. The outliers in the study variables were examined for proper data entry. Outliers were identified in PSI #3 decubitus ulcer rates, PSI #7 central venous catheter bloodstream

infection rates, and PSI #13 postoperative sepsis rates. Two outliers were found in both decubitus ulcer and postoperative sepsis. Only one outlier was identified in PSI #7.

Hospital demographics were examined using box plots to explore each outlier. The box plot displays the distribution of Mahalanobis distances intuitively and identifies extreme values. Upon exploration of the case numbers, it was discovered that the outliers in PSI #3 and PSI #7 had the same hospital identification number: a small, rural hospital located in the South with fewer than 360 discharges. Demographics for postoperative sepsis also were explored. The cases identified as outliers were not deleted or transformed from the sample because of the relationship to other data elements within the sample and the value that is added to the analysis.

Data Analysis

Data were analyzed using the latest Graduate Statistical Package for the Social Sciences® 23. The methods, measures, and analysis of the variables are delineated in Table 7. Hospital rates of occurrence for each of three AHRQ PSIs for decubitus ulcers and infections, postoperative sepsis, and central venous line bloodstream infection were calculated by applying the PSI software version 5.0 to the NIS dataset.

The five structural variables of the study were NPSGs, RN FTE staffing per APD, geographic region, hospital bed size, and hospital teaching status and location. The outcome variables were the risk-adjusted PSI rates for decubitus ulcer, central venous catheter bloodstream infection, and postoperative sepsis. A detailed description of the analyses for each of the four research questions will follow.

Descriptive statistics such as mean, median, range, and frequency on the continuous variable of RN FTEs were calculated, and a frequency distribution was conducted for categorical variables of teaching status, NPSG, bed size, and location. The study framework for structural components (hospital characteristics), process components (patient safety practices), and outcome elements (PSIs) were examined using the frequency and distribution of the sample and sample characteristics. The association of the independent variable to the dependent variable was assessed by conducting univariate and multivariate regression analyses. Logistic regression was performed to identify variable relationships to model the criterion variables and provide odds ratios to determine the probability of changes in regressor values.

The data were examined in the following manner: The relationship between hospital characteristics (teaching status, bed size, geographic location, and nurse staffing levels) on patient safety practices was examined first using a Mann Whitney U test. Next, the association of NPSG compliance and its relationship to patient safety outcomes was evaluated for each PSI using a logistic regression analysis. Finally, the association of hospital characteristics of teaching status, bed size, geographic location, nurse staffing, and NPSG compliance with patient outcomes was evaluated using Kruskal-Wallis.

Data Analysis Plan

Research Question 1

Is there a relationship between NPSG compliance and the AHRQ's PSI risk-adjusted hospital outcome rates for decubitus ulcer, postoperative sepsis, and central

venous catheter bloodstream infection in acute care hospitals accredited by The Joint Commission?

Aim: To explore whether a relationship exists between the implementation of NPSGs and differences in the AHRQ's PSI outcomes. Statistics were used to describe the characteristics of accredited hospitals that implemented NPSGs, versus those hospitals that did not implement NPSGs. Mean, median, range, and frequency were identified on all continuous variables within the study (decubitus ulcer, central venous catheter-related bloodstream infection, and postoperative sepsis).

Mann-Whitney U tests were conducted to determine whether hospital NPSG-compliance was associated with select adverse outcomes (PSIs) in accredited acute care hospitals. A chi square analysis also was performed to explore differences in the groups, specifically the number and type of PSIs.

Research Question 2

What is the relationship between hospital characteristics and NPSG compliance in acute care hospitals?

Aim: To describe which acute care hospital organizational characteristics—teaching status, region, location, or bed size—are associated with the implementation of patient safety practices as measured NPSG compliance in accredited acute care hospitals.

The relationship between the independent variables (bed size, geographic region, teaching status and location, and RN staffing levels) to the dependent variable (NPSG-compliance) was explored using univariate and simple logistic regression analyses.

Regression was used to develop a model for study variables that were related as follows: Statistics for the overall model fit, classification table predicting group membership, and summary of model variables were performed. Chi square statistics were calculated with levels of significance for the mode, block, and step. The calculation was appropriate as the resulting model represents the difference between the constant-only and model generated (Mertler & Vannatta, 2005).

Several statistics—B, S.E. Wald, df, Sig., R, Exp(B), and odds ratio 95% CI—were interpreted for each variable. The odds ratio represents the risk increase—or decrease if Exp (B) is less than 1—as the predictor variable increases by one unit. Logistic regression did not require adherence to any assumptions about the distribution of predictor variables (Tabachnik & Fidell, 2001).

Research Question 3

What is the relationship between hospital characteristics and AHRQ Patient Safety Indicator outcome rates of decubitus ulcer, postoperative sepsis, and central venous catheter bloodstream infection in accredited acute care hospitals?

Aim: Explore the relationship between hospital characteristics (bed size, census region, teaching status and location, RN staffing levels, and NPSGs) and selected AHRQ PSIs (postoperative sepsis, central venous line bloodstream infection, and decubitus ulcer). The independent variables included both continuous variables (nurse staffing) and categorical variables (geographic region, teaching status and location, and bed size). The AHRQ's PSIs were treated as the dependent variables (postoperative sepsis, central venous line bloodstream infection, and decubitus ulcer).

The Kruskal-Wallis test was used to conduct this analysis. It is a nonparametric test used when the assumptions of the ANOVA statistical test are not met for one or more reasons. The test was used in this research because each group of PSIs was not distributed normally in the sample, and the variance of the score for each group of interest was not equal. It assessed significant differences on the continuous dependent variable by grouping independent variables (with three or more groups). It is considered as an equivalent to the ANOVA.

Research Question 4

What are the independent predictors of adverse hospital AHRQ PSIs for decubitus ulcer, postoperative sepsis, and central venous catheter bloodstream infection in accredited acute care hospitals?

Aim: Identify the independent predictors for AHRQ's risk-adjusted PSI rates (decubitus ulcer, postoperative sepsis, and central venous catheter bloodstream infection) in accredited acute care hospitals associated with hospital characteristics of bed size, teaching status and location, and RN staffing levels. The independent variables were hospital characteristics, including RN staffing levels, and the dependent variables were the three PSIs used for this study. Binary logistic regression was utilized to determine which combinations of the five independent variables—hospital bed size, geographic region, teaching status and location, RN FTE/1,000 APD days, and NPSG-compliance—predict the probability of occurrence of the selected adverse event PSIs (decubitus ulcer, central venous line bloodstream infection, and postoperative sepsis).

In a multiple regression model such as this, independent categorical variables with more than two levels were dummy coded to ensure that results were interpretable. These steps include recoding the categorical variable into a number of separate, dichotomous variables. Dummy code variable is a variable created to represent an attribute with two or more distinct categories or levels. Independent variables recoded were as follows: hospital bed size, geographic region, teaching status and location, and RN staffing level. Each PSI in this study was used as a dependent variable. They also were dummy coded into two dichotomous variables. Each PSI dependent variable was divided into two groups related to the likelihood of having or avoiding a PSI.

Human Subject Protection

The researcher obtained permission for the study through George Mason University's Human Subjects Review Board. Because no human subjects were directly involved in this study, an institutional review board waiver was requested and granted. This study was exempt from board review because of the use of secondary data and because analysis of administrative data of all hospitals was de-identified. An HCUP orientation course was required by the AHRQ prior to the release of the NIS data.

The data use agreement signed with the AHRQ executes the data protections of the Health Insurance Portability and Accountability Act of 1996 and the AHRQ's confidentiality statute. This agreement prohibits any attempt to identify any person's or individual organization's data within the HCUP-NIS database. The AHA and Joint Commission data were linked to HCUP-NIS using the AHA and HCUP hospital identifiers. All identifiers were removed from the data file, and random numbers were

assigned to the hospitals included in the study. Participating hospitals were not identified by name for data variables.

The Joint Commission quality data are available to the public through its website, The Joint Commission Quality Check®, at <http://www.jcaho.org>. HCUP-NIS and AHA data are confidential. However, once the data are linked, the data were secured and protected on a computer and an external hard drive that required an access code. Only the researcher had access to the database codes and data. Prohibitions on the data agreement included disclosing the dataset to parties outside of the agreement, and use by any other party other than the requester and persons who completed the NIS-HCUP training module. De-identified data printouts were stored in a locked file drawer accessible only by the researcher.

CHAPTER 4: RESULTS

This study examined the relationship among Joint Commission accredited hospitals, hospital characteristics, and AHRQ's PSIs to gain a broader understanding of the possible influence of accreditation and other structural processes on selected adverse patient outcomes. The results of this study may inform hospital leaders' knowledge about the differences in adverse patient outcomes and how hospital structure and process variables relate to such selected adverse outcomes (PSIs).

This chapter commences with an overview of variable construction and a description of the population and sample of hospitals as depicted using central tendency statistics. It includes a description of data notes for the study database and discloses the results of the statistical analysis for each of the four research questions. The chapter concludes with a summary of key findings.

Descriptive Analysis

This section presents descriptive statistics from the study. The study sample was derived from the 2011 HCUP-NIS, a survey of U.S. hospitals that included 1,049 hospitals and more than 8 million inpatient discharge records. The inclusion criteria yielded 1,737,242 inpatient discharge records from 149 hospitals in 28 states for this study sample.

As presented in Table 10, the number of hospitals in the 2011 sample varied by state. Florida had the most (253), while Rhode Island and Vermont each had 16. The number of Joint Commission accredited hospitals likewise varied by state. California had the most (335) with Vermont having the fewest (9). Finally, in the study sample, the number of accredited hospitals in each state varied from 20 in Florida to one in Montana.

Table 10

Number and Accreditation Status of U.S. Hospitals in 2011 by State

Sample State	Number of Hospitals	Number of Accredited Hospitals	Percentage of Hospitals Accredited in 2011
Arizona	99	54	2%
Arkansas	103	53	2%
California	419	335	13%
Colorado	95	66	5%
Connecticut	46	40	3%
Florida	253	215	13%
Illinois	215	153	8%
Iowa	126	39	0.7%
Kentucky	130	93	4%
Maryland	69	65	0.7%
Massachusetts	119	109	4%
Minnesota	148	77	3%
Mississippi	116	59	4%
Montana	65	14	0.7%
Nevada	58	38	2%
New Jersey	95	83	3%
New York	235	189	6%
North Carolina	144	127	3%
North Dakota	50	17	3%
Oregon	65	40	1%
Pennsylvania	243	187	5%
Rhode Island	16	16	1%
Vermont	16	9	0.7%
Virginia	121	103	5%
Washington	107	65	2%
West Virginia	65	51	0.7%
Wisconsin	150	109	4%
Total	4614	2405	149

Note. Data from American Hospital Association, 2013.

The demographic characteristics of hospitals that were of interest to this investigator were the type of hospital, geographic location, teaching status, and size.

Table 11 presents the demographics of hospitals in the study sample (n = 149).

Table 11

Distribution of Hospitals by Region, Size, Teaching Status, and Location

Characteristic	Category	Frequency (n = 149)	Percentage
Region	1-Northeast	34	22.8%
	2-Midwest	24	16.1%
	3-South	49	32.9%
	4-West	42	28.2%
Bed Size	1-Small	51	34.2%
	2-Medium	38	25.5%
	3-Large	60	40.3%
Teaching Status and Location	1-Rural	40	26.8%
	2-Urban nonteaching	74	49.7%
	3-Urban teaching	35	23.5%
NPSG	No	20	13.4%
	Yes	129	85.9%

Note: Healthcare Cost and Utilization Project National Inpatient Sample 2011 database and The Joint Commission Quality Check® data.

Table 12 presents a listing of the 28 HCUP-participating states by region.

Table 12

Healthcare Cost and Utilization Project-Participating Hospitals by States and Region

Region	States
Northeast	Connecticut, Maine, Massachusetts, New Jersey, New York, Rhode Island, Vermont, Pennsylvania

Region	States
Midwest	Illinois, Iowa, Minnesota, Missouri, Montana, North Dakota, Wisconsin
South	Arkansas, Florida, Kentucky, Maryland, North Carolina, South Carolina, Virginia, West Virginia
West	Arizona, California, Colorado, Oregon, Washington

Note. Healthcare Cost and Utilization Project National Inpatient Sample 2011 data.

Joint Commission accredited hospitals in the sample were distributed across four geographic locations defined by the U.S. Census Bureau: Northeast, Midwest, South, and West as shown in Table 12. While sample hospitals evenly were distributed regionally, the majority of discharges (32%) came from hospitals in South ($n = 49$). Among the U.S. hospital population (2011 NIS hospitals), 39.8% of all discharges were attributable to those located in the South. Within the study sample, the region having the fewest hospitals was the Midwest with 16.9% of all hospitals. The Northeast followed with 22%, then the West with 32.9%.

Large institutions comprised 39.4% of those in the NIS study with 36.1% being medium and 34.2% being small. Among hospitals in this study, the number in each size category varied considerably from one to 425. (See the AHA 2011 definition of hospital bed size categories in Table 3.) Among all bed sizes, large hospitals represented 8% of all inpatient hospital discharges in the United States. In the 2011 NIS study, large hospitals accounted for 29% of total hospital inpatient discharges reported, while in this study, large hospitals accounted for 40% of the inpatient hospital discharges.

Considering differences in teaching status and location, about half (49.7%) of hospitals in the NIS study were identified as urban nonteaching, while about a quarter

(24.5%) were classified as urban teaching and another quarter (25.8%) were rural.

Inpatient hospital discharges were distributed evenly between hospitals classified as rural and urban teaching. Approximately half of hospital inpatient discharges from the study sample were attributable to nonteaching facilities in urban areas. This finding is comparable to the 2011 NIS hospital population that had a similar distribution. Urban nonteaching hospitals accounted for 43% of discharges in the 2011 NIS population and 49.7% of discharges in the study sample. Joint Commission accredited urban hospitals accounted for 64% of all hospitals in the sample, and 54% were classified further as nonteaching.

A greater concentration of large hospitals ($n = 60$) and those classified as urban nonteaching ($n = 74$) were located in the South ($n = 49$). They accounted for the largest number of hospital inpatient discharges in the study sample. Among 2011 NIS hospitals, fewer were classified as large hospitals and more classified as small. Hospitals with the fewest number of inpatient discharges in the sample were reported among medium-size facilities ($n = 38$) and urban teaching hospitals ($n = 35$) located in the Midwest. Table 11 presents the distribution of hospitals in the study sample ($n = 149$) by the demographic characteristics of interest to this study.

There were 149 Joint Commission sample hospitals accredited in 2011. Hospitals surveyed by The Joint Commission comprised 33% of the 1,049 NIS hospitals in 2011. About 85% of Joint Commission accredited hospitals were NPSG-compliant. Among Joint Commission hospitals in the study sample, 13% did not meet NPSGs.

Three PSIs were selected for use in this study. The selected PSIs were reported for a total of 1.7 million inpatient discharges. PSIs were reported by the rate of incidence per 1,000 patient discharges and incidence frequency. The percentage of sample hospitals reporting an adverse event versus those not reporting any adverse events was equally distributed. Findings by each PSI of interest in this study follows.

Decubitus ulcer, PSI #3, had a mean occurrence rate of 5.17/1,000 discharges in the 149-hospital inpatient discharge sample. The rate of PSI #3 is lower than the rate in the 2011 NIS population (7.86/1,000). As shown by the standard deviation scores in Table 13, the sample revealed moderate variability.

Table 13

Mean Rate of Hospital-Reported Patient Safety Indicators

PSI Reported	Joint Commission Accredited Study Hospitals (n = 149)		NIS Hospitals (n = 1049)
	Rate	SD	Rate
PSI #3 Decubitus Ulcer	5.17	6.9	7.86
PSI #7 Central Venous Line	0.46	0.85	0.75
PSI #13 Postoperative Sepsis	12.0	40.67	17.43
Registered nurse full-time equivalent per average patient discharge	3.5	1.50	

Note. Data from Healthcare Cost and Utilization Project National Inpatient Sample 2011 and American Hospital Association 2013 databases.

The rate of PSI #7, central venous catheter bloodstream infections, was 46/1,000 APD. The central venous line bloodstream infection rate among hospitals in the study sample was lower than that reported among hospitals in the 2011 NIS population:

0.75/1,000 discharges compared with PSI #7. Little variation was revealed between study-sample hospitals and the population of NIS hospitals for this indicator. This is reflected in the frequencies of hospital-reported PSIs in Table 14. While central venous line bloodstream infection was reported by 59% of study hospitals, it had the highest rate of occurrence. However, central venous line bloodstream infections accounted for the lowest observed rate among the three, inpatient PSI outcomes.

PSI #13, postoperative sepsis, had an observed rate of 12/1,000 APD in the study hospitals. This rate was the highest among studied PSIs as shown in Table 14. The observed rate of postoperative sepsis was lower than that reported by 2011 NIS hospitals, which was 17.43/1,000 discharges. Postoperative sepsis had the largest variability in the sample (standard deviation of 40.67) as depicted in Table 14. Postoperative sepsis, PSI #13, accounted for one of the lowest frequencies of adverse outcomes among the three PSIs analyzed in this study.

Findings Reported by Research Questions

The results of the data analysis reported in this section are organized according to the research questions. This exploratory, descriptive research project utilized quantitative methods to analyze the relationship between select adverse patient outcomes and hospital characteristic predictor variables.

Research Question 1

To identify and describe the relationship between NPSGs and risk-adjusted PSI outcome rates (postoperative sepsis, decubitus ulcer, and central venous catheter bloodstream infection).

The characteristics and distribution of sample hospitals were analyzed using descriptive statistics. Relationships between hospital characteristics and adverse outcomes of interest in the study were explored using the Mann Whitney U test. The relationship between hospitals' NPSG compliance and rate of adverse outcomes was analyzed.

As shown in Table 14, 86.6% of the 149 acute care hospitals in the study sample (n = 129) complied with NPSGs, whereas 13.4% (n = 20) were not NPSG-compliant.

Table 14

Hospital Patient Safety Indicator Frequency by National Patient Safety Goal Compliance

(n = 149)	PSI #3		PSI #7		PSI #13	
NPSG	No	Yes	No	Yes	No	Yes
<u>Noncompliant (n)</u>	7	13	11	9	11	9
% within NPSG	35%	65%	55%	45%	55%	45.5%
<u>NPSG Compliant (n)</u>	63	66	50	79	64	65
% within PSI	90%	83.5%	82%	89.8%	85.3%	87%

Note. Analysis of The Joint Commission Quality Check® 2011 data.

Hospitals that did not attain NPSG compliance had higher adverse event rates for PSIs reported as compared with hospitals that complied with NPSGs. Comparing the 2011 NIS hospital PSI rates and study sample PSI rates, hospitals that did not comply with NPSGs demonstrated a higher occurrence of the three adverse events studied. Small hospitals had the highest frequency of adverse event occurrences among the three studied PSIs. However, the observed occurrence rates for small hospitals remained lower than the study-sample hospitals and 2011 NIS hospital rates.

Among hospitals that attained compliance with NPSGs, the incidence of occurrence was similar within all three PSIs. Overall rates of occurrence of adverse events for the selected PSIs in hospitals that complied with NPSGs were lower for two of three PSIs compared with the hospital sample and 2011 NIS rates. The study next analyzed PSI occurrence in U.S. hospitals by hospital characteristics as shown in Table 15. It begins with an examination of geographic location.

Table 15

Patient Safety Indicator Rates by National Patient Safety Goal Compliance for Sample Hospitals Studied

(n = 149)	PSI #3 Rate		PSI #7 Rate		PSI #13 Rate	
Study Sample Rate	5.17		.46		12.0	
NPSG compliance	No	Yes	No	Yes	No	Yes
Rate/1000 discharges	36.77	8.16	.487	.259	5.87	5.07
Bed Size						
Small	5.49	3.77	.183	.51	16.0	4.8
Medium	7.36	4.49	.176	.44	37.27	9.83
Large	6.51	5.50	.311	.496	9.9	10.26
Region						
Northeast	5.02	4.88	.180	.418	8.93	7.32
Midwest	10.76	2.89	.676	.335	8.8	5.74
South	8.63	7.48	.222	.744	73.85	10.94
West	2.60	2.20	.150	.338	27.04	7.02
Teaching Status/Location						
Rural	5.87	1.05	.211	.177	22.0	2.59
Urban Nonteaching	7.23	5.60	.375	.646	67.0	9.15
Urban Teaching	7.60	1.10	.110	.444	11.05	1.34

Note. Analysis of Healthcare Cost and Utilization Project National Inpatient Sample 2011 data.

NIS hospitals located in the North, Midwest, and West that attained compliance with NPSGs had lower rates of adverse outcomes than did hospitals in the study sample. NIS hospitals located in the South that attained NPSG compliance had higher PSI rates

than those reported by study hospitals. In addition, hospitals located in the South had higher frequencies of the adverse events studied. The PSIs with the lowest incidence of occurrence was reported by NPSG-compliant hospitals in the Midwest. The range of hospital reported adverse outcomes varied by region and by PSI studied as shown in Table 16. Next, the study analyzed PSI occurrence by hospital teaching status and location (rural, urban nonteaching, and urban teaching).

Table 16

Patient Safety Indicator Frequency by Hospital Geographic Region

Hospital Region (n = 149)	PSI #3		PSI #7		PSI #13	
PSI observed	No	Yes	No	Yes	No	Yes
<u>Northeast (n)</u>	14	20	14	20	19	15
% within PSI	41.2%	58.8%	41.2%	58.8%	55.9%	44.1%
<u>Midwest (n)</u>	12	12	12	12	12	12
% within PSI	50%	50%	50%	50%	50%	50%
<u>South (n)</u>	14	35	17	32	16	33
% within PSI	28.6%	71.4%	34.7%	65.3%	32.7%	67.3%
<u>West (n)</u>	30	12	18	24	28	14
% within PSI	71.4%	28.6%	42.9%	57.1%	66.7%	33.3%

Note. Analysis of Healthcare Cost and Utilization Project National Inpatient Sample 2011 and American Hospital Association 2013 data.

Among teaching status and location, a higher percentage of urban teaching hospitals were NPSG-compliant regardless of adverse events reported. Among urban nonteaching hospitals that were NPSG-compliant, PSI rates hospitals were higher than rural and urban teaching rates for all studied PSIs. Table 17 illustrates the lowest observed frequency of all three PSIs was found in rural hospitals as compared with urban teaching and urban nonteaching hospitals. This is particularly interesting in that a higher

percentage of rural hospitals were NPSG compliance when compared with urban teaching and urban nonteaching hospitals. Next, the study analyzed PSI occurrence by RN staffing levels (low, medium, and high) as determined by RN FTE per 1000 APD.

Table 17

Patient Safety Indicator Frequency by Teaching Status and Location

Teaching status and Location (n = 149)	PSI #3		PSI #7		PSI #13	
PSI observed	No	Yes	No	Yes	No	Yes
<u>Rural (n)</u>	26	14	30	10	29	11
% within PSI	65%	35%	75%	25%	72.5%	27.5%
<u>Urban nonteaching (n)</u>	36	38	38	51	35	39
% within PSI	48.6%	51.4%	51.4%	68.9%	47.3%	52.7%
<u>Urban teaching (n)</u>	8	27	8	27	11	24
% within PSI	22.9%	77.1%	22.9%	77.1%	31.4%	68.6%

Note. Analysis of Healthcare Cost and Utilization Project National Inpatient Sample 2011 and American Hospital Association 2013 data.

Hospitals with RN staffing levels, medium level (3 to 5 FTEs/1000 APD) had higher compliance with NPSGs than did hospitals with high (≥ 5 FTEs/1000 APD) or low RN staffing levels (< 3 FTEs/1000 APD). A higher percentage of hospitals with low RN staffing levels were non-NPSG-compliant, regardless of PSI reported. Table 18 indicates hospitals with high levels of RN staffing also had lower total adverse events regardless of PSI.

Table 18

Frequency of Patient Safety Indicator by Registered Nurse Staffing Levels

Level of RN staffing (n = 139)	PSI #3		PSI #7		PSI #13	
PSI observed	No	Yes	No	Yes	No	Yes
Low staffing (< 3 RN FTEs/1000 APD)	32	18	27	23	37	13
% hospital with PSI	64%	36%	54%	46%	74%	26%
Medium staffing (3-5 RN FTEs/1000 APD)	21	43	19	45	22	42
% within PSI	32.8%	67.2%	29.7%	70.3%	34.4%	65.6%
High (\geq 5 FTEs/1000 APD)	11	10	6	15	10	11
% within PSI	52.4%	47.6%	28.6%	71.4%	47.6%	52.4%

Note. Analysis of Healthcare Cost and Utilization Project National Inpatient Sample 2011 data.

RN = registered nurse. FTE = full-time equivalent. APD = adjusted patient discharge. PSI = patient safety indicator.

Next, the study analyzed PSI occurrence by hospital bed size (small, medium, and large), as defined by the AHA.

Table 19 depicts the frequency of Patient Safety Indicator frequency examined by hospital bed size. Large hospitals were found to have higher rates of adverse events regardless of PSI. However, overall adverse event rates were lower than that reported for small and medium size hospitals. A larger percentage of large hospitals were NPSG compliant than were medium and small hospitals. Medium size hospitals had the lowest NPSG compliance compared with small and large hospitals. Among bed sizes, small hospitals had the lowest percentage of adverse event occurrence rates regardless of PSI studied.

Table 19

Patient Safety Indicator Frequency by Hospital Bed Size

Hospital by bed size (n = 149)	PSI #3		PSI #7		PSI #13	
PSI observed	No	Yes	No	Yes	No	Yes
<u>Small hospital</u>	35	16	33	18	38	13
% with PSI	68.6%	31.4%	64.7%	35.3%	74.5%	25.5%
<u>Medium hospital</u>	19	19	13	25	20	18
% with PSI	50%	50%	34.2%	65.8%	52.6%	47.4%
<u>Large hospital</u>	16	44	15	45	17	43
% with PSI	26.7%	73.3%	25%	75%	28.3%	71.7%

Note. Analysis of Healthcare Cost and Utilization Project National Inpatient Sample 2011 and American Hospital Association study data.

This section covers hospital reported adverse events by selected PSIs (decubitus ulcer, central venous catheter bloodstream infection, and postoperative sepsis). Among NPSG-compliant hospitals in the study sample, the rates of each reported PSIs varied. The rate of decubitus ulcer ($M = 8.16/1000$ APD) were higher in the 2011 NIS population than were found in the study's sample. Large hospitals' adverse event rates for decubitus ulcer ($M = 5.50/1000$ APD) were higher than both the 2011 NIS population and the study's sample. The decubitus ulcer rates in small and medium hospitals were lower than that reported for the 2011 NIS population hospitals ($7.86/1000$ APD). The rate observed for PSI #3 was lower than that found in sample hospitals (NPSG-compliant and noncompliant). The risk-adjusted rate for decubitus ulcer in hospitals that were not NPSG-compliant was higher ($M = 5.87/1000$ APD) than was found in the sample for decubitus ulcer. It was not however as high as the 2011 NIS population rate of $7.86/1000$ APD. For NPSG-compliant hospitals in the South, higher rates of decubitus ulcer ($7.48/1000$ APD) were found, as compared to that reported for hospitals in the sample

(5.12/1000 APD). Hospitals with RN staffing levels classified as high (≥ 5.0 FTE/1000 APD) experienced the highest rates of decubitus ulcer.

Central venous catheter bloodstream risk-adjusted infection rates were low for both NPSG compliant and noncompliant hospitals in the NIS population. Both groups had a rate that was lower than reported by hospitals in the sample (rate of .46/1000 discharges).

The risk-adjusted postoperative sepsis rate for NPSG-compliant hospitals was 5.07/1000 discharges. This rate was lower than both the observed rate in the hospital study sample (12.00/1000 APD) and the 2011 NIS (17.43/1000 APD). However, the mean rate of postoperative sepsis in non-NPSG-compliant hospitals was higher (36.77/1000 APD). NPSG compliant large hospitals and those located in the South had higher postoperative sepsis rates. Conversely, their sepsis rate was lower than that found in both the hospital study sample and the 2011 NIS population. Postoperative sepsis had the highest mean rate among all three PSIs studied.

The frequency and presence of each adverse event were analyzed for all study sample hospitals. Over 38% of the hospitals in the study sample ($n = 149$) reported all three PSIs studied. Of the hospitals in the study, only 14% had two-PSI adverse events, whereas 23.4% reported one adverse event. Further, 25% of the hospitals in the study sample did not report any adverse event. Of the sample hospitals that reported two PSIs, more than 40% included a central venous catheter-related bloodstream infection event. Central venous catheter-related bloodstream infection was the most frequent adverse event reported among the PSIs studied, yet these adverse event rates were the lowest per

1000 discharges among the three PSIs studied. In addition to the frequency of reported central venous catheter-related bloodstream infection rates, more than 51% of hospitals in the study sample reported an adverse event for postoperative sepsis. The hospital rate for PSI postoperative sepsis was higher than that reported for the other two PSIs of interest in this study.

The investigator used a Mann-Whitney U test to explore a possible relationship between PSIs and NPSG compliance the in sample of Joint Commission accredited hospitals. The investigator examined differences in risk-adjusted adverse outcome rates for the study PSIs in NPSG-compliant and noncompliant hospitals. No significant difference was found between three PSIs (NPSG-compliant and noncompliant hospitals) of interest in the study. Results are presented in Table 20.

Table 20

Relationship Between Hospital National Patient Safety Goal Compliance and Patient Safety Indicator Rate, Mann Whitney Results

RQ1 (n = 149)	Met NPSG		Did Not Meet NPSG		
PSI	Median	IQR	Median	IQR	Mann-Whitney p-value
Decubitus ulcer	2.58	0–8.94	2.85	0–12.52	.419
CVCBSI	0.26	0–0.57	0	0–0.42	.188
Postoperative sepsis	4.08	0–14.62	0	0–18.07	.990

Note. Analysis of Healthcare Cost and Utilization Project National Inpatient Sample 2011. PSI = patient safety indicator. CVCBSI = central venous catheter-related bloodstream infection. IQR = interquartile ratio. NPSG = national patient safety goal. Grouping variable is NPSG compliance.

The distribution and frequency of PSIs did not differ significantly between hospitals that complied with NPSGs and those that did not. The median rate for PSI #3, decubitus ulcer, was similar for the hospitals that complied with NPSGs as it was for

those that did not as shown in Table 21. Results of analysis using the Mann Whitney analysis test ($U = 1152$, $p = 0.419$) revealed no significant difference in hospital decubitus ulcer PSI rates.

Table 21

Logistic Regression Coefficients for Hospitals by Bed Size, Region, and Teaching Status

Hospital Characteristics	Met NPSG		Did Not Meet NPSG		Logistic Regression	
	N	%	N	%	Odds Ratio (95% CI)	p-value
Bed Size						
Small (number of beds)	47	36.4	4	20	2.93	.079
Medium	34	26.4	4	20	2.12	.224
Large	48	37.2	12	60	[ref]	[ref]
Region						
Northeast	31	24	3	15	2.07	.322
Midwest	21	16.3	3	15	1.4	.651
South	42	32.6	7	35	1.2	.754
West	35	27.1	7	35	[ref]	[ref]
Teaching and Location						
Rural	29	22.5	11	55	[ref]	[ref]
Urban Nonteaching	67	51.9	7	35	.160	.024
Urban Teaching	33	25.6	2	10	.580	.511

Note. Analysis of Healthcare Cost and Utilization Project National Inpatient Sample 2011 data. [ref] = reference.

Likewise, little variation in central venous bloodstream infection rates was found between compliant and noncompliant hospitals. Further, no significant difference in the central venous bloodstream infection rates among hospitals was found using the Mann Whitney test ($U = 1062$, $p = 0.188$).

Conversely, significant variation was found among NPSG-compliant and noncompliant hospitals in the frequency and distribution of postoperative sepsis. The mean rate of postoperative sepsis in compliant hospitals was five times higher than in the

noncompliant institutions. However, the Mann Whitney results indicated no significant difference in the postoperative sepsis rate ($U = 1288$, $p = 0.99$) in the two groups.

Research Question 2

To identify and describe the relationship between hospital characteristics and compliance with NPSGs.

Descriptive statistics and logistic regression was used to explore whether hospital system characteristics were related to hospital adoption of patient safety practices and adverse outcomes. The majority of hospitals in the study sample ($n=149$), 86.5%, were NPSG-compliant ($n= 129$).

Hospitals NPSG compliance based on bed size (small = 36.4%, medium = 26.4%, and large = 37.2%) were evenly distributed. However, hospitals that did not meet NPSGs were more likely to be large (60%). Considering hospital location, Table 22 shows that hospitals that met NPSGs were distributed evenly across three geographic regions with the smallest proportion of the sample found in the Midwest (16.3%). The South and West had larger numbers of hospitals with NPSG compliance equally distributed at 35% for each of the two. The two groups differed on teaching status and location. More than half of NPSG-compliant hospitals were located in urban nonteaching facilities (51.9%), and most of the hospitals that did not meet NPSGs were found to be rural facilities (55%).

Bed size and geographic region did not predict whether hospitals would be more likely to meet NPSG compliance. Teaching status and location were, however, significant predictors of whether a hospital would meet NPSGs. Hospitals classified as urban teaching ($p = .024$) were virtually no less likely to meet NPSG compliance than rural

hospitals. Interpretation of the regression analysis focused on determining the adequacy of the regression model. The R², F, and p values, as well as the standardized beta weight and bivariate correlation coefficients, were examined. Partial logistic regression was computed to determine if hospital bed size, geographic region, and teaching status and location were predictors of NPSG compliance.

Table 22

Hospital Bed Size, Region, Location, and National Patient Safety Goal Compliance, Chi Square Results

Variable	Chi-Square	df	p-value
Bed size	4.926	2	0.085
Region	9.309	3	0.025
Teaching Status and Location	18.134	2	p < 0.01

Note. Analysis of Healthcare Cost and Utilization Project National Inpatient Sample 2011 data.

Chi-square results shown in Table 22 indicated two predictors of interest: region ($\chi^2 (3) = 9.309$, $p = 0.025$) and teaching status ($\chi^2 (2) = 18.134$, $p < 0.001$). Both were statistically reliable in distinguishing between hospitals that met NPSG compliance compared with those that did not. No such relationship was found based on hospital bed size ($\chi^2 (2) = 4.926$, $p = 0.085$).

Research Question 3

To identify and describe the relationship between hospital organizational characteristics and risk-adjusted PSI outcome rates (decubitus ulcer, central venous catheter bloodstream infection, and postoperative sepsis).

Kruskal-Wallis and binary regression analysis were performed to examine the relationships between organizational characteristics of hospitals and AHRQ's risk-adjusted PSIs. Dependent variables in the study—risk-adjusted rates for decubitus ulcers, central venous line bloodstream infections, and postoperative sepsis were continuous. A Kruskal-Wallis was computed to compare PSIs by hospital characteristic groups for bed size, geographic region, teaching status and location.

Significant differences were found for selected hospital characteristics and PSI rates ($p < .05$). One significant difference ($p < .05$) was found between decubitus ulcer PSI rates and hospital characteristics. Higher rates of decubitus ulcer were reported among hospitals based on bed size, region, teaching/location, and RN staffing. Central venous catheter bloodstream infections were found to be significantly related ($p < .05$) to hospitals by bed size, teaching status and location, and RN staffing. Postoperative sepsis was found to be significantly associated ($p < .05$) with two variables—bed size, and teaching status and location. Bed size was significantly associated with all three of the PSIs with variable rates of occurrence for each as shown in Table 23.

Table 23

Kruskal-Wallis Test Results for Hospital Characteristics and Patient Safety Indicator Outcomes Relationships

PSIs	Decubitus Ulcer		Central Venous Catheter Blood-Stream Infection		Postoperative Sepsis	
Hospital Characteristics	<u>Chi</u> <u>Chi-square</u>	<u>Kruskal-</u> <u>Kruskal-</u> <u>Wallis</u> <u>p-value</u>	<u>Chi</u> <u>Chi-square</u>	<u>Kruskal-</u> <u>Kruskal-</u> <u>Wallis</u> <u>p-value</u>	<u>Chi</u> <u>Chi-square</u>	<u>Kruskal-</u> <u>Kruskal-</u> <u>Wallis</u> <u>p-value</u>
Bed Size	13.68	.001	10.21	.006	14.11	.001
Region	21.76	<.001	4.03	.258	7.35	.062

PSIs	Decubitus Ulcer		Central Venous Catheter Blood-Stream Infection		Postoperative Sepsis	
Teaching and Location	14.37	.001	20.64	<.001	8.37	.013
NPSG	.654	.419	1.73	.188	<.001	.990
RN Staffing	10.59	.005	9.30	.010	14.46	.001

Note. NPSG = national patient safety goal. RN = registered nurse.

Hospital region was found to be significant ($H(3) = 21.76, p < .001$) for PSI decubitus ulcer, and the adverse event rates varied by geographic region. These data indicate that patients discharged from hospitals in the South had the highest rate of decubitus ulcer adverse event outcomes among all regions in the study sample. The West had the lowest adverse rate for decubitus ulcer. These results are consistent with descriptive statistics shown in Table 24 in which the South had the highest mean rate among all three of the PSIs examined. The data further indicate that patients discharged from urban teaching hospitals had the highest adverse event rate ($M = 9.37/1000$ APD) for decubitus ulcer. This rate was higher than that found in the hospital study sample ($M = 5.17/1000$ APD). Among hospitals by teaching status and location, rural hospitals had the lowest average rates for decubitus ulcer ($M = 3.06/1000$ APD). Bed size was also significant for decubitus ulcer ($p = .001$). Medium-sized hospitals had the highest rate ($M = 7.83/1000$ APD) of decubitus ulcer compared with small hospitals and in comparison with the study sample of hospitals ($M = 5.17/1000$ APD). Small hospitals had the lowest rate of decubitus ulcers ($M = 6.86/1000$ APD) and this PSI was found to be the lowest for any of the three PSIs studied. This said, the small hospital rate for decubitus ulcers was higher than that reported by hospitals in the study sample ($M = 5.17/1000$ APD).

Table 24

2011 National Inpatient Sample Patient Safety Indicator Rates Per Hospital Study Sample Characteristic

(n = 149)	PSI #3 Decubitus Ulcer	PSI #7 CVLBSI	PSI #13 Sepsis	(n = 149)	PSI #3 Decubitus Ulcer	PSI #7 CVLBSI	PSI #13 Sepsis
Hospital Size				RN Staffing			
Small	Rates	Rates	Rates	Low	Rates	Rates	Rates
n	29	51	37	n	50	50	50
Mean	6.86	.49	18.73	Mean	3.13	2.82	6.46
SD	10.96	1.30	76.46	SD	4.99	.464	21.86
Medium				Medium			
n	25	38	30	n	64	64	64
Mean	7.83	.413	16.11	Mean	7.26	.595	17.32
SD	5.52	.445	28.46	SD	8.57	1.13	9.53
Large				High			
n	51	60	53	n	21	21	21
Mean	7.43	.459	11.54	Mean	4.85	.640	9.53
SD	5.34	.512	9.28	SD	5.68	.750	11.17
Region				Teaching Status and Location			
Northeast				Rural			
n	23	34	32	n	31	40	32
Mean	7.41	.397	7.17	Mean	3.06	.186	10.19
SD	4.62	.573	10.40	SD	4.85	.453	27.21
Midwest				Urban Nonteaching			
n	19	24	21	n	47	74	56
Mean	4.89	.377	7.00	Mean	9.06	.620	19.54
SD	5.46	.558	6.99	SD	8.64	1.11	61.97
South				Urban Teaching			
n	43	49	45	n	27	35	32
Mean	9.65	.670	21.70	Mean	9.37	.425	11.48
SD	9.19	1.29	68.80	SD	4.71	.387	10.07
West							
n	20	42	22				
Mean	4.77	.307	19.78				
SD	5.17	.493	31.76				

Note. Analysis of Healthcare Cost and Utilization Project National Inpatient Safety 2011 data. CVLBSI = central venous line bloodstream infection.

The mean rate for central venous line bloodstream infections by hospital bed size was equally distributed among hospitals of all sizes. Descriptive statistics presented in

Table 24 indicate that the mean central venous line bloodstream infections rates were lower among all hospitals (regardless of demographic characteristic) as compared to the rate of decubitus ulcer and postoperative sepsis rates. Conversely, the central venous line bloodstream infections rate for the South ($M = .670$) was higher than reported by hospitals in other regions, and was higher than in the hospital study sample ($M = 0.46/1000$ APD). In addition, the South had the highest percentage (58.8%) of hospitals with an occurrence of central venous catheter bloodstream infections.

The rate of postoperative sepsis was significant for hospitals by bed size ($p = .001$). Hospitals classified as small had the highest mean rate ($M = 18.73/1000$ APD), and large hospitals had the lowest mean rate ($M = 11.54/1000$ APD). Small hospital adverse event rates were higher than the hospital study sample rate ($M = 12.0/1000$ APD). Conversely, large hospitals' postoperative sepsis mean rates were lower compared with the hospital study sample rates. Hospital characteristics, teaching, and location also were significantly related to postoperative sepsis ($p = .013/1000$ APD). Patients discharged from urban nonteaching hospitals had the highest mean rate of postoperative sepsis ($M = 19.54/1000$ APD). The PSI postoperative sepsis adverse event outcome rate was higher in urban nonteaching hospitals compared with both the hospital study sample rate and 2011 NIS population rate. Both rural and urban teaching hospital postoperative sepsis rates were lower than the hospital study sample rate.

In addition, RN staffing was also found to be significantly related to postoperative sepsis. Hospitals that had RN staffing classified as medium (3.0 to 5.0 RN FTE/1,000 APD) had the highest mean rate of postoperative sepsis ($M = 17.32$).

Further analysis using multiple logistic regression was performed to determine predictors of decubitus ulcer, central venous line bloodstream infections, and postoperative sepsis based on hospital region, bed size, teaching status and location, NPSGs, and RN FTE APD.

Research Question 4

Binary logistic regression was used to determine which combinations of the five independent variables (hospital bed size, geographic region, teaching status and location, RN FTE/1,000 patient days, and NPSG compliance) would predict the probability of an adverse event of at least one PSI (decubitus ulcer, central venous line bloodstream infection, or postoperative sepsis). Independent categorical variables with more than two levels were dummy coded to ensure that the results were interpretable. These steps included recoding the categorical variable into a number of separate, dichotomous variables. Multicollinearity was assessed by evaluating tolerance, variance inflation index, and condition index for each independent variable. The assumption of multicollinearity was met.

Each PSI dependent variable was divided into two groups: (1) hospitals with scores of zero or (2) hospitals with scores greater than zero, as required to perform logistic regression analysis. Before multivariate analysis, a simple logistic regression was conducted with each independent and dependent variable. The goal was to examine the probabilities of adverse event outcomes (decubitus ulcer, central venous bloodstream infection, and postoperative sepsis) for each independent variable (hospital bed size,

region, teaching status and location, RN FTE per 1,000 patient days, and NPSG compliance).

Univariate analysis results revealed that PSI #3, decubitus ulcer, adverse events were more likely to be found in the following: small versus large hospitals ($p = < 0.001$), rural versus urban teaching ($p = 0.001$), and hospitals located in the following regions: Northeast ($p = 0.011$) and South ($p = < 0.001$). RN staffing classified as low (< 3 RN FTE/1000 APD) was significantly related to all adverse event outcomes studied.

PSI #7, central venous line bloodstream infections, was found to be more significantly associated with the following hospital characteristics: small compared with large bed-size hospitals ($p = < 0.001$), and rural compared with urban teaching hospitals ($p = 0.001$). In univariate analysis, central venous line bloodstream infection was not found to be significant by region. RN staffing classified as low (< 3 RN FTE/1,000 APD) was found to be significantly related to central venous line bloodstream infection rates. Region was not found to be significantly related to central venous line bloodstream infection.

In univariate analysis, PSI #13, postoperative sepsis, was significantly more common in small ($p = < 0.001$) and medium hospitals ($p = 0.017$) versus those with large numbers of beds, rural versus urban teaching ($p = 0.001$), and hospitals located in the South ($p = < 0.001$) compared with those in the West. RN staffing classified as low (< 3 RN FTE/1,000 APD) was significant when examining all adverse event outcomes independently.

The multivariate logistic regression model included four of the five original predictors. At each initial step of the regression, the test compared the actual values for the cases on the dependent variable with the predicted values. All steps resulted in significant values ($p < .001$), indicating that the overall model of the four predictors (hospital bed size, geographic region, teaching status and location, and RN FTEs) was significant and important in predicting each dependent variable (decubitus ulcer, central venous catheter bloodstream infection, and postoperative sepsis). Each of the PSIs was statistically reliable in distinguishing between hospitals with zero PSI occurrences versus those with any PSIs (*PSI #3*: $\chi^2 (10) = 61.04$, $p < .001$; *PSI #7*: $\chi^2 (10) = 50.19$, $p < .001$; and *PSI #13*: $\chi^2 (10) = 59.01$, $p < .001$). The model correctly classified 80% of decubitus ulcer and central venous line bloodstream infections and 58% of postoperative sepsis.

Three separate logistic regression analyses were conducted to determine the relationship to each PSI based upon the hospital characteristic variables of bed size, region, teaching status and location, and RN staffing FTEs. Regression coefficient results are presented in Tables 25, 26, and 27. Overall, significant differences were noted in PSI occurrences based on hospital bed size ($p \leq .05$) for all three PSIs (decubitus ulcer, central venous line bloodstream infection, and postoperative sepsis). Geographic region of the hospital was found to be a significant predictor ($p \leq .05$) of occurrences for two of the three PSIs (decubitus ulcer and postoperative sepsis). Teaching status and location were also a significant predictor for hospitals with all adverse event outcomes (decubitus ulcer, central venous line bloodstream infection, and postoperative sepsis). RN staffing (RN FTE 1000/APD) was not a significant predictor ($p \geq .05$) for any of the outcome

variables in the multivariate logistic regression. However, this result differs from the univariate analysis that found hospitals with low levels of RN staffing (< 3 FTE/1000 APD) significant for all three PSIs. The univariate and multivariate findings were consistent for hospital bed size, and teaching status and location.

Table 25

Logistic Regression Univariate and Multivariate–Decubitus Ulcer

Hospital Characteristics	Univariate Odds Ratio	Univariate Odds Ratio (95% CI)	Univariate p-value	Multivariate Odds Ratio	Multivariate Odds Ratio (95% CI)	Multivariate p-value
Bed Size						
Small	.166	.073-.379	<.001	.131	.045-.376	.000
Medium	.364	.155-.855	.020	.419	.139-1.258	.121
Large	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Region						
Northeast	3.571	1.372-9.294	.009	5.889	1.498-23.156	.011
Midwest	2.500	.881-7.096	.085	6.139	1.542-24.443	.010
South	6.250	2.510-15.563	.000	14.332	4.057-50.625	.000
West	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Teaching and Location						
Rural	.160	.057-.443	.000	.113	.025-.508	.004
Urban Nonteaching	.313	.126-.778	.012	.375	.118-1.195	.097
Urban Teaching	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
RN FTE per 1,000 discharge						
Lowest	.160	.057-.443	.000	1.322	.307-5.697	.708
Medium	.313	.126-.778	.012	3.094	.817-11.718	.096
Highest	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
NPSG	.564	.211-1.50	.253	.233	.063-852	.028

Note. Analysis of Healthcare Cost and Utilization Project National Inpatient Sample 2011 data. [ref] = reference.

Logistic regression results indicated that certain hospital characteristics—rural, small bed size, and hospital locations in the Northeast, Midwest, and South—were reliable predictors of decubitus ulcer occurrences. Rural hospitals reported fewer decubitus ulcer occurrences ($p = .004$) compared with urban teaching and nonteaching hospitals. Rural hospitals accounted for the smallest percentage (25%) of accredited hospitals in the sample and had the smallest RN staffing mean rates ($M = 2.42$ RN FTE/1,000 APD). While small hospitals ($p = < 0.001$) were a significant predictor of decubitus ulcer, the odds ratio was very small ($\text{Expo (B)} = .131$) compared with large hospitals. Among regions, three of the four were significant predictors for decubitus ulcer. Hospitals located in the Northeast ($p = 0.011$) were six times more likely to have an adverse event rate for decubitus ulcer than hospitals located in the West. Midwest hospitals ($p = 0.010$) were likewise six times more likely to have a higher adverse event rate for decubitus ulcer than hospitals located in the West.

Finally, hospitals located in the South ($p = < .001$) were found to be 14 times more likely to have a decubitus ulcer incident than hospitals located in the West as shown in Table 26. Hospitals in the South had the highest incidence (44%) of decubitus ulcer as shown in Table 26. Hospitals with high levels of RN FTE staffing ($\geq 5.0/1000$ APD) had the lowest incidence of decubitus ulcer. In 2006, there were 503,300 total hospital stays with pressure ulcers noted as a diagnosis—an increase of nearly 80% since 1993. Adult stays totaled \$11 billion in hospital costs. More than 90% of pressure ulcer-

related stays among adults were for the principal treatment of other conditions such as septicemia, pneumonia, and urinary tract infections (Lyder et al., 2012). The 95% confidence interval for the odds ratio comparing regions that had an incident of decubitus ulcer in the West was wide (1.49 to 50.62).

The South also had the highest percentages of adverse events among central venous line bloodstream infections and postoperative sepsis. However, region was not significant for central venous line bloodstream infections. Logistic regression results indicated that neither geographic region nor RN staffing were significant predictors of central venous line bloodstream infections. Rural hospitals and those classified as small bed size were predictors of central venous line bloodstream infections. While small hospitals were a significant predictor of central venous line bloodstream infections ($p = < .001$), the odds ratio was small ($\text{Expo (B)} = .097$) when compared with the constant of large hospitals as shown in Table 26. Rural hospitals were more likely to have a central venous line bloodstream infection incident than hospitals located in the West ($p = < .001$).

Table 26

Logistic Regression Univariate and Multivariate—Central Venous Line Bloodstream Infection

Hospital Characteristics	Univariate Odds Ratio	Univariate Odds Ratio (95% CI)	Univariate p-value	Multivariate Odds Ratio	Multivariate Odds Ratio (95% CI)	Multivariate p-value
Bed Size						
Small	.182	.080-.413	<.001	.097	.030-.319	.000
Medium	.641	.263-1.56	.327	.362	.106-1.237	.105
Large	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Region						
Northeast	1.071	.428-2.679	.883	1.315	.349-4.963	.686

Hospital Characteristics	Univariate Odds Ratio	Univariate Odds Ratio (95% CI)	Univariate p-value	Multivariate Odds Ratio	Multivariate Odds Ratio (95% CI)	Multivariate p-value
Midwest	.750	.274-2.053	.575	1.163	.304-4.440	.826
South	1.412	.604-3.297	.426	1.926	.607-6.109	.266
West	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Teaching and Location						
Rural	.099	.034-.287	.000	.028	.005-.153	.000
Urban Nonteaching	.657	.259-1.665	.376	.406	.115-1.437	.162
Urban Teaching	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
RN FTE average patient discharge per 1,000						
Lowest	.099	.034-.287	.000	1.324	.306-5.726	.707
Medium	.657	.259-1.665	.376	1.185	.310-4.526	.804
Highest	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
NPSG	1.93	.747-4.99	.174	1.14	.343-3.75	.83

Note: Analysis of Healthcare Cost and Utilization Project National Inpatient Sample 2011 data. [ref] = reference.

The importance of this finding is assumed to be related to The Joint Commission's recent focus on reducing central venous line bloodstream infections. The overall incidence of central venous line bloodstream infections was extremely low for this study sample. The central venous line bloodstream infections mean occurrence rate was .46/1,000 APD in the 149-hospital inpatient discharge sample. This rate was even lower than the 2011 NIS population rate of 0.75/1000 APD. Central venous line bloodstream infections also had small variability in the sample as shown by the standard deviation scores. Further, rural hospitals accounted for the smallest portion of the sample (25%). Therefore, this finding for rural hospitals may have questionable significance.

Table 27

Logistic Regression Univariate and Multivariate–Postoperative Sepsis

Hospital Characteristics	Univariate Odds Ratio	Univariate Odds Ratio (95% CI)	Univariate p-value	Multivariate Odds Ratio	Multivariate Odds Ratio (95% CI)	Multivariate p-value
Bed Size						
Small	1.35	.058-.314	.000	.101	.034-.302	.000
Medium	.356	.152-.832	.017	.296	.097-.904	.033
Large	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Region						
Northeast	1.579	.621-4.013	.337	1.723	.435-6.825	.439
Midwest	2.000	.717-5.577	.185	5.154	1.268-20.943	.022
South	4.125	1.717-9.909	.002	8.904	2.580-30.727	.001
West	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Teaching and Location						
Rural	.174	.064-.470	.001	.082	.017-.399	.002
Urban Nonteaching	.511	.219-1.191	.120	.416	.128-1.35	.145
Urban Teaching	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
RN FTE per 1,000 discharge						
Lowest	.319	.110-.926	.036	.691	.165-2.898	.614
Medium	1.736	.639-4.716	.280	2.191	.611-7.853	.229
Highest	[ref]	[ref]	.827	[ref]	[ref]	[ref]
NPSG	1.25	.482-3.19	.654	.962	.277-3.33	.952

Note. Analysis of Healthcare Cost and Utilization Project National Inpatient Sample 2011 data. [ref] = reference.

Analysis results indicated that rural hospitals with bed size classified as small ($p = 0.001$) and those classified as medium ($p = 0.033$) located in the Midwest and South were

predictors of postoperative sepsis. Hospitals located in rural areas ($p = .011$) also were significant predictors of postoperative sepsis. Rural hospitals accounted for the smallest percentage (25%) of accredited hospitals in the sample and had the smallest RN staffing mean ($M = 2.42$ RN FTE/1000 APD) among the variables. While rural hospital status was a significant predictor of postoperative sepsis, the odds ratio was small ($\text{Expo (B)} = .197$) when compared to against the constant of urban nonteaching hospitals.

Hospitals in the Midwest region were five times more likely to have a higher rate of postoperative sepsis than were hospitals in the West. Hospitals in the South ($p = .001$) were nine times more likely to have an incident of postoperative sepsis than were hospitals in the West. Hospitals in the South also had the highest mean rate of postoperative sepsis ($M = 8.47/1000$ APD). Further, descriptive statistics reflected that hospitals located in the South had the highest incidence (45%) of postoperative sepsis. Exactly why hospital location is related to unfavorable outcomes is not known. A number of extraneous organizational factors such as nurse education, skill mix, unit manager leadership, and socio-economics are thought to influence this finding.

Summary of Results

PSI rates did not differ significantly between hospitals that complied with NPSGs and those that did not. Descriptive statistics revealed differences in the sample based on the characteristics of compliance with NPSGs, bed size, location, RN FTEs per 1000 APD, and teaching status and location. Postoperative sepsis had higher mean rates on all variables associated with bed size, region, RN staffing FTE/1000 APD, NPSG

compliance, and teaching status and location. Central venous line bloodstream infection had the lowest mean rates among all variables associated with bed size, region, RN staffing FTE/1000 APD, NPSG compliance, and teaching status and location.

The Mann Whitney U test did not find a significant difference in PSI adverse outcome rate (decubitus ulcer, postoperative sepsis, and central venous catheter bloodstream infection) in hospitals with NPSG compliance versus those that were not NPSG-compliance.

Hospitals compliant with NPSGs were more balanced across bed sizes (small = 36.4%, medium = 26.4%, and large = 37.2%), while hospitals that were not NPSG-compliant were primarily large in size (60%). Hospitals that were NPSG-compliant were distributed more evenly across the three regions with the smallest sample in the Midwest (16.3%). The South and West had larger samples but were equal in distribution (South = 35% and West = 35%). The two groups differed on teaching status and location. Most NPSG-compliant hospitals were located in urban nonteaching areas (51.9%). The noncompliant NPSG hospitals were rural (55%) facilities.

The reliability of the overall model of two predictors, region ($\chi^2 (3) = 9.309$, $p < .05$) and teaching status ($\chi^2 (2) = 18.134$, $p < .05$), was identified through regression analysis. These predictors were statistically reliable in distinguishing between NPSG-compliant and noncompliant hospitals. However, bed size was questionable ($\chi^2 (2) = 4.926$, $p > .05$).

Several significant differences ($p < .05$) among hospital characteristics and adverse event outcomes were found through the Kruskal-Wallis analysis. Significance (p

< .05) was found in the relationship between decubitus ulcer and a number of hospital characteristics (bed size, region, RN staffing, and teaching status and location). Results of the analysis indicated a significant ($p < .05$) relationship between PSI #7, central venous line bloodstream infection, and several hospital characteristics (bed size, teaching status and location, and RN staffing). Postoperative sepsis was found to have a significant ($p < .05$) relationship between two variables (bed size, and teaching status and location).

Statistical significance for bed size ($p \leq .05$) and all three adverse event outcome variables (decubitus ulcer, central venous line bloodstream infection, and postoperative sepsis) were found through the binary logistic regression analysis. Region was a significant predictor ($p = < .05$) for two of three outcome variables (decubitus ulcer and postoperative sepsis). Teaching status and location also was found to be a significant predictor for all three adverse event outcome variables (decubitus ulcer, central venous line bloodstream infection, and postoperative sepsis). Further discussions and implications of these findings will be addressed in Chapter 5.

CHAPTER 5: DISCUSSION AND RECOMMENDATIONS

Hospitals struggle with the impact and consequences of organizational structure and process at the system level. In 2013, hospital deaths associated with preventable errors was estimated at more than 200,000 per year (James, 2013). This estimate is more than double the original estimates provided more than a decade ago in the IOM report *To Err is Human: Building a Safer Health System* (Kohn et al., 2000). The loss of life and irreversible harm to patients in hospitals generates an urgency and increased vigilance to address the problem of harm to patients who seek safe, high-quality care. This chapter addresses implications for nursing research, the role of leaders in steering a quality-focused organization, comparison literature related to the study's findings, study limitations, and recommendations for further research.

Because of the heightened attention toward improving patient safety over the past decade, healthcare leaders have turned to the safety science literature to help explain patient safety and provide direction for creating safety management systems (Flin, 2007). Efforts to improve safety have been encumbered, in part, by the difficulty in examining systemic failures that occur in complex, dynamic environments such as hospitals. Adding to the challenge is the realization that the influences of patient safety practices remain relatively unexplored in healthcare settings. Thornlow and Merwin (2009) assert that the relationship between utilization of patient safety practices, specifically The Joint

Commission's NPSGs, has not been well studied, making it difficult for hospitals to understand and identify useful actions to solve problems and create improved patient outcomes. This study's findings add insight to the understanding of the relationship between patient safety practices and patient outcomes.

Existing data from HCUP-NIS, AHA, and The Joint Commission were used to analyze relationships among selected risk-adjusted PSIs (decubitus ulcer, central venous line bloodstream infection, and postoperative sepsis), NPSG compliance, and hospital structural characteristics, including RN FTE/1,000 APD. Study results provided evidence that hospital system characteristics such as bed size, region, teaching status and location, and nurse staffing levels are related to hospital compliance of NPSGs, and this, in turn, predicts the findings as discussed regarding the selected PSIs.

Question 1

In this study, outcome rates for three selected PSIs—decubitus ulcer, central venous line bloodstream infections, and postoperative sepsis—were not found to be significantly related to the implementation of patient safety practices such as NPSGs. Hospitals accredited in 2011 make up 33% of the total Joint Commission 2011 NIS database. Eighty-six percent of the sample hospitals are NPSG-compliant, while only 14% are noncompliant. Distributions for the selected outcome variables did not significantly differ between hospitals that complied with the national patient safety practice guidelines and those that did not.

While the analysis was not statistically significant, the data revealed crucial findings that support the value of patient safety practices. Within hospitals that were

found not NPSG-compliant, higher rates of adverse events were seen for each of the PSIs in this study. Moreover, little research has examined the influence of patient safety practices such as NPSG-compliance on patient safety outcomes. Specifically, past studies were limited to measuring Joint Commission accreditation scoring and the relationships with the AHRQ's PSIs (Miller et al., 2005; Masica et al., 2009; Thornlow & Merwin, 2009).

Two studies examined the association between Joint Commission accreditation scores, quality measures, and mortality (Chen et al., 2003) and inpatient quality and PSIs (Miller et al., 2005). Consistent with the findings of this study, the 2003 research found no significant relationship between The Joint Commission accreditation decisions and performance. Chen et al. (2003) examined the association between Joint Commission hospital accreditation, the hospitals' quality of care using three quality indicators and survival among Medicare patients hospitalized for acute myocardial infarction. Hospitals not surveyed by The Joint Commission revealed lower quality and higher 30-day mortality rates than those surveyed. Although the variables of the 2003 study differ from the present study in that it examined outcomes in Joint Commission accredited hospitals compared with those not accredited, the results are similar. In the present study, hospitals that complied with NPSGs had lower adverse event rates for two of the three PSIs compared with the hospital sample and 2011 NIS rates.

In 2005, Miller et al. (2005) examined the relationship between Joint Commission accreditation scores and PSIs from HCUP administrative data ($n = 24$ states and $n = 2,116$ hospitals) and Joint Commission accreditation data from 1997 to 1999. The study

revealed that when Joint Commission scores did not vary significantly, the PSI rates exhibited wide variation. The conclusion was that no relationship exists between Joint Commission accreditation and the PSIs studied. In contrast, this study uses Joint Commission NPSG compliance rather than Joint Commission scoring, which no longer is used in the accreditation process. The findings from this study are consistent with the findings of the research reported by Miller et al (2005).

Question 2

In this study, compliance with NPSGs varied by hospital characteristic, some of which were found to be predictive of adverse outcomes. Hospital bed size and geographic region were not found to predict hospital compliance with NPSGs. Teaching status and location of a hospital were, however, significant predictors of whether a hospital was NPSG-compliant. Urban teaching hospitals were less likely to be NPSG-compliant than were rural hospitals. No studies were found in the literature that examined the relationship between hospital characteristics and compliance with hospital NPSGs (a proxy for patient safety practices).

While studies have shown associations between hospital characteristics such as bed size, teaching status, and patient outcomes (Ayanian & Weissman, 2002; Devereaux et al., 2002; Kupersmith, 2005; Thornlow & Merwin, 2009), little or no published evidence that examines how these structural characteristics affect utilization of patient safety practices in accredited hospitals was found. One research study (Al-Haider & Wan, 1991) found higher mortality rates, and another found an increase in preventable adverse events (Thornlow & Stukenborg, 2006) among patients in urban teaching hospitals. In

addition, consistent with this study's findings, several researchers reported poorer outcomes for patients receiving care in rural hospitals (Baldwin et al., 2004; Maynard et al., 2000).

In this current study, rural hospitals had the lowest rate of NPSG compliance when compared with urban teaching and urban nonteaching hospitals. Likewise, rural hospitals had the highest rates of noncompliance with NPSGs across all specified PSIs.

In this study, hospital adverse outcomes differed depending on selected hospital characteristics; this finding was consistent with previous studies (Baker et al., 2002; Romano et al., 2003; Thornlow & Merwin, 2009; Thornlow & Stukenborg, 2006). This study found that teaching hospitals and those with medium RN staffing levels (3 to 5 FTEs/1000 APD) had a higher percentages of compliance with NPSGs for all three selected adverse events, especially as compared with rural and urban nonteaching hospitals. Low RN staffing levels was associated with the highest rates of noncompliance with NPSGs, regardless of PSI. If, as the data suggest, urban teaching hospitals are less likely to meet or implement patient safety practices such as NPSGs, the failure to embrace recommended hospital practices may explain the high adverse event rates for teaching hospitals as compared with nonteaching institutions.

The Joint Commission accreditation process attempts to create evidenced-based practices (Kizer & Blum, 2005; Shojania et al., 2002), but no study to date has examined patient outcomes and the relationship of hospital system structures with the implementation of NPSGs. Statistical analysis did not reveal a relationship between NPSG compliance and selected adverse events in this study. Descriptive statistics showed

that teaching hospitals, large hospitals, and those with RN staffing levels at a medium frequency (3 to 5 FTEs/1000 APD) had high percentages of NPSG compliance for all three selected adverse events compared with rural and urban nonteaching hospitals. Teaching hospitals' leadership structure is more formalized, thereby creating an environment that is more supportive of the implementation of practice guidelines. Staffing levels have a direct impact on NPSG compliance and patient outcomes. Hospitals with low RN staffing levels had lower rates of NPSG compliance, regardless of the PSI studied.

Question 3

This study analyzed multiple hospital characteristics to determine whether a relationship exists between hospital characteristics and the rate of each selected PSI. The current study did not consistently find hospital system characteristics related to the three selected adverse patient outcomes. Study findings reveal that relationships between hospital characteristics and PSIs varied. In particular, there is a significant relationship between bed size, teaching, and location for all three selected PSIs. Region was significant for two of the three PSIs. This finding is consistent with those from previous studies in which patient outcomes differed based on the hospital characteristic variable studied (Baker et al., 2002; Romano et al., 2003; Thornlow & Merwin, 2009; Thornlow & Stukenborg, 2006).

The hospital characteristics in this study that were associated significantly with the adverse outcome of decubitus ulcer were bed size, teaching, location, region, and RN staffing. Central venous catheter bloodstream infections significantly were related to

hospitals by bed size, teaching status and location, and RN staffing. Three variables—bed size, teaching status, and location—were found to be significantly associated with postoperative sepsis rates. RN staffing was significant in univariate analysis. However, RN staffing was not found to be significant when multivariate factors such as bed size, teaching status and location, and region were added.

Hospital Bed Size

In this study, comparing hospital bed size was one fundamental approach to benchmarking that will provide meaningful data for the nation's smallest hospitals, whose service volumes, patient characteristics, and system resources may vary more than do those of larger hospitals. Hospital bed size was statistically significant for all three of the PSIs studied with variable rates of occurrence; hospital bed size was significant for the PSI decubitus ulcer ($p = .001$).

In 2006, the AHRQ (2013a) examined the relationship between the effects of low volume and patient outcomes. Researchers found strong evidence of patient volume-outcome effect with low volumes being associated with poorer outcomes. For comparison purposes, low volume is an analogous variable with small and medium bed-size hospitals for this study. This study found medium size hospitals to have the highest rate for decubitus ulcer ($M = 7.83$), which were found to be higher than those reported in the hospital study sample ($M = 5.17$). Small hospitals had the highest mean rate ($M = 18.73$) of postoperative sepsis. Rates for small hospitals were also higher in the NIS population than in the hospital study sample rate ($M = 12.0$).

Finally, the current study found large NPSG-compliant hospitals to have higher adverse outcome rates for both decubitus ulcer and postoperative sepsis. These findings are consistent with a study conducted by the ANA (2013) in which hospitals with more than 200 beds had higher rates of decubitus ulcers compared with those having fewer than 200 beds.

Teaching Status and Location

Both teaching status and location are hospital characteristics and study variables used for comparison in this study. While both variables were found to be significant, hospital teaching status could not be disentangled from hospital location. There is evidence that quality of care is generally higher in teaching hospitals than in nonteaching institutions (based on lower rates of adverse outcomes). Further, acute care hospital system characteristics such as teaching status were found to be related to more favorable adverse event rates (Ayanian & Weissman, 2002; Kupersmith, 2005). These findings are consistent with those in the studies cited. A higher percentage of urban teaching hospitals were NPSG-compliant, regardless of PSI. Further, adverse event rates for NPSG-compliant hospitals were higher in urban nonteaching hospitals than in rural and urban teaching hospitals for all studied PSIs.

Rivard et al. (2008) were among the first to compare teaching and nonteaching hospitals using a regression model that incorporated hospital structural characteristics similar to those used in this study. Using AHRQ's PSIs and adult male patient discharges from VA and nonfederal hospitals, the researchers examined the likelihood of incurring an adverse event classified as a PSI. Consistent with the results of this current study, they

found higher PSI rates in major teaching hospitals than in nonteaching hospitals, and that PSI events were more likely to occur in teaching hospitals compared with nonteaching hospitals (Rivard et al., 2008). In this study, adverse event rates for decubitus ulcer were likewise higher in urban teaching hospitals compared with nonteaching facilities. In contrast, several studies of potentially preventable adverse events reported inconsistent findings from teaching and nonteaching hospitals (Romano et al., 2003; Thornlow & Stukenborg, 2006; Kohn et al., 2000). Similarly, this study found the same inconsistencies in the relationship between teaching status and various patient safety outcomes. The relationship between teaching status and patient safety appears to be less clear.

RN Staffing

The findings related to hospital RN staffing are of particular importance. RN staffing significantly is associated with the frequency of the selected PSIs in this study. This study found RN staffing was related to lower infection rates, similar to findings in other research projects examining the relationship between staffing and patient outcomes. Specifically, higher RN staffing levels were found to be related to lower nosocomial infection rates in multiple studies (ANA, 2013; Kane et al., 2007; Kovner & Gergen, 1998; Lichting et al., 1999; Needleman et al., 2002a, 2002b). In this study, hospitals with high RN staffing levels (≥ 5 FTEs/1000 APD) experienced lower adverse event occurrences regardless of the studied PSI. Seago's (2001) evidence-based review of literature similarly found low RN staffing levels associated with increased postoperative

sepsis infections. According to Fridkin et al. (1996), hospitals with low RN staffing levels experienced the highest rates of central venous catheter-related bloodstream infection.

Geographic Region

This study found hospital region to be a significant factor related to PSI outcomes. Past studies (Skinner, Staiger, & Fisher, 2006; Fisher et al., 2003) have examined the relationship between medical spending, hospital beds, and outcomes by geographic region. It can be hypothesized from existing geographic studies that in regions where there are more hospital beds per capita, Medicare spending will be higher. This reasoning also applies to regions where there are more intensive care unit beds. More patients will be cared for in the ICU, and Medicare will spend more on ICU care (Skinner et al., 2006; Fisher et al., 2003). Conversely, higher spending does not necessarily translate into better access to healthcare. The findings of this current study are consistent with the arguments of Skinner, Staiger, and Fisher (2006) in which they contend that an increase in hospitalizations leads to an increase in the risk of errors and adverse events.

In this study sample, 149 hospitals (48%) were large facilities. More than 45% of all large hospitals in the sample were located in the South. Findings of this study illustrate that the South has the highest adverse event rates among the four regions.

In summary, no single factor influences higher adverse events in one region over another. Findings from this study indicate that ecology of the local healthcare environment—local reimbursement rates, capacity, and social norms—may influence patient care processes and, ultimately, patient outcomes.

Question 4

The study examined the predictors of hospital bed size, region, teaching status and location, RN FTEs, and NPSGs. This is the first study to date to compare patient safety outcomes and patient safety practices across hospitals, based exclusively on their geographic region.

Teaching Status and Location

This current study shows that small and rural hospitals have a higher rate of all three of the specified PSIs. This finding is consistent with studies that report high rates of decubitus ulcer, central venous line bloodstream infection, and postoperative sepsis using univariate and multivariate regression analysis. However, no appreciable differences were noted in the strength or direction of the relationship. Both teaching status and location relied on hospital comparisons in this study.

In this study, patients in urban nonteaching hospitals were more likely to experience postoperative sepsis and central venous line bloodstream infection as compared with rural and teaching hospitals. Small hospitals had higher rates of central venous line bloodstream infection and postoperative sepsis. Conversely, a study by Vogel et al. (2010) found that patients in large-size hospitals were more likely to develop sepsis after elective surgical procedures, compared with patients in small-size hospitals.

Urban teaching and large hospitals had higher rates of decubitus ulcer. Studies comparing the quality of care in urban and rural hospitals are limited, and those that exist have produced mixed results (Baker et al., 2002; Romano et al., 2003; Thornlow & Merwin, 2009; Thornlow & Stukenborg, 2006). The findings from this study replicate

previous work cited above in which associations differed, depending on the variable and outcome event measured.

Thornlow and Merwin (2009) reported that large hospitals exhibited higher rates of adverse outcomes than smaller hospitals for two of the four indicators analyzed—infections and postoperative respiratory failure. In contrast, a previously reported AHRQ study (2013a) examined the relationship between the effects of low volume and patient outcomes. The study found a strong relationship between low patient volumes and adverse outcomes. There is much debate in the literature suggesting that smaller hospitals, often in rural settings, vary in their adherence to evidence-based guidelines and practice patterns compared with larger hospitals (Werner, Goldman, & Dudley, 2008; Lutfiya et al., 2007). In this current study, findings suggest higher adverse event rates for central venous line bloodstream infection in small hospitals compared with medium and large hospitals. The findings of this study are consistent with the literature reporting a variance in small hospitals' adherence to practice patterns and evidence-based guidelines, ultimately leading to poor outcomes.

Studies (Brennan, 2000; Romano et al., 2003) that compared patient safety outcomes or adverse event rates among urban and rural hospitals reported better patient safety outcomes and lower adverse event rates at rural hospitals than at urban hospitals. Brennan (2000) used medical records reviews to examine the rates of adverse events in New York state hospitals. The researchers found rural hospitals in upstate New York to have significantly fewer adverse events than urban hospitals. Further, Romano et al. (2003), using risk-adjusted rates for 19 PSIs, evaluated urban and rural hospitals and

discovered that rural hospitals had the lowest overall PSI rates compared with urban teaching facilities. This finding suggested a higher level of patient safety at rural hospitals and differed from the findings of this study in which PSI rates were higher in rural hospitals.

One conjecture that may explain this difference is lack of adequate nurse staffing or the characteristics of the nurses and other resources in small hospitals that may result in poorer outcomes. In some cases, small hospitals are affiliated with larger hospital systems where additional resources are available, as compared with rural hospitals that are most often standalone facilities. As hospital patient volume shifts, small and rural hospitals lack the flexibility to address adequately the challenge of nurse staffing. Both small and rural hospitals have lower RN-staffing-to-bed ratios. Therefore, when there is a census increase, it is likely that RN staffing does not increase. In addition, small hospitals do not have specialty patient care units. As such, patients with multiple diagnoses are placed in one unit with the expectation that staff will be equipped to manage care that actually requires multiple specialized skill sets. Vartak et al. (2008) found that small hospitals had a higher percentage of surgical admissions as well as a higher average DRG weight, which indicates that they either treat sicker patients or perform more complicated procedures, or both.

Patient outcomes are affected by many factors in small and rural hospitals. The implementation of evidence-based guidelines in rural hospitals is laden with factors that prove challenging. Nurse-manager support is vital to the effectiveness and execution of evidenced-based guidelines. However, such support is challenging in rural hospitals

because many do not possess the requisite skills or knowledge base to support evidenced-based practice. Other factors that affect patient outcomes in small hospitals include education and training as most nurses working in small rural hospitals are trained locally and gain their experience within the geographic area where they were educated. Further, many nurses working in small hospitals are educated at local community colleges at the associate-degree level. Therefore, experience and exposure to new guidelines or practice patterns may be limited.

Geographic Region

All regions—Northeast, Midwest, South, and West—were found to be significant predictors of two of the three outcome indicators studied: decubitus ulcer and postoperative sepsis. Specifically, hospitals located in the South had the highest adverse occurrence rates for all three indicators. The study findings indicate that patients admitted to hospitals in the South have a higher risk of decubitus ulcer and postoperative sepsis. These findings are consistent with the 2011 National Health Disparities Report (AHRQ, 2012a) in which western states (Montana, New Mexico, Nevada, and Wyoming) made up the majority of the worst performers in preventive care, while southern states (Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Texas, and Tennessee) made up the majority of the worst performers in acute care. The report (AHRQ, 2012a) also found states in the South were most often in the bottom quartile. In comparison, 2006 NIS data found that the Northeast had the highest rates of decubitus ulcer (Lyder et al., 2012).

The exact reasons for how locality influences outcomes are unclear. Two previous studies (Skinner et al., 2006; Fisher et al., 2003) document the difficulty in making the

connection between outcomes and region. The first, conducted by Skinner et al. (2006), found that regions experiencing the greatest increase in healthcare spending for myocardial patients exhibited the least improvement in health outcomes. The second study (Fisher et al., 2003) found that regions including the South with high healthcare spending had higher mortality following acute myocardial infarction, hip fracture, and colorectal cancer diagnoses. The finding of this study reveals that the South had the highest rates of adverse outcomes among all regions. Further, the South had the largest number of hospitals in the study sample had the largest percentage (46%) of large hospitals. It is possible that that high volume leads to increased risk and adverse events, and as such, may explain the regional differences observed in this study.

According to Meade and Erickson (2000), one of the challenges of examining the influences of region on outcomes relates to the linking of individual patient events with population rates. More importantly, it comes down to the process by which health data are reported. These researchers contend that data are compiled according to the political and administrative organization of governments. As in this study, risk-adjusted rates for the PSIs were based on denominators expressed as the population of a unit. Meade and Erickson (2000) assert that rates and indicators that reflect the community context and healthcare workers are influenced by both clinical and political factors.

It is difficult to characterize a single factor that influences higher adverse events in one region compared with another. However, it is evident that the local ecology of healthcare, which includes such factors as the local reimbursement rate, capacity, and social norms, strongly influences clinical decisions of providers, thereby influencing

patient outcomes (Fisher et al., 2003). As demonstrated by the work of other researchers, findings are inconsistent regarding the relationship between hospital characteristics and patient outcomes.

Recommendations for Further Nursing Research

Given the increasingly sophisticated nature of healthcare and the continued emphasis on patient safety, it is of utmost importance to determine what structural factors, including hospital characteristics, may affect patient outcomes. Further, it is paramount not only to understand the relationship between structural influences and patient outcomes but also to examine factors that affect the implementation of patient safety practices. One cannot effectively design and implement systems and safety solutions in healthcare without a complete understanding of how and why an organization's structural characteristics affect patient outcomes.

Few published studies have examined the influence of the AHRQ's PSIs and their relationship with NPSGs. Given that the influence of patient safety practices and adverse event outcome variables have not been widely studied, it is challenging to monitor trends and patterns of nurse-sensitive adverse events that can lead to safety and quality improvements. The Joint Commission's NPSG component of the accreditation process contains a large element related to infection prevention, specifically post-surgical infections and central venous lines. This study found no relationship between patient safety practices and infection rates. Given the importance of hospital infections, this area requires further inquiry.

The AHRQ's PSIs have been used as outcome measurements for public reporting for many entities assessing healthcare quality and outcomes. The Joint Commission examines hospital quality against its evidence-based clinical processes for certain conditions, including heart attack, heart failure, pneumonia, surgical care, children's asthma, inpatient psychiatric services, venous thromboembolism, stroke, perinatal care, immunization, tobacco treatment, and substance use (The Joint Commission, 2012). According to the 2000 IOM report, structure, process, and outcome indicators are commonly recognized as measures of quality. It is uncertain whether there is uniformity in the measurement and definition of quality among quality-focused organizations. Few studies have been published that examine quality measures of other quality-focused groups against patient safety outcome indicators, which further widens the gap in research in patient safety.

The findings from this study indicate the geographic location of hospitals to be a significant predictor for two of the three selected outcomes—risk-adjusted decubitus ulcer and postoperative sepsis. A better understanding of geographic uniqueness and how it influences patient care practices and nurse performance (especially related to nursing education and staff training) is needed. Further study is also needed to explore other factors that may explain patient outcome differences in geographic areas such as hospital ownership, socioeconomics, population, health disparities, and health care delivery models.

The methodology used in this study represents an approach to examining the implementation of patient safety processes and their association with patient outcomes.

Accredited hospitals may use this approach to examine and screen for adverse events while identifying opportunities for improvement. Further exploration and research are needed to determine the effectiveness of the implementation of NPSGs overall on patient safety outcomes.

Finally, further research to determine whether other organizational characteristics, beyond those in this study, affect patient safety outcomes.

Implications for Nursing Practice

Hospitals perceive that they are delivering high-quality care, and most Americans want to believe that they are receiving the best care available. However, Americans receive appropriate, evidence-based care when they need it only 55% of the time, according to Asch, Adams, Keeseey, Hicks, DeCristofaro, and Kerr. (2003). It is, therefore, essential that efforts be made to influence quality agencies' collaboration to shape analogous measurements of quality. The path toward improving the quality of healthcare lay in establishing a common method of measurement. Perhaps nurse-sensitive outcome measures as used in this study should guide the focus of further research in patient safety.

A prerequisite to designing patient safety solutions is having a clear understanding of the association between patient safety practices and hospital system characteristics, including nurse staffing and patient outcomes. Nursing leaders throughout the United States are best positioned to influence hospital healthcare quality. In the healthcare workforce, nurses make up the largest component of workers. Further, the nurse's role in detecting and abating adverse events is central to patient safety.

The findings in this study suggest that some hospital characteristics are predictors of decubitus ulcer outcomes. Equally important, researchers (Russo, Steiner, & Spector, 2008) have found decubitus ulcer events to be significant independent predictors of hospital costs, in which more than \$11 billion in hospital expenses have been linked to decubitus ulcer. According to researchers, decubitus ulcers can be treated successfully or prevented when evidence-based care protocols are implemented. The use of *Guidelines for the Prevention and Treatment of Pressure Ulcers* (National Pressure Ulcer Advisory Panel, 2014) in clinical practice is fundamental to prevention, decrease in length of stay, and the costs associated with decubitus ulcers. Research into quality outcome measures related to the implementation of patient safety practices by hospitals is necessary to improve the quality of care.

In 2009, 18,000 central-line bloodstream infections occurred in patients hospitalized in ICUs. This number represents 58% fewer infections compared with 2001. Overall, the decrease in infections saved approximately 27,000 lives (CDC, 2011). Representative of the impact of evidenced-based practices, references such as the *Guidelines for the Prevention of Intravascular Catheter-Related Infections* (O'Grady et al., 2002) reduce catheter-related bloodstream infection rates (Behrenholtz et al., 2004; Stone et al., 2007).

Along with how effectively guidelines are implemented, another factor affecting hospital infection rates relates to healthcare worker compliance with infection control policies and procedures, and hand-washing compliance (Peterson & Walker, 2006; Thornlow & Merwin, 2009). Patient outcome measures that are affected by nurse

clinicians and practitioners and those that have the most potential impact, such as nosocomial infection rates, should be a priority for future research. Nurses perform an important role in the delivery of safe, high-quality healthcare. It is imperative that strategies are developed to mitigate adverse events that begin at the point of care delivery. Such strategies must be evidenced-based and linked to SPO relationships.

The World Health Organization in 2014 estimated that one out of every 10 hospitalized patients in the United States would acquire a healthcare-associated infection. Findings of this current study suggest that selected adverse events such as postoperative sepsis and central venous line bloodstream infections may be shaped and reduced through process standards that are reflected in The Joint Commission's NPSGs. Implementation of Joint Commission standards is highly dependent upon the commitment of both hospital administration and nursing leaders. Likewise, it is important to establish the linkage between The Joint Commission's accreditation assessments of quality care and adverse patient outcome measures by other quality organizations such as the AHRQ.

The Joint Commission is the premier organization utilized for assessing patient safety and healthcare quality, but no existing studies were found that examined relationships between The Joint Commission's assessments and other independent, quality agency outcome measures as performed in this study. Further exploration is needed to determine whether a single set of measures can serve multiple purposes. In other words, does a hospital that meets NPSGs as reviewed by The Joint Commission fare well on the AHRQ's PSIs? The lack of answers suggests the need for considerable

research regarding analogous measurements of patient quality. Development of equivalent quality measurements should be an aim of future patient safety research.

Strengths and Limitations

Strengths

One of the strengths of this research is the use of a large, nationally representative sample derived from an administrative database—HCUP-NIS—that provided access to multiple sites and a variety of patients. The sample included patients discharged from 149 hospitals representing 28 states. It also included more than 1.7 million discharge records, providing greater opportunity to analyze a considerable number of subjects. The HCUP-NIS hospital-level data were designed to link readily with other data sources such as AHA data, making available a number of organizational characteristic variables at the hospital level for analysis.

Additional strengths included using HCUP-NIS and The Joint Commission accreditation Quality Check data, which are readily accessible and publicly available from federal, private, and nonprofit agencies. Since HCUP-NIS data are available dating to 1988, there is greater availability to use the data set for research purposes. Data can be compared and trended over time, and easily replicated. Further, hospital discharge abstracts are based on computerized data collected by nearly all U.S. hospitals. That makes using administrative datasets suitable (Romano et al., 2003).

Donabedian's quality assessment framework was used to support the study's underpinnings. The selection was appropriate and adequate, considering the focus of the study relating quality outcomes to structural components. Using study variables, two out

of three main elements of quality—structure and outcome—were evaluated. Overall, the use of large secondary data was extremely beneficial to the relevance of the study findings.

Limitations

Limitations of this study include those related to study design and sampling methodology that affect the generalizability of the findings. The study results are limited to Joint Commission accredited hospitals in the United States. Characteristics of the sample revealed that most hospitals were large, urban nonteaching institutions located in the South. The study's sample hospitals differed from the 2011 NIS sample because the study sample had fewer small hospitals, rural hospitals, and hospitals located in the Midwest. Because the study's hospitals differed from the national sample, there is limited ability to generalize findings to rural and small hospital populations.

Several limitations are inherent in using secondary administrative data to study the quality of care delivered by healthcare providers. There is an inherent potential that administrative data may reflect bias in the timeliness of data availability (Rantz & Connolly, 2004), coding bias or accuracy, missing data elements, or incomplete data due to fear of reprisal and lack of clinical detail (Iezzoni et al., 1994; Lawthers et al., 2000; Miller et al., 2001; Weingart et al., 2000; Zhan & Miller, 2003).

For this study, a potential coding bias existed in detecting certain types of patient safety events, specifically surgical complications. Surgical complications are more amenable to ICD-9-CM coding (Rosen et al., 2005). Therefore, administrative databases are better screens for detecting surgical complications compared with the detection of

medical complications (Lawthers et al., 2000). Postoperative sepsis was an indicator used in the study, which relied on the identification of surgical complications. Decubitus ulcer and central venous line bloodstream infection relied on reporting of both medical and surgical complications.

Timeliness of data is a limitation of administrative datasets (Rantz & Connolly, 2004). The 2011 NIS data were used for this study. Data available for 2011 by HCUP represented 46 states. The inclusion criteria for the study further limited the sample, which limited findings to those states participating in HCUP and Joint Commission accredited hospitals that underwent survey in 2011. VA hospitals and other federal facilities were not represented in the HCUP sample. Findings from this study are therefore limited, and will not be generalizable to the patient population served by VA and other federal hospitals.

Accuracy is an inherent limitation based on the notion that coded documentation found within discharge records is only as accurate as that coded by trained staff. There is a real possibility that poor documentation quality and coding could lead to capture of lower complication rates, thus indicating fewer adverse events and an assumption of higher quality and safety.

Caution must be exercised in the use of administrative data sets regarding the limited clinical detail (Rosen et al., 2005) and the calculation of severity of illness (Zhan & Miller, 2003b). In this study, the AHRQ's comorbidity measure was designed to adjust for severity of illness using administrative data in conjunction with the PSI software (Elixhauser et al., 1998).

Codes are subject to change each October, as new codes are introduced annually (AHRQ, 2010c), and may limit data comparisons. In addition, midway through 2007, the national coding standards were revised. According to HCUP (2015), the changeover date was not followed universally by all states and hospitals, and it could affect how hospital-level data were to be loaded into quality improvement programs. Data comparisons over time may be limited by these anomalies.

There were limitations for 2011 data as they applied to the state of New Hampshire (AHRQ, 2011). New Hampshire was not included in the HCUP-NIS data because the data were submitted past the deadline. Therefore, New Hampshire hospitals were unavailable for study.

Finally, data elements related to nurse staffing were retrieved from AHA and merged with HCUP data for this study. Nursing characteristics such as education level, years of experience, and specialty certification were unavailable. The unavailability of these components may influence the value of the study findings. Researchers have linked some of these characteristics to patient outcomes (Aiken et al., 2003).

Conclusion

This research provided evidence that the characteristics of some hospitals were related to patient safety practices that are associated with poor patient outcomes. The effect of implementing patient safety practices associated with NPSGs, specifically the resultant impact on patient outcomes, varied and for selected adverse outcomes was associated with adverse PSI rates. For example, a number of hospital characteristics were

significantly associated with selected adverse outcomes (decubitus ulcer and postoperative sepsis) but not others (central venous bloodstream infections). Findings indicate that bed size was a predictor of central venous line bloodstream infections and postoperative sepsis and not decubitus ulcer. Patients in hospitals classified as small were more likely to experience an adverse event than those in large hospitals. Whereas small hospitals had higher postoperative sepsis rates, larger hospitals demonstrated higher decubitus ulcer rates. Geographic region was a predictor for two of the three adverse patient outcomes, and teaching status and location were significant predictors in all three of the selected outcomes. These findings provide evidence of the challenges in managing hospital structural characteristics and patient care processes to reduce adverse patient outcomes.

Previous research has shown that preventive procedures such as protocols and guidelines may reduce adverse events related to decubitus ulcer and infections. However, the results of this study highlight the need to understand how organizational characteristics and patient safety practices are related and influences patient outcomes beyond the variables in this study. This study contributes important knowledge to the body of nursing and hospital management science in understanding organizational and structural variable and patient care practices related to patient safety and quality of care.

Each year, The Joint Commission evaluates its NPSGs to determine their effectiveness and whether other areas should be placed on a high-priority list of new goals. While this evaluation is valuable, more research is needed to determine if these patient safety practices, for which hospitals allocate enormous resources, actually

influence patient outcomes. Such research will provide significant movement toward uniformity in the measurement and definition of quality among quality-focused organizations to decrease adverse outcomes of hospitalized patients. Because of the growing complexity of healthcare and the public's focus on patient safety, additional research is needed to fully elucidate the relationships between hospital systems, patient safety practices, and patient safety outcomes.

APPENDIX A

Abbreviations

Acronym	Description
AHA	American Hospital Association
AHRQ	Agency for Healthcare Research and Quality
ANA	American Nurses Association
APD	average patient discharge
DRG	diagnosis related group
FTE	full-time equivalent
HCUP	Healthcare Cost and Utilization Project
HHS	U.S. Department of Health and Human Services
IOM	Institute of Medicine
NIS	National Inpatient Sample
NPSG	national patient safety goals
PSIs	patient safety indicators
RN	registered nurse
VA	Veterans Health Administration

APPENDIX B

The Joint Commission Accreditation Decision Rule

Accreditation Decision	Definition of Term
Accredited	Awarded to a healthcare organization that is in compliance with all standards at the time of the onsite survey or successfully has addressed requirements for improvement in an evidence of standards compliance (ESC) within 45 or 60 days following the posting of the accreditation summary findings report.
Provisional Accreditation	Results when a healthcare organization fails to successfully address all requirements for improvement in an ESC within 45 or 60 days following the posting of the accreditation summary findings report.
Conditional Accreditation	Results when a healthcare organization previously was in preliminary denial of accreditation due to an immediate threat to health or safety situation; failed to resolve the requirements of a provisional accreditation; or was not in substantial compliance with the applicable standards, as usually evidenced by a single issue or multiple issues that pose a risk to patient care or safety.
Preliminary Denial of Accreditation	Results when there is justification to deny accreditation to a healthcare organization due to one or more of the following: an immediate threat to health or safety for patients or the public; failure to resolve the requirements of an accreditation with follow-up survey status after two opportunities to do so; failure to resolve the requirements of a contingent accreditation status; or significant noncompliance with Joint Commission standards.
Denial of Accreditation	Results when a healthcare organization has been denied accreditation. All review and appeal opportunities have been exhausted.

Note. The Joint Commission, 2012.

APPENDIX C

Health Forum Data License Agreement

ATTACHMENT #1 TO HEALTH FORUM DATA LICENSE AGREEMENT

This Attachment is incorporated into the Health Forum Data License Agreement between the Health Forum and the Licensee dated 9/8/15. All terms not defined in this Attachment shall have the meaning set forth in the Agreement.

Licensee	George Mason University Graduate student: Phyllis Morris-Griffith
Licensed Data	FY2011 AHA Annual Survey Database AHA ID and Medicare ID Hospital name, address, city, state and zip Approval code: Joint Commission Control/Ownership Total facility beds
Licensed Users	1
Permitted Uses	The licensed data will be used for academic research and be attached to HCUP data. The results of the research may be published as long as no individual hospital is identified.
Term	Three years from the date of the agreement.
Fees	Licensee shall pay Health Forum a fee of \$1,500.00
Delivery Method	Email/Electronic Excel
Additional Terms	This contract as written is good for 30 days as of 9/8/2015

APPENDIX D

George Mason University Institutional Review Board Approval



Office of Research Integrity and Assurance

Research Hall, 4400 University Drive, MS 6D5, Fairfax, Virginia 22030
Phone: 703-993-5445; Fax: 703-993-9590

DATE: January 7, 2015

TO: Dr. Peggy J Maddox, EdD
FROM: George Mason University IRB

Project Title: [691384-1] National patient safety goals and patient safety indicators in accredited acute care hospitals

SUBMISSION TYPE: New Project

ACTION: DETERMINATION OF NOT HUMAN SUBJECT RESEARCH
DECISION DATE: January 7, 2015

Thank you for your submission of New Project materials for this project. The Office of Research Integrity & Assurance (ORIA) has determined this project does not meet the definition of human subject research under the purview of the IRB according to federal regulations.

Please remember that if you modify this project to include human subjects research activities, you are required to submit revisions to the ORIA prior to initiation. If you have any questions, please contact Karen Motsinger at 703-993-4208 or kmotsing@gmu.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within George Mason University IRB's records.

APPENDIX E

Healthcare Cost and Utilization Project Indemnification and Training Agreements



DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service

Agency for Healthcare
Research and Quality
540 Gaither Road
Rockville, MD 20850

March 25, 2014

Phyllis Morris-Griffith
George Mason University
School of Nursing
12894 Darnick Ct
Bristow, VA 20136-2550

Dear Ms. Morris-Griffith,

Thank you for your purchase of the Healthcare Cost and Utilization Project (HCUP) 2011 Nationwide Inpatient Sample (NIS). The binder includes a brief overview of the database and CD-ROMs containing the data files and documentation.

The release of the HCUP data is made possible through a Federal-State-Industry partnership to develop and maintain a family of longitudinal health care databases, related tools, products, and user support services. This partnership is sponsored by the Agency for Healthcare Research and Quality (AHRQ) and managed in the Center for Delivery, Organization and Markets (CDOM).

If you have any questions or need technical assistance, please contact the HCUP User Support (HCUP-US) team:

- Telephone: 1-866-290-HCUP (toll-free 1-866-290-4287)
- E - mail: hcup@ahrq.gov
- Web site: <http://www.hcup-us.ahrq.gov>

If you have any questions concerning the purchase of HCUP databases, please contact the HCUP Central Distributor:

- Telephone: 1-866-556-HCUP (toll-free 1-866-556-4287). Please call between the hours of 8:00 a.m. and 5:00 p.m. (Eastern).
- Fax: HCUP Central Distributor at (866) 792-5313
- E mail: hcup@s-3.com

Thank you again for your interest in the HCUP databases.

Sincerely,

A handwritten signature in blue ink that reads "Herbert Wong, Ph.D." is written over the typed name.

Herbert Wong, Ph.D.
Center for Delivery, Organization, and Markets (CDOM)

Part IV: Indemnification Clause

The Data Recipient ("Recipient") shall, to the extent permitted by Federal and State law, indemnify and hold Truven Health Analytics Inc. and its directors, officers, employees, agents, affiliates and subsidiaries harmless from any and all losses, claims, damages, liabilities, costs and expenses (including, without limitation, reasonable attorney's fees and costs) arising out of any claim arising from any third parties, including but not limited to any or some combination of the several States comprising the United States of America and/or the Government of the United States of America, concerning Recipient's use of the NIS, NEDS, or KID data provided by Truven Health Analytics Inc. Further, Recipient agrees that Truven Health Analytics Inc. shall not be liable to Recipient for any reason whatsoever arising out of the NIS, NEDS, or KID data or the Recipient's use of the NIS, NEDS, or KID data.

Recipient certifies and warrants that it has made no representations to Truven Health Analytics Inc. concerning any uses it (Recipient) intends to make of the NIS, NEDS, or KID data provided by Truven Health Analytics Inc. under the terms and conditions of Truven Health Analytics Inc. contract with the U.S. Department of Health and Human Services, Agency for Healthcare Research and Quality. Further, Recipient agrees that no representation of Recipient as to the Recipient's intended use of the NIS, NEDS, or KID data was used to determine whether the Recipient's request to use NIS, NEDS, or KID data would be approved.

The Data Recipient ("Recipient") shall, to the extent permitted by Federal and State law, indemnify and hold Social & Scientific Systems, Inc. (SSS) and its directors, officers, employees, owners, and agents harmless from any and all losses, claims, damages, liabilities, costs and expenses (including, without limitation, reasonable attorney's fees and costs) arising out of any claim arising from any third parties, including but not limited to any or some combination of the several States comprising the United States of America and/or the Government of the United States of America, concerning Recipient's use of the NIS, NEDS, or KID data provided by SSS. Further, Recipient agrees that SSS shall not be liable to Recipient for any reason whatsoever arising out of the NIS, NEDS, or KID data or the Recipient's use of the NIS, NEDS, or KID data.

Recipient certifies and warrants that it has made no representations to SSS concerning any uses it (Recipient) intends to make of the NIS, NEDS, or KID data provided by SSS under the terms and conditions of its contract with the U.S. Department of Health and Human Services, Agency for Healthcare Research and Quality. Further, Recipient agrees that no representation of Recipient as to the Recipient's intended use of the NIS, NEDS, or KID data was used to determine whether the Recipient's request to use NIS, NEDS, or KID data would be approved.

Signed:  Date: 3/19/14

Part V: HCUP Data Use Agreement Training

Because of the sensitive nature of the data contained in the Healthcare Cost and Utilization Project (HCUP) databases, there is a continued need to reinforce the safeguards and restrictions placed on use of the data. All data purchasers and users of HCUP data must complete the HCUP Data Use Agreement (DUA) Training Tool. This course emphasizes the importance of data protection, helps to reduce the risk of inadvertent violations, and describes your individual responsibility when using HCUP data. The course will take approximately 15 minutes to complete and you will not be required to take it more than once.

If you have not previously completed the HCUP DUA Training Tool, please go to the HCUP-US website at http://www.hcup-us.ahrq.gov/tech_assist/dua.jsp, complete the online HCUP DUA Training Tool, and enter the certification number at the end of the course in the space provided below.

HCUP DUA Training Tool Certification Code

HC WLP 1H23GYW08

APPENDIX F

Healthcare Cost and Utilization Project Data Use Agreement



**DATA USE AGREEMENT for the
Nationwide Databases from the
Healthcare Cost and Utilization Project
Agency for Healthcare Research and Quality**

This Data Use Agreement ("Agreement") governs the disclosure and use of data in the HCUP Nationwide Databases from the Healthcare Cost and Utilization Project (HCUP) which are maintained by the Center for Delivery, Organization, and Markets (CDOM) within the Agency for Healthcare Research and Quality (AHRQ). The HCUP Nationwide databases include the Nationwide Inpatient Sample (NIS), Nationwide Emergency Department Sample (NEDS), and Kids' Inpatient Database (KID). Any person ("the data recipient") seeking permission from AHRQ to access HCUP Nationwide Databases data must sign and submit this Agreement to AHRQ or its agent, and complete the online Data Use Agreement Training Tool at <http://www.hcup-us.ahrq.gov>, as a precondition to the granting of such permission.

Section 944(c) of the Public Health Service Act (42 U.S.C. 299c-3(c)) ("the AHRQ Confidentiality Statute"), requires that data collected by AHRQ that identify individuals or establishments be used only for the purpose for which they were supplied. Pursuant to this Agreement, data released to AHRQ for the HCUP Databases are subject to the data standards and protections established by the Health Insurance Portability and Accountability Act of 1996 (HIPAA) (P.L. 104-191) and implementing regulations ("the Privacy Rule"). Accordingly, HCUP Databases data may only be released in "limited data set" form, as that term is defined by the Privacy Rule, 45 C.F.R. § 164.514(e). HCUP data may only be used by the data recipient for research which may include analysis and aggregate statistical reporting. AHRQ classifies HCUP data as protected health information under the HIPAA Privacy Rule, 45 C.F.R. § 160.103. By executing this Agreement, the data recipient understands and affirms that HCUP data may only be used for the prescribed purposes, and consistent with the following standards:

No Identification of Persons—The AHRQ Confidentiality Statute prohibits the use of HCUP data to identify any person (including but not limited to patients, physicians, and other health care providers). The use of HCUP Databases data to identify any person constitutes a violation of this Agreement and may constitute a violation of the AHRQ Confidentiality Statute and the HIPAA Privacy Rule. This Agreement prohibits data recipients from releasing, disclosing, publishing, or presenting any individually identifying information obtained under its terms. AHRQ omits from the data set all direct identifiers that are required to be excluded from limited data sets as consistent with the HIPAA Privacy Rule. AHRQ and the data recipient(s) acknowledge that it may be possible for a data recipient, through deliberate technical analysis of the data sets and with outside information, to attempt to ascertain the identity of particular persons. Risk of individual identification of persons is increased when observations (i.e., individual discharge records) in any given cell of tabulated data is less than or equal to 10. This Agreement expressly prohibits any attempt to identify individuals, and information that could be used to identify individuals directly or indirectly shall not be disclosed, released, or published. Data recipients shall not attempt to contact individuals for any purpose whatsoever, including verifying information supplied in the data set. Any questions about the data must be referred exclusively to AHRQ. By executing this Agreement, the data recipient understands and agrees that actual and considerable harm will ensue if he or she attempts to identify individuals. The data recipient also understands and agrees that actual and considerable harm will ensue if he or she intentionally or negligently discloses, releases, or publishes information that identifies individuals or can be used to identify individuals.

Use of Establishment Identifiers—The AHRQ Confidentiality Statute prohibits the use of HCUP data to identify establishments unless the individual establishment has consented. Permission is obtained from the HCUP data sources (i.e., state data organizations, hospital associations, and data consortia) to use the identification of hospital establishments (when such identification appears in the data sets) for research, analysis, and aggregate statistical reporting. This may include linking institutional information from outside data

sets for these purposes. Such purpose does *not* include the use of information in the data sets concerning individual establishments for commercial or competitive purposes involving those individual establishments, or to determine the rights, benefits, or privileges of establishments. Data recipients are prohibited from identifying establishments directly or by inference in disseminated material. In addition, users of the data are prohibited from contacting establishments for the purpose of verifying information supplied in the data set. Any questions about the data must be referred exclusively to AHRQ. Misuse of identifiable HCUP data about hospitals or any other establishment constitutes a violation of this Agreement and may constitute a violation of the AHRQ Confidentiality Statute.

The undersigned data recipients provide the following affirmations concerning HCUP data:

Protection of Individuals

- I will not release or disclose, and will take all necessary and reasonable precautions to prohibit others from releasing or disclosing, any information that directly or indirectly identifies persons. I acknowledge that the release or disclosure of information where the number of observations (i.e., individual discharge records) in any given cell of tabulated data is less than or equal to 10 can increase the risk for identification of persons. I will consider this risk and avoid publication of cell sizes less than or equal to 10.
- I will not attempt to link, and will prohibit others from attempting to link, the discharge records of persons in the data set with individually identifiable records from any other source.
- I will not attempt to use and will take all necessary and reasonable precautions to prohibit others from using the data set to contact any persons in the data for any purpose.

Protection of Establishments

- I will not publish or report, through any medium, data that could identify individual establishments directly or by inference.
- When the identities of establishments are not provided in the data sets, I will not attempt to use and will take all necessary and reasonable precautions to prohibit others from using the data set to learn the identity of any establishment.
- In accordance with the AHRQ Confidentiality Statute, I will not use and will take all necessary and reasonable precautions to prohibit others from using the data set concerning individual establishments: (1) for commercial or competitive purposes involving those individual establishments; or (2) to determine the rights, benefits, or privileges of individual establishments.
- I will not contact and will take all necessary and reasonable precautions to prohibit others from contacting establishments identified in the data set to question, verify, or discuss data in the HCUP databases.
- I acknowledge that the HCUP NIS and KID may contain data elements from proprietary restricted computer software (3M APR-DRGs, OptumInsight APS-DRGs, and Medstat Disease Staging) supplied by private vendors to AHRQ for the sole purpose of supporting research and analysis with the HCUP NIS and KID. While I may freely use these data elements in my research work using the HCUP NIS and KID, I agree that I will not use and will prohibit others from using these proprietary data elements for any commercial purpose. In addition, I will enter into a separate agreement with the appropriate organization or firm for the right to use such proprietary data elements for commercial purposes. In particular, I agree not to disassemble, decompile, or otherwise reverse-engineer the proprietary software, and I will prohibit others from doing so.

Limitations on the Disclosure of Data and Safeguards

- I, the undersigned data recipient, acknowledge and affirm that I am personally responsible for compliance with the terms of this Agreement, to the exclusion of any other party, regardless of such party's role in sponsoring or funding the research that is the subject of this Agreement.

- I will not release or disclose, and will prohibit others from releasing or disclosing, the data set or any part to any person who is not an employee, member, or contractor of the organization (specified below), except with the express written approval of AHRQ. I acknowledge that when releasing or disclosing the data set or any part to others in my organization, I retain full responsibility for the privacy and security of the data and will prohibit others from further release or disclosure of the data.
- I will require others employed in my organization who will use or will have access to HCUP data to become authorized users of the data set by signing a copy of this data use agreement and completing the online Data Use Agreement Training Tool at <http://www.hcup-us.ahrq.gov>. Before granting any individual access to the data set, I will submit the signed data use agreements to the address at the end of this Agreement.
- I will ensure that the data are kept in a secured environment and that only authorized users will have access to the data.
- I will not use or disclose and I will prohibit others from using or disclosing the data set, or any part thereof, except for research, analysis, and aggregate statistical reporting, and only as permitted by this Agreement.
- I acknowledge and affirm that interpretations, conclusions, and/or opinions that I reach as a result of my analyses of the data sets are my interpretations, conclusions, and/or opinions, and do not constitute the findings, policies, or recommendations of the U.S. Government, the U.S. Department of Health and Human Services, or AHRQ.
- I will indemnify, defend, and hold harmless AHRQ and the data organizations that provide data to AHRQ for HCUP from any or all claims and losses accruing to any person, organizations, or other legal entity as a result of violation of this agreement. This provision applies only to the extent permitted by Federal and State law.
- I agree to acknowledge in all reports based on these data that the source of the data is the "Nationwide Inpatient Sample (NIS), Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality." Substitute Nationwide Emergency Department Sample (NEDS) or Kids' Inpatient Database (KID), as appropriate.
- I agree to report the violation or apparent violation of any term of this Agreement to AHRQ without unreasonable delay and in no case later than 30 calendar days of becoming aware of the violation or apparent violation.

Terms, Breach, and Compliance

Any violation of the terms of this Agreement shall be grounds for immediate termination of this Agreement. AHRQ shall determine whether a data recipient has violated any term of the Agreement. AHRQ shall determine what actions, if any, are necessary to remedy a violation of this Agreement, and the data recipient(s) shall comply with pertinent instructions from AHRQ. Actions taken by AHRQ may include but not be limited to providing notice of the termination or violation to affected parties and prohibiting data recipient(s) from accessing HCUP data in the future.

In the event AHRQ terminates this Agreement due to a violation, or finds the data recipient(s) to be in violation of this Agreement, AHRQ may direct that the undersigned data recipient(s) immediately return all copies of the HCUP Nationwide Databases to AHRQ or its designee without refund of purchase fees.

Acknowledgment

I understand that this Agreement is requested by the United States Agency for Healthcare Research and Quality to ensure compliance with the AHRQ Confidentiality Statute. My signature indicates that I understand the terms of this Agreement and that I agree to comply with its terms. I understand that a violation of the AHRQ Confidentiality Statute may be subject to a civil penalty of up to \$10,000 under 42 U.S.C. 299c-3(d), and that deliberately making a false statement about this or any matter within the jurisdiction of any department or agency of the Federal Government violates 18 U.S.C. § 1001 and is punishable by a fine of up to \$10,000 or up to five years in prison. Violators of this Agreement may also be subject to penalties under state confidentiality statutes that apply to these data for particular states.

Signed: Phyllis Morris-Griffith Date: 3/19/14
Print or Type Name: Phyllis Morris-Griffith
Title: Student PhD
Organization: George Mason Univ - Nsg Dept
Address: 12894 Darnick Ct
Address:
City: Bristow State: VA ZIP Code: 20136
Phone: 571-330-0945 Fax: 703-392-1253
E-mail: pmorrisg@gmu.edu

The information above is maintained by AHRQ only for the purpose of enforcement of this Agreement.

Note to Purchaser: Shipment of the requested data product will only be made to the person who signs this Agreement, unless special arrangements that safeguard the data are made with AHRQ or its agent.

Submission Information

Please send signed HCUP Data Use Agreements and proof of online training to:

HCUP Central Distributor
Social & Scientific Systems, Inc.
8757 Georgia Avenue, 12th Floor
Silver Spring, MD 20910
E-mail: HCUPDistributor@AHRQ.gov
Fax: (866) 792-5313

According to the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0935-0206. The time required to complete this information collection is estimated to average 30 minutes per response, including the time to review instructions, search existing data resources, gather the data needed, and complete and review the information collection. If you have any comments concerning the accuracy of the time estimate(s) or suggestions for improving this form, please write to: AHRQ, 540 Gaither Road, Attn: Reports Clearance Officer, Rockville, Maryland 20850.

OMB Control No. 0935-0206 expires 12/31/2015.

REFERENCES

- Agency for Healthcare Research and Quality. (2002). *Measures of patient safety based on hospital administrative data—The patient safety indicators*. Retrieved from <http://www.qualityindicators.ahrq.gov/documentation.html>
- Agency for Healthcare Research and Quality. (2007). *AHRQ quality indicators*. Retrieved from <http://www.qualityindicators.ahrq.gov>
- Agency for Healthcare Research and Quality. F(2010a). *Guide to the prevention quality indicators*. Retrieved from http://www.qualityindicators.ahrq.gov/downloads/pqi/pqi_guide_v31.pdf
- Agency for Healthcare Research and Quality. (2010b). *Hospital survey on patient safety culture: 2010 user comparative database report*. Retrieved from <http://www.ahrq.gov/qual/hospsurvey10/hosp/ochl.htm>
- Agency for Healthcare Research and Quality. (2010c). *AHRQ quality indicators. Patient safety indicators: Technical specifications*. Retrieved from <http://www.qualityindicators.ahrq.gov>
- Agency for Healthcare Research and Quality. (2010d). *Introduction to the HCUP nationwide inpatient sample (NIS)*. Retrieved from http://hcup-us.ahrq.gov/db/nation/NIS/2006NIS_introduction.pdf
- Agency for Healthcare Research and Quality. (2011). *AHRQ quality indicators*. Retrieved from <http://www.qualityindicators.ahrq.gov>
- Agency for Healthcare Research and Quality. (2012a). *National healthcare disparities report* (AHRQ Publication No. 12-0006). Retrieved from <http://archive.ahrq.gov/research/findings/nhqdr/nhdr11/nhdr11.pdf>
- Agency for Healthcare Research and Quality. (2012b). *Refinement of the HCUP quality indicators* (AHRQ Publication No. 01-0035). Retrieved from <http://www.qualityindicators.ahrq.gov>

- Agency for Healthcare Research and Quality. (2013a). *Medical teamwork and patient safety*. Retrieved from <http://archive.ahrq.gov/research/findings/final-reports/medteam/index.html>
- Agency for Healthcare Research and Quality. (2013b). *HCUP data use agreement for the nationwide inpatient sample from Healthcare Cost and Utilization Project*. Retrieved from http://www.hcupus.ahrq.gov/team/NIS%20DUA_%20062508.pdf
- Agency for Healthcare Research and Quality. (2013c). *Healthcare Cost and Utilization Project data use agreement course*. Retrieved from http://www.hcupus.ahrq.gov/DUA/508_course_032008/module/00_introduction/lp_00_010.htm
- Aiken, L., Clarke, S., Cheung, R., Sloane, D., & Silber, J. (2003). Educational levels of hospital nurses and surgical patient mortality. *The Journal of the American Medical Association*, 290(12), 1617-1623.
- Aiken, L., Sloane, D., & Klocinski, J. (1997). Hospital nurses' occupational exposure to blood: Prospective, retrospective, and institutional reports. *American Journal of Public Health*, 81(1), 103-107.
- Aiken, L., Sochalski, J., & Lake, E. (1997). Studying outcomes of organizational change in health services. *Medical Care*, 35 [Supplemental material], NS6-NS18.
- Al-Haider, A., & Wan, T. (1991). Modeling organizational determinants of hospital mortality. *Health Services Research*, 26(3), 303-323.
- Allison, J., Kiefe, C., Weissman, W., Person, S., Rouscupp, M., Canto, J., ... Centor, R. (2000). Relationship of hospital teaching status with quality of care and mortality for Medicare patients with acute MI. *The Journal of the American Medical Association*, 284, 1256-1262.
- Altair, D., Gacki-Smith, J., Bauer, M. R., Jepsen, D., Paparella, S., VonGoerres, B., & MacLean, S. (2009). Barriers to emergency department's adherence to four medication safety-related joint commission national patient safety goals. *The Joint Commission Journal on Quality and Patient Safety*, 35(1), 49-59.
- American Hospital Association. (2013). *American Hospital Association annual survey database*. Prepared by Health Forum, L.L.C. Retrieved from <http://www.ahadataviewer.com>
- American Nurses Association. (2013). *Nurse staffing and patient outcomes in the inpatient hospital setting*. Washington, DC: American Nurses Publishing.

- Andrews, L., Stocking, C., Krizek, T., Gottlieb, L., Krizek, C., Vargish, T., & Siegler, M. (1997). An alternative strategy for studying adverse events in medical care. *Lancet*, 349, 309-13.
- Apolone, G. (2000). The state of research on the multipurpose severity of illness scoring systems: Are we on target? *Intensive Care Medicine*, 26, 1727-1729.
- Asch, S. M., Adams, J., Keeseey, J., Hicks, J., DeCristofaro, A., & Kerr, E. A. (2003). The quality of health care delivered to adults in the United States. *The New England Journal of Medicine*, 348, 2635-2645.
- Ayanian, J. Z., & Weissman, J. S. (2002). Teaching hospitals and quality of care: A review of the literature. *Milbank Quarterly*, 80(3), 569-593.
- Baker, C. M., Messmer, P. L., Gyurko, C. C., Domagala, S. E., Conly, F. M., Eads, T. S., ... Layne, M. K. (2002). Hospital ownership, performance, and outcomes: Assessing the state-of-the-science. *The Journal of Nursing Administration*, 30(5), 227-240.
- Baldwin, L., MacLehose, R. F., Hart, G., Beaver, S. K., Every, N., & Chan, L. (2004). Quality of care for acute myocardial infarction in rural and urban U.S. hospitals. *The Journal of Rural Health*, 20(2), 99-108.
- Ball, J. K., Elixhauser, A., Johantgen, M., Harris, D. R., & Goldfarb, M. (1998). *HCUP quality indicators, software user's guide, version 1.1: Outcome, utilization, and access measures for quality improvement* (AHCPR Publication No. 98-0036). Rockville, MD: Agency for Healthcare Policy and Research.
- Behrenholtz, S., Pronovost, P., & Lipsett, P. (2004). Eliminating catheter-related bloodstream infections in the intensive care unit. *Critical Care Medicine*, 32(10), 2014-2020.
- Berntsen, K. J. (2004). Valuable lessons in patient safety. *Journal of Nursing Care Quality*, 19(3), 177-179.
- Blegen, M., Goode, C., & Reed, L. (1998). Nurse staffing and patient outcomes. *Nursing Research*, 47(1), 43-50.
- Blegen, M., Goode, C., Spetz, J., Vaughn, T., & Park, S. (2011). Nurse staffing effects on patient outcomes: Safety-net and non-safety-net hospitals. *Medical Care*, 49(4), 406-414.

- Blegen, M. A., Vaughn, T., Pepper, G., Vojir, C., Stratton, K., Boyd, M., Armstrong, G. (2004). Patient and staff safety: voluntary reporting. *American Journal of Medical Quality*, 19(2), 67-74.
- Bradley, E. H., Curry, L.A., Webster, T. R., Mattera, J. A., Roumanis, S. A., Radford, M. J., Krumholz, H. M. (2006). Achieving rapid door-to-door balloon times: How top hospitals improve complex clinical systems. *Circulation*, 113(8), 1079-1085.
- Brennan, T. A. (2000). The Institute of Medicine report of medical errors—Could it do harm? *The New England Journal of Medicine*, 342(15), 1123-1125.
- Brennan, T. A., Hebert, L., Laird, N., Lawthers, A., Thorpe, K., Leape, L., ... Hiatt, H. (1991). Hospital characteristics associated with adverse events and substandard care. *The Journal of the American Medical Association*, 265(24), 3265-3269.
- Brennan, T. A., Leape, L. L., Laird, N., Hebert, L., Localio, R., Lawthers, A., ... Hiatt, H. (1991). Incidence of adverse events and negligence in hospitalized patients: Results of the Harvard Medical Practice Study I. *The New England Journal of Medicine*, 324, 370-376.
- Brook, R., McGlynn, E., & Cleary, P. (1996). Quality of health care. Part 2: Measuring quality of care. *The New England Journal of Medicine*, 334(13), 996-970.
- Buerhaus, P. (2004). Lucian Leape on patient safety in the U.S. hospitals. *Journal of Nursing Scholarship*, 36(4), 366-370.
- Campbell, E., Singer, S., Kitch, B. T., Iezzoni, L. I., & Myer, G. S. (2010). Patient safety climate in hospitals: Act locally on variation across units. *The Joint Commission Journal on Quality and Safety*, 36(7), 319-326.
- Centers for Disease Control and Prevention. (2011). *Making health care safer*. Retrieved from <http://www.cdc.gov/VitalSigns/pdf/2011-03-vitalsigns.pdf>
- Centers for Disease Control and Prevention, National Center for Health Statistics. (2005). *NCHS overview*. Retrieved from http://www.cdc.gov/nchs/data/factsheets/factsheet_overview.htm
- Centers for Medicare & Medicaid Services. (2005). *Premier hospital quality incentive demonstration*. Retrieved from http://www.cms.hhs.gov/HospitalQualityInits/35_HospitalPremier.asp
- Centers for Medicare & Medicaid Services. (2010). *Hospital quality initiatives*. Retrieved from http://www.cms.hhs.gov/HospitalQualityInits/16_InpatientMeasures.asp

- Chaiken, B. P., & Holmquest, D. L. (2002). Patient safety: Modifying processes to eliminate medical errors. *Journal of Quality Healthcare*, 1(2), 20-23.
- Chassin, M. R., & Leob, J. M. (2011). The ongoing quality improvement journey: Next stop, high reliability. *Health Affairs*, 30(4), 559-568.
- Chen, J., Rathore, S. S., Radford, M. J., & Krumholz, H. M. (2003). JCAHO accreditation and quality of care for acute myocardial infarction. *Health Affairs*, 22(2), 243-254.
- Choi, J., Bakken, S., Larson, E., Du, Y., & Stone, P. (2004). Perceived nursing work environment of critical care nurses. *Nursing Research*, 53, 370-378.
- Clarke, S. P. (2014). Review: A realist logic model of the links between nurse staffing and the outcomes of nursing. *Journal of Research in Nursing*, 19(1), 24-25.
- Clarke, S. P., & Aiken L. H. (2011). Failure to rescue: Needless deaths are prime examples of the need for more nurses at the bedside. *American Journal of Nursing*, 103, 42-47.
- Classen, D., Resar, R., Griffin, F., Federico, F., Frankel, T., Kimmel, N. ... Brent, J. (2011). Global trigger tool show that adverse events in hospitals may be ten times greater than previously measured. *Health Affairs*, 30(4), 581-589.
- Cohen, H., Robinson, E. S., & Mandrack, M. (2003). Getting to the root of medication errors: Survey results. *Nursing 2003*, 33(9), 36-45.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Cohen, J., & Cohen, P. (1983), *Applied Multiple Regression*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Cooper J. B., Gaba, D. M., Liang B., Woods, D., & Blum, L. N. (2000). *National Patient Safety Foundation agenda for research and development in patient safety*. Retrieved from <http://www.medscape.com/viewarticle/408064>
- Couzigou, C., Lamory, J., Salmon-Ceron, D., Figard, J., & Vidal-Trecan, G. (2004). Short peripheral venous catheters: Effect of evidence-based guidelines on insertion, maintenance and outcomes in a university hospital. *Journal of Hospital Infection*, 59, 197-204.

- Covell, C. L., & Ritchie, J. A. (2009). Nurse's responses to medication errors: Suggestions for the development of organizational strategies to improve reporting. *Journal of Nursing Quality Care*, 24(4), 287-297.
- Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: Sage Publishing.
- Cunningham, W., Tisnado, D., Lui, H. H., Nakazono, T., & Carlisle, D. M. (1999). The effect of hospital experience on mortality among patients hospitalized with acquired immunodeficiency syndrome in California. *American Journal of Medicine*, 107, 137-143.
- Curchoe, R. M., Powers, J., & El-Daher, N. (2002). Weekly transparent dressing changes linked to increased bacteria rates. *Infection Control and Hospital Epidemiology*, 23(12), 730-732.
- Death. (2012). In *MedicineNet*. Retrieved from <http://www.medterms.com/script/main/art.asp?articlekey=33438>
- Devereaux, P. J., Choi, P., Lachetti, C., Weaver, B., Schunemann, H., Haines, T. ... Guyatt, G. (2002). A systematic review and meta-analysis of studies comparing mortality rates of private for-profit and private not-for profit hospitals. *Canadian Medical Association Journal*, 166, 1399-1406.
- Devers, K. J., Pham, H., & Liu, G. (2004). What is driving hospitals' patient-safety efforts? *Health Affairs*, 23(2), 103-115.
- Donabedian, A. (1966). Evaluating the quality of medical care [Supplemental material]. *Milbank Quarterly*, 44, 166-206.
- Donabedian, A. (1969). Part II-Some issues in evaluating the quality of nursing care. *American Journal of Public Health*, 59(10), 1833-1835.
- Donabedian, A. (1978). The quality of medical care. *Science*, 200, 856-864.
- Donabedian, A. (1980). *Exploration in quality assessment and monitoring. Vol. 1: The definition of quality and approaches to its assessment*. Ann Arbor, MI: Health Administration Press.
- Donabedian, A. (1988). The quality of care: How can it be assessed? *Journal of the American Medical Association*, 260(12), 1743-1748.
- Donabedian, A. (1997). The quality of care. How can it be assessed? 1988. *Archives of Pathology & Laboratory Medicine*, 121(11), 1145-1150.

- Donabedian, A. (2003). *An introduction to quality assurance in health care*. (1st ed., Vol. 1). New York, NY: Oxford University Press.
- Donabedian, A. (2005). Evaluating the quality of medical care. 1966. *The Milbank Quarterly*, 83(4), 691-729.
- Dudley, R., Johanser, K., Brand, R., Rennie, D., & Milstein, A. (2000). Selective referral to high-volume hospitals: Estimating potentially avoidable deaths. *Journal of the American Medical Association*, 283, 1159-1166.
- Duffy, M. E. (2002). Methodological issues in web-based research. *Journal of Nursing Scholarship*, 34(1), 83-88.
- Duggirala, A., Chen, F., & Gergen, P. (2004). Postoperative adverse events in teaching and nonteaching hospitals. *Family Medicine*, 36(7), 508-513.
- Dupont, W., & Plummer, W. (1998). Sample size calculation for studies using linear regression. *Controlled Clinical Trials*, 19, 589-601.
- Eaton, J., & Struthers, C. W. (2002). *Measures of patient safety based on hospital administrative data—The patient safety indicators*. Retrieved from <http://www.qualityindicators.ahrq.gov/documentation.html>
- Eaton, J., & Struthers, C. W. (2002). Using the Internet for organizational research: A study of cynicism in the workplace. *Cyber Psychology & Behavior*, 5(4), 305-313.
- Elashoff, J. D. (2007). NQueryadvisor® Release 7.0 Study Planning Software [Software]. Boston, MA: Statistical Solutions, Ltd.
- Elixhauser, A., Steiner, C., & Fraser, I. (2003). Volume thresholds and hospital characteristics in the United States. *Health Affairs*, 22(2), 167-177.
- Elixhauser, A., Steiner, C., Harris, R., & Coffey, R. (2006). Comorbidity measures for use with administrative data. *Medical Care*, 36(1), 8-27.
- Edmond M., & Eickhoff, T. C. (2008). Who is steering the ship? External influences on infection control programs. *Clinical Infectious Diseases*, 11(46), 1746-1750.
- Etchells, E., Lester, R., Morgan, B., & Johnson, B. (2005). Striking a balance: Who is accountable for patient safety? *Healthcare Quarterly*, 8, 146-150.

- Fareed, N. (2012). Size matters: A meta-analysis on the impact of hospital size on patient mortality. *International Journal of Evidence-Based Healthcare*, 10, 103-111.
- Fisher, E. S., Wennberg, D. E., Stukel, T. A., Gottlieb, D. J., Lucas, F. L., & Pinder, E. L. (2003). The implications of regional variations in Medicare spending. Part 1: The content, quality, and accessibility of care. *Annals of Internal Medicine*, 138, 273-287.
- Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin*, 4(51), 327-358.
- Fleming, S., McMahon, L., Deshamais, S., Chesney, J., & Wroblewski, R. (1991). The measurement of mortality: A risk-adjusted variable time window approach. *Medical Care*, 29, 815-828.
- Flin, R. (2007). Measuring safety culture in healthcare: A care for accurate diagnosis. *Safety Science*, 45, 653-667.
- Flood, S., & Diers, D. (1988). Nurse staffing, patient outcomes and cost. *Nursing Management*, 19(5), 35-43.
- Fonarow, C., Yancy, C., & Heywood, J. (2005). Adherence to heart failure quality of care indicators in U.S. hospitals: Analysis of the Adhere registry. *Archives of Internal Medicine*, 135(13), 1469-1477.
- Frankenfield, D., Sugarman, J., Presley, R., Helgersen, S., & Rocco, M. (2000). Impact of facility size and profit status on intermediate outcomes in chronic dialysis patients. *American Journal of Kidney Diseases*, 36(2), 318-326.
- Fridkin, S., Pear, S., Williamson, T., Gallgiani, J., & Jarvis, W. (1996). The role of understaffing in central venous catheter-associated bloodstream infections. *Infection Control and Hospital Epidemiology*, 17, 150-158.
- Galpern, D., Guerrero, A., Tu, A., Fahoum, B., & Wise, L. (2008). Effectiveness of a central line bundle campaign on line-associated infections in the intensive care unit. *Journal of Surgery*, 144, 492-495.
- Gastmeier, P., & Geffers, C. (2006). Prevention of catheter-related bloodstream infections: Analysis of studies published between 2002 and 2005. *Journal of Hospital Infection*, 64(4), 326-335.
- Glickman, S. W., Baggett, K. A., Krubert, C. G., Peterson, E. D., & Schulman, K. A. (2007). Promoting quality: The health-care organization from a management perspective. *International Journal of Quality Health Care*, 19(6), 341-348.

- Goldman, L. E., & Dudley, R. A. (2008). United States rural hospital quality in the hospital: Compare database-accounting for hospital characteristics. *Health Policy*, 87(1), 112-127.
- Hall, M. J., Levant, S., & DeFrances, C. J. (2013). *Trends in inpatient hospital deaths: National hospital discharge survey, 2000-2010* (Data Brief No. 118). Retrieved from <http://www.cdc.gov/nchs/data/databriefs/db118.htm>
- Halm, E., Lee, C., & Chassin, M. (2002). Is volume related to outcome in health care? A systematic review and methodologic critique of literature. *Annals of Internal Medicine*, 137(137), 511-520.
- Hart, A., & Stegman, M. (Eds.). (2007). *ICD-9-CM expert for hospitals: International classification of diseases, 9th revision clinical modification*. Salt Lake City, UT: Ingenix.
- Hartz, A., Krakauer, H., Kuhn, E., Young, M., Jacobsen, S., Gay, G., ... Rimm, A. (1989). Hospital characteristics and mortality rates. *The New England Journal of Medicine*, 321(25), 1720-1725.
- Healthcare Cost and Utilization Project. (2011a). *Introduction to the HCUP nationwide inpatient sample 2011*. Retrieved from http://www.hcup-us.ahrq.gov/db/nation/nis/NIS_Introduction_2011.pdf
- Healthcare Cost and Utilization Project. (2011b). *HCUP summary statistics report: 2011 AHA annual survey of hospitals, contents of AHA survey file*. Retrieved from http://www.hcup-us.ahrq.gov/db/other/aha/AHA_2011_Survey_SummaryStats.PDF
- Healthcare Cost and Utilization Project. (2011c). *Elixhauser Comorbidity Software, Version 3.7*. Retrieved from <http://www.hcup-us.ahrq.gov/toolssoftware/comorbidity/comorbidity.jsp>
- Healthcare Cost and Utilization Project. (2013). *NIS Description of data elements: Region of hospital*. Retrieved from http://www.hcup-us.ahrq.gov/db/vars/hosp_region/nisnote.jsp
- Healthcare Cost and Utilization Project. (2015). *NIS description of data elements: Bedsize of hospital*. Retrieved from http://www.hcup-us.ahrq.gov/db/vars/hosp_bedsize/nisnote.jsp

- Healthgrades. (2004). *Patient safety in American hospitals*. Retrieved from http://www.providersedge.com/ehdocs/ehr_articles/Patient_Safety_in_American_Hospitals-2004.pdf
- Healthgrades. (2010). *Patient safety incidents at U.S. hospitals show no decline: Cost \$9 billion*. Retrieved from <https://www.healthgrades.com/about/press-room/patient-safety-incidents-at-us-hospitals-show-no-decline-cost-9-billion>
- Healthgrades. (2014). *American hospital quality outcomes*. Retrieved from <https://d2dcgio3q2u5fb.cloudfront.net/56/90/e07df9f64a5fb741ab59924a9e0d/2013-american-hospital-quality-outcomes-2014-healthgrades-report-to-the-nation.pdf>
- Health Forum, LLC. (2008). *Data sources for AHADData.com*. Retrieved from <http://www.ahadataviewer.com>
- Hegyvary, S. (1991). Issues in outcomes research. *Journal of Nursing Quality Assurance*, 5(2), 1-6.
- Hibbard, J. H., & Pawlson, L. G. (2004). Why not give consumers a framework for understanding quality? *Joint Commission Journal on Quality Improvement*, 30(6), 347-351.
- Hoff, T. J., & Sutcliffe, K. M. (2006). Studying patient safety in health care organizations: Accentuate the qualitative. *Joint Commission Journal on Quality & Patient Safety*, 32(1), 5-15.
- Hofmann, D. A., & Mark, B. (2006). An investigation of the relationship between safety climate and medication errors as well as other nurse and patient outcomes. *Personnel Psychology*, 59(4), 847-869.
- Houchens, R., Elixhauser, A., & Romano, P. (2008). How often are potential patient safety events present on admission? *The Joint Commission Journal on Quality & Patient Safety*, 34(3), 154-163.
- Hougland, P., Nebeker, J., Pickard, S., Tuinen, M., Masheter, C., Elder, S., ... Xu, W. (2008). *Using ICD-9-CM codes in hospital claims data to detect adverse events in patient safety surveillance*. Retrieved from http://www.ahrq.gov/downloads/pub/advances2/vol1/advances-Hougland_26.pdf
- Hughes, R., & Kelly, P. (2008). The health care environment. In P. Kelly (Ed.), *Nursing leadership and management* (2nd ed.). Clifton Park, NY: Delmar Learning.

- Hussey, P., Mattke, S., Morse, L., & Ridgely, M. (2006). *Evaluation of the use of the AHRQ and other quality indicators* (Rand Report WR-426-HS, Prepared for the Agency for Healthcare Research and Quality). Santa Monica, CA: Rand Health.
- Hyman, W. (2014). A work plan for The Joint Commission alarm national patient safety goal. *Journal of Clinical Engineering*, 39(1), 23-27.
- Iezzoni, L. I. (1994). Risk adjustment for medical effectiveness research: An overview of conceptual and methodological considerations. *Journal of Investigative Medicine*, 43(2), 136-150.
- Iezzoni, L. I. (1997). Assessing quality using administrative data. *Annals of Internal Medicine*, 127, 666-674.
- Iezzoni, L. I., Daley, J., Heeren, T., Foley, S. M., Hughes, J. S., Fisher, E., ... Coffman, G. A. (1994). Using administrative data to screen hospitals for high complication rates. *Inquiry*, 31, 40-45.
- Iezzoni, L. I., Mackiernan, Y. D., Cahalane, M. J., Phillips, R. S., Davis, R. B., & Miller, K. (1999). Screening inpatient quality using post-discharge events. *Medical Care*, 37(4), 384-398.
- Institute for Healthcare Improvement. (2006). *100K Lives Campaign*. Retrieved from <http://www.ihl.org/engage/initiatives/completed/5MillionLivesCampaign/Pages/default.aspx>
- Institute for Healthcare Improvement. (2010). *Respectful management of serious clinical adverse events*. Retrieved from <https://www.transplantpro.org/wp-content/uploads/sites/3/IHIManagementofClinicalAdverseEventsSep10.pdf>
- Institute of Medicine. (1999). *Medicare: A strategy for quality assurance (Vol. 1)*. Washington, DC: National Academies Press.
- Institute of Medicine. (2000). *To err is human: Building a safer health system*. Washington, DC: The National Academies Press.
- Institute of Medicine. (2001). *Crossing the quality chasm: A new health system for the 21st century*. Washington, DC: The National Academies Press.
- Institute of Medicine. (2003). *Health professions education: A bridge to quality*. A. Greiner, & E. Knebal (Eds.). Washington, DC: The National Academies Press.
- Institute of Medicine. (2004a). *Keeping patients safe: Transforming the work environment of nurses*. Washington, DC: The National Academies Press.

- Institute of Medicine. (2004b). *Patient safety: Achieving a new standard for care*. Washington, DC: The National Academies Press.
- Isaac, T., & Jha, A. (2008). Are patient safety indicators related to widely used measures of hospital quality? *Journal of General Internal Medicine*, 23(9), 1373-1378.
- James, J. T. (2013). A new, evidence-based estimate of patient harms associated with hospital care. *Journal of Patient Safety*, 9(3), 122-128.
- Jha, A. K., Li, Z., Orav, E. J., Epstein, A. M. (2005). Care in U.S. hospitals: The hospital quality alliance program. *The New England Journal of Medicine*, 353(3), 265-274.
- Kane, R., Shamliyan, T., Mueller, C., Duval, S., & Wilt, T. (2007). *Nursing staffing and quality of care* (Prepared by Minnesota Evidence-based Practice Center under Contract No. 290-02-0009, Evidence Report, Technology Assessment No. 151). Rockville, MD: Agency for Healthcare Research and Quality.
- Kim, J., An, K., Kang Kim, M., & Yoon, S. H. (2007). Nurses perception of error reporting and patient safety culture in Korea. *Western Journal of Nursing Research*, 29(7), 827-844.
- King, T., & Byers, J. F. (2007). A review of organizational culture instruments for nurse executives. *The Journal of Nursing Administration*, 37(1), 21-31.
- Kizer, K. W., & Blum, L. N. (2005). Safe practices for better health care. In Agency for Healthcare Research and Quality, *Advances in Patient Safety: From research to implementation* (AHRQ Publication No. 05-0021-4). Rockville, MD: Agency for Healthcare Research and Quality.
- Kohn, L. T., Corrigan, J. M., & Donaldson, M. S. (1999). *To err is human: Building a safer health system*. Retrieved from <http://www.nap.edu/catalog/9728.html>
- Kohn, L. T., Corrigan, J. M., & Donaldson, M. S. (2000). *To err is human: Building a safer health system. A report of the Committee on Quality of Health Care in America*, Institute of Medicine. Washington, DC: The National Academies Press.
- Kovner, C., & Gergen, P. (1998). Nurse staffing levels and adverse events following surgery in U.S. hospitals. *Journal of Nursing Scholarship*, 30(4), 315-321.
- Kovner, C., Jones, J., Zhan, C., Gergen, P., & Basu, J. (2002). Nurse staffing and postsurgical adverse events: An analysis of administrative data from a sample of U.S. hospitals, 1990-1996. *Health Services Research*, 37(3), 611-629.

- Kramer, M., & Hafner, L. P. (1989). Shared values: Impact on staff nurse job satisfaction and perceived productivity. *Nursing Research*, 38(3), 172-177.
- Kupersmith, J. (2005). Quality of care in teaching hospitals: A literature review. *Academic Medicine*, 80(5), 458-466.
- Lagasse, R. (2002). Anesthesia safety: Model or myth. *Anesthesiology*, 97(6), 1609-1617.
- Lake, E. T., & Friese, C. R. (2006). Variations in nursing practice environments: Relation to staffing and hospital characteristics. *Nursing Research*, 1(55), 1-9.
- Landrigan, C. P., Parry, G. J., Bones, C. B., Hackbarth, A. D., Goldmann, D. A., & Sharek, P. J. (2010). Temporal trends in rates of patient harm resulting from medical care. *The New England Journal of Medicine*, 363, 2124-2134.
- Lang, T. A., Hodge, M., Olson, V., Romano, P. S., & Kravitz, R. L. (2004). Nurse-patient ratios: A systematic review on the effects of nurse staffing on patient, nurse employee, and hospital outcomes. *The Journal of Nursing Administration* 34(7-8), 326-337.
- Lawthers, A., McCarthy, E., Davis, R., Peterson, L., Palmer, H., & Iezzoni, L. I. (2000). Identification of in-hospital complications from claims data: Is it valid? *Medical Care*, 35(8), 785-795.
- Leape, L. L. (1994). Error in medicine. *The Journal of American Medical Association*, 272(23), 1851-1857.
- Leape, L. L. (2002). Reporting of adverse events. *The New England Journal of Medicine*, 347(20), 1633-1638.
- Leape, L. L., & Berwick, D. M. (2005). Five years after To Err is Human: What have we learned? *The Journal of the American Medical Association*, 293(19), 2384-2390.
- Leape, L. L., Berwick, D. M., & Bates, D. (2002). What practices will most improve safety? *The Journal of the American Medical Association*, 288(4), 501-507.
- Leape, L. L., Brennan, T., Laird, N., Hebert, L., Localio, R., Lawthers, A., ... Hiatt, H. (1991). The nature of adverse in hospitalized patients: Results of the Harvard Medical Practice Study II. *The New England Journal of Medicine*, 324, 377-384.
- Lee, J., Chang, B., Pearson, M., Kahn, K., & Rubenstein, L. (1999). Does what nurses do affect clinical outcomes for hospitalized patients? A review of the literature. Part 1. *Health Services Research*, 34(5), 1011-1027.

- Lehman, L., Puopolo, A., Shaykevich, S., & Brennan, T. (2005). Iatrogenic events resulting in intensive care admission: Frequency, cause, and disclosure to patients and institutions. *The American Journal of Medicine*, 118, 409-413.
- Levit, K., Ryan, K., Elixhauser, A., Stranges, E., Kassed, C., & Coffee, R. (2007). *HCUP facts and figures: Statistics on hospital-based care in the United States, 2005*. Retrieved from https://www.hcup-us.ahrq.gov/reports/factsandfigures/HAR_2005.pdf
- Lichting, L., Knauf, R., & Milholland, D. (1999). Some impacts of nursing on acute care hospital outcomes. *The Journal of Nursing Administration*, 29(2), 25-33.
- Loux, S., Payne, S., & Knott, A. (2005). Comparing patient safety in rural hospitals by bed count. In Agency for Healthcare Research and Quality, *Advances in patient safety: From research to implementation, Vol. 1* (AHRQ Publication No. 05-0021-1). Retrieved from <http://www.ahrq.gov/sites/default/files/wysiwyg/professionals/quality-patient-safety/patient-safety-resources/resources/advances-in-patient-safety/vol1/Loux.pdf>
- Lyder, C. H., Wang, Y., Metersky, M., Curry, M., Kliman R., Verzier, N. R., & Hunt, D. R. (2012). Hospital-acquired pressure ulcers: Results from the national Medicare patient safety monitoring system study. *Journal of the American Geriatrics Society*, 60(9), 1603-1608.
- Maddox, P. J., Wakefield, M., & Bull, J. (2001). Patient safety and the need for professional and educational change. *Nursing Outlook*, 49(1), 8-13.
- Mangram, A. J., Horan, T. C., Pearson, M. L., Silver, L., & Jarvis, W. (1999). Guideline for prevention of surgical site infection, 1999. *Infection Control & Hospital Epidemiology*. Retrieved from <https://www.cdc.gov/hicpac/pdf/SSIguidelines.pdf>
- Masica, A., Richter, K., Convery, P., & Haydar, Z. (2009). Linking Joint Commission inpatient core measures and national patient safety goals with evidence. *Baylor University Medical Center Proceedings*, 22(2), 103-111.
- Maynard, C., Every, N., Chapko, M. K., & Ritchie, J. L. (2000). Outcomes of coronary angioplasty procedures performed in rural hospitals. *The American Journal of Medicine*, 108(9), 710-713.
- McDonald, K., Romano, P., Geppert, J., Davies, S., Duncan, B., & Shojania, K. (2002). *Measures of patient safety based on hospital administrative data: The patient safety indicators* (Prepared by the University of California San Francisco-

Stanford Evidence-based Practice Center under Contract No. 290-97-0013, AHRQ Publication No. 02-0038). Rockville, MD: Agency for Healthcare Research and Quality.

McGillis Hall, L., Irvine Doran, D., Baker, G., Pink, G., Sidani, S., O'Brien-Pallas, L., & Donner, G. (2001). *A study of the impact of nursing staff mix models and organizational change strategies on patient, system and nurse outcomes*. Toronto, Ontario: Faculty of Nursing, University of Toronto and Canadian Health Service Research Foundation/Ontario Council of Teaching Hospitals.

McGillis Hall, L., Irvine Doran, D., & Pink, G. H. (2004). Nurse staffing models, nursing hours, and patient safety outcomes. *The Journal of Nursing Administration*, 34(1), 41-45.

Meade, M., & Erickson, R. J. (2000). *Medical Geography*. New York, NY: The Guilford Press.

Mello, M. M., Kelly, C. N., & Brennan, T. A. (2005). Fostering rational regulation of patient safety. *Journal of Health Politics, Policy and Law*, 30(3), 375-426.

Merrill, C. A., & Elixhauser, A. (2005). *Hospitalization in the United States, 2002* (HCUP Fact Book No. 6., AHRQ Publication No. 05-0056). Rockville, MD: Agency for Healthcare Research and Quality.

Mertler, C. A., & Vannatta, R. A. (2005). *Advanced and multivariate statistical methods* (3rd ed.). Glendale, CA: Pyrczak Publishing.

Merwin, E., & Thomlow, D. (2006). Methodologies used in nursing research designed to improve patient safety. *Annual Review of Nursing Research*, 24, 273-292.

Miller, M. R., Elixhauser, A., Zhan, C., & Meyer, G. S. (2001). Patient safety indicators: Using administrative data to identify patient safety concerns. *Health Services Research*, 36, 110-132.

Miller, M. R., Pronovost, P. J., Donithan, M., Zeger, S., Zhan, C., Morlock, L., & Meyer, G. S. (2005). Relationship between performance measurement and accreditation: Implications for quality of care and patient safety. *American Journal of Medical Quality*, 20(5), 239-252.

Mitchell, P., & Shortell, S. (1997). Adverse outcomes and variations in organization of care delivery. *Medical Care*, 35, NS19-NS32.

- Mitchell, P. H., Ferketich, S., Jennings, B. M., & American Academy of Nursing Expert Panel on Quality Health Care. (1998). Quality health outcomes model. *Journal of Nursing Scholarship*, 30(1), 43-46.
- Moody, R. F. (2006). *Safety culture on hospital nursing units: Human performance and organizational system factors that make a difference* (Unpublished dissertation). Indiana University, Indianapolis, IN.
- Moore, L., Moore, F. A., Todd, S. R., Jones, S. L., Turner, K., & Bass, B. L. (2010). Sepsis in general surgery: The 2005-2007 National Surgical Quality Improvement Program perspective. *Archives of Surgery*, 145(7), 695-700.
- Moorhead, S., Johnson, M., Maas, M., & Swanson, E. (2008). Outcome development and significance. In S. Moorhead, M. Johnson, M. Maas, & E. Swanson (Eds.), *Nursing Outcomes Classification* (4th ed.). St. Louis, MO: Mosby Elsevier.
- Morello, R., Lowthian, J., Barker, A. L., McGinnes, R. A., Dunt, D., & Brand, C. (2012). Strategies for improving patient safety culture in hospitals: A systematic review. *BJM Quality and Safety*, 22(1), 1-8.
- Morgan, D. L. (1998). Practical strategies for combining qualitative and quantitative methods: Applications to health research. *Qualitative Health Research*, 8(3), 362-376.
- Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing Research*, 40, 120-123.
- Munro, B. H. (2005). *Statistical methods for health care research* (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.
- National Patient Safety Foundation. (2003). *National agenda for action: Patients and families in patient safety, Nothing about me, without me*. Retrieved from http://c.ymcdn.com/sites/www.npsf.org/resource/collection/abab3ca8-4e0a-41c5-a480-6de8b793536c/Nothing_About_Me.pdf
- National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel, & Pan Pacific Pressure Injury Alliance. (2014). Interventions for prevention and treatment of pressure ulcers. In *Prevention and treatment of pressure ulcers: Clinical practice guideline*. Retrieved from <http://www.guideline.gov/content.aspx?id=48865>
- National Quality Forum. (2006). *Safe practices for better healthcare: A consensus report*. Washington, DC: National Quality Forum.

- National Quality Forum. (2010). *Safe practices for better healthcare: A consensus report*. Washington, DC: National Quality Forum.
- National Quality Forum. (2010). *About us*. Retrieved from <http://www.qualityforum.org/about>
- Needleman, J., Buerhaus, P., Mattke, S., Stewart, M., & Zelevinsky, K. (2001). *Nurse staffing and patient outcomes in hospitals* (Report No. 230-99-0021). Boston, MA: Health Services Administration.
- Needleman, J., Buerhaus, P., Mattke, S., Stewart, M., & Zelevinsky, K. (2002). Nurse staffing levels and the quality of care in hospitals. *The New England Journal of Medicine*, 346, 1715-1722.
- Nieva, V., & Sorra, J. (2003). Safety culture assessment: A tool for improving patient safety in health care organizations. *Quality & Safety in Health Care*, 12(Supplement 2), ii17-ii23.
- Nordgren, L. D., Johnson, T., Kirschbaum, M., & Peterson, M. L. (2004). Medical errors: Excess hospital costs and lengths of stay. *Journal for Healthcare Quality*, 26(2), 42-48.
- O'Grady, N. P., Alexander, M., Dellinger, P., Gerberding, J., Heard, S., Maki, D. ... Weinstein, R. A. (2002). Guidelines for the prevention of intravascular catheter-related infections, 2002. *Infection Control and Hospital Epidemiology*, 23(12), 759-769.
- O'Malley, K., Cook, K., Price, M. D., Wildes, K. R., Hurdle, J. F., & Ashton, C. M. (2005). Measuring diagnoses: ICD code accuracy. *Health Services Research*, 40(5), 1620-1639.
- Park, E. R., Brook, R. H., Kosecoff, J., Keesey, J., Rubenstein, L., Keeler, E., ... Chassin, M. R. (1990). Explaining variations in hospital death rates randomness, severity of illness, quality of care. *The Journal of the American Medical Association*, 264(4), 484-490.
- Pedhazur, E. J. (1984). Sense and nonsense in hierarchical regression analysis: Comment on Smyth. *Journal of Personality and Social Psychology*, 46(2), 479-482.
- Perrin, E. (2002). Some thought on outcomes research, quality improvement, and performance measurement. *Medical Care*. 40(6), 89-91.

- Person, S. D., Allison, J. J., Kiefe, C., Weaver, M. T., Williams, O. D., Centor, R., & Weissman, N. W. (2004). Nurse staffing and mortality for Medicare patients with acute myocardial infarction. *Medical Care*, 42(1), 4-12.
- Peterson, A. M., & Walker, P. H. (2006). Hospital-acquired infections as patient safety indicators. *Annual Review of Nursing Research*, 24, 75-99.
- Peterson, E., DeLong, E., Jollis, J., Muhlbaier, L., & Mark, D. (1998). The effects of New York's bypass surgery provider profiling on access to care and patient outcomes in the elderly. *Journal of American College of Cardiology*, 32, 993-999.
- Pierce, S. F. (1997). Nurse-sensitive health care outcomes in acute care settings: An integrative analysis of the literature. *Journal of Nursing Care Quality*, 11(4), 7-8.
- Polit, D. F., & Beck, C. T. (2004). *Nursing research: Principles and methods* (7th ed.). Philadelphia, PA: Lippincott, Williams & Wilkins.
- Polit, D. F., & Beck, C. T. (2008). *Nursing research: Principles and methods* (8th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.
- Pringle, D., & Doran, D. M. (2003). Patient outcomes as an accountability. In D. Doran (Ed.), *Nursing-sensitive outcomes: State of the science* (pp.1-25). Sudbury, MA: Jones and Bartlett.
- Pronovost, P. J., Weast, B., Holzmueller, C. G., Rosenstein, B. J., Kidwell, R. P., Haller, K. B., & Rubin, H. R. (2003). Evaluation of the culture of safety: Survey of clinicians and managers in an academic medical center. *Quality and Safety in Health Care*, 12, 405-410.
- Rantz, M. J., & Connolly, R. P. (2004). Measuring nursing care quality and using large data sets in non-acute care settings: State of the science. *Nursing Outlook*, 52, 23-37.
- Reason, J. T. (1990). The contribution of latent human failures to the breakdown of complex systems. *Philosophical Transactions of the Royal Society of London*, 327, 475-484.
- Reason, J. T. (1998). *Human error*. Cambridge, United Kingdom: Cambridge University Press.
- Reason, J. T. (2000). Human error: Models and management. *British Medical Journal*, 3(20), 768-770.

- Respiratory Failure. (n.d.). In *MedicineNet.com*. Retrieved from <http://www.medterms.com/script/main/art.asp?articlekey=10698>
- Rivard, P. E., Luther, S., Christiansen, C., Zhao, S., Loveland, S., Elixhauser, A., ... Rosen, A. K. (2008). Using patient safety indicators to estimate the impact of potential adverse events on outcomes. *Medical Care Research and Review*, 65(1), 67-87.
- Rivard, P. E., Rosen, A. K., & Carroll, J. S. (2006). Enhancing patient safety through organizational learning: Are patient safety indicators a step in the right direction? *Health Services Research*, 41(4), 1633-1649.
- Rogowski, J., Horbar, J. D., Staiger, D., Kenny M., Carpenter, J., & Geppert, J. (2004). Indirect and direct hospital quality indicators for very low weight birth weight infants. *The Journal of the American Medical Association*, 291(2), 202-209.
- Rojas, M., Silver, A., Llewellyn, C., & Ranees, L. (2005). Study of adverse occurrences and major functional impairment following surgery. *Advances in patient safety: From research to implementation* (AHRQ Publication Nos. 050021 1-4). Rockville, MD: Agency for Healthcare Research and Quality.
- Romano, P. S., Chan, B. K., Schembri, M. E., & Rainwater, J. A. (2002). Can administrative data be used to compare postoperative complication rates across hospitals? *Medical Care*, 40(10), 856-867.
- Romano, P. S., Geppert, J. J., Davies, S., Miller, M. R., Elixhauser, A., & McDonald, K. M. (2003). A national profile of patient safety in U.S. hospitals. *Health Affairs*, 22(2), 154-165.
- Romano, P. S., Mull, H. J., Rivard, P. E., Zhao, S., Henderson, W. G., Loveland, S., ... Rosen, A. K. (2009). Validity of selected AHRQ patient safety indicators based on VA national surgical quality improvement program data. *Health Services Research*, 44, 182-204.
- Romano, P. S., Roos, L. L., & Jollis, J. G. (1993). Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases: Differing perspectives. *Journal of Clinical Epidemiology*, 45, 613-619.
- Rondenau, K. V., & Waga, T. H. (2002). Organizational learning and continuous quality improvement: Examining the impact on nursing home performance. *Healthcare Management Forum*, 15(2), 17-23.

- Rosen, A. K., Rivard, P., Zhao, S., Loveland, S., Tsilimingras, D., Christiansen, C. L., ... Romano, P. S. (2005). Evaluating the patient safety indicators: How well do they perform on Veterans Health Administration data? *Medical Care*, 43(9), 873-884.
- Rosen, A., Zhao, S., Rivard, P., Loveland, S., Montez-Rath, M., & Elixhauser, A. (2006). Tracking rates of patient safety indicators over time: Lessons from the Veterans Administration. *Medical Care*, 44(9), 850-861.
- Rosenthal, G., Harper, D., Quinn, L., & Cooper, G. S. (1997). Severity-adjusted mortality and length of stay in teaching and nonteaching hospitals. *The Journal of the American Medical Association*, 278(6), 485-490.
- Rothschild, J. M., Hurley, A. C., Landrigan, C. P., Cronin, J. W., Martell-Waldrop, K., Foskett, C., ... Bates, D. W. (2006). Recovery from medical errors: The critical care nursing safety net. *Joint Commission Journal on Quality and Patient Safety*, 32(2), 63-72.
- Russo, C. H., Steiner, C., & Spector, W. (2008). *Hospitalizations related to pressure ulcers among adults 18 years and older*. Rockville, MD: Agency for Healthcare Research and Quality.
- Salive, M., Mayfield, J., & Weissman, N. (1990). Patient outcomes research teams and the Agency for Health Care Policy and Research. *Health Services Research*, 25, 697-708.
- Sammer, C. E., Lykens, K., Singh, K. P., Mains, D. A., & Lackan, N. A. (2010). What is patient safety culture? A review of the literature. *Journal of Nursing Scholarship*, 42(2), 156-165.
- Sandhu, A., Moscucci, M., Dixon, S., Wohns, D. H., Share, D., LaLonde, T., ... Gurm, H. S. (2013). Differences in the outcome of patients undergoing percutaneous coronary interventions at teaching versus nonteaching hospitals. *American Heart Journal*, 166(3), 401-408.
- Savitz, L. A., Jones, C. B., & Bernard, S. (2004). Quality indicators sensitive to nurse staffing in acute care settings. *Advances in Patient Safety*, 4, 375-385.
- Schein, E. (1995). *Defining organizational culture*. In J. T. Wren (Ed.), *The leader's companion: Insights on leadership through the ages*. New York, NY: The Free Press.
- Schimmel, E. M. (1964). The hazards of hospitalization. *Annals of Internal Medicine*, 60, 100-109.

- Scott, T., Mannion, R., Davies, H., Martin N., & Marshall, M. (2003). Implementing culture change in health care: Theory and practice. *International Journal for Quality in Health Care*, 15(2) 111-118.
- Scott-Cawiezell, J., Vogelsmeier, A., McKenney, C, Rantz, M., Hicks, L., & Zellmer, D. (2006). Moving from a culture of blame to a culture of safety in nursing home setting. *Nursing Forum*, 41, 133-140.
- Seago, J. (2001). *Nurse staffing, models of care delivery, and interventions: Evidence report, technology assessment No. 43*. Rockville, MD: Agency for Healthcare Research and Quality.
- Sepsis. (n.d.). In *Sepsis Alliance*. Retrieved from <http://www.sepsis.org/sepsis/definition>
- Schimmel, E. M. (1964). The hazards of hospitalization. *Annals of Internal Medicine*, 60, 100-109.
- Sharpe, V.A. (2003). Promoting patient safety: An ethical basis for policy deliberation. *Hasting Center Report*, 33, S1-S20.
- Shojania, K., Duncan, B., McDonald, K., & Wachter, R. (2001). *Making health care safer: A critical analysis of patient safety practices* (Evidence Report, Technology Assessment No. 43, No 01-E058). Rockville, MD: Agency for Healthcare Research and Quality.
- Shojania, K., Duncan, B., McDonald, K., & Wachter, R. (2002). Safe but sound: Patient safety meets evidence-based medicine. *The Journal of the American Medical Association*, 288(4), 508-513.
- Shreve, J, van Den Bos, J., Gray, T., Halford, M., Rustagi, K., & Ziemkiewicz, E. (2010) *The economic measurement of medical errors*. Retrieved from <https://www.soa.org/files/research/projects/research-econ-measurement.pdf>
- Silber, J. H., Williams, S. V., Krakauer, H., & Schwartz, J. S. (1992). Hospital and patient characteristics associated with death after surgery: A study of adverse occurrence and failure to rescue. *Medical Care*, 30(7), 615-629.
- Singer, S. J., Gaba, D. M., Geppert, J. J., Sinaiko, A. D., Howard, S. K., & Park, K. C. (2003). The culture of safety: Results of an organization-wide survey in 15 California hospitals. *Quality & Safety in Health Care*, 12(2), 112-118.
- Skinner J. S., Staiger, D. O., Fisher, E. S. (2006). Is technological change in medicine always worth it? The case of acute myocardial infarction. *Health Affairs*, 25, 34-47.

- Sloan, F., Conover, C. J., & Provenziale, D. (2000). Hospital credentialing and quality of care. *Social Science Medicine*, 50, 77-88.
- Sorra, J. S., & Dyer, N. (2010). Multilevel psychometric properties of the AHRQ hospital survey on patient safety culture. *BMC Health Services Research*, 70, 199.
- Sorra, J. S., & Nieva, V. F. (2004). *Hospital survey on patient safety culture* (Prepared by Westat under Contract No. 290-96-0004, AHRQ Publication No. 04-0041). Rockville, MD: Agency for Healthcare Research and Quality.
- Stanton, M. (2004). Hospital nurse staffing and quality of care. In *Research in Action* (Issue 14, AHRQ Publication No. 04-0029). Rockville, MD: Agency for Healthcare Research and Quality.
- Stelfox, H. T., Palmisiani, S., Scurlock, C., Orav, E. J., & Bates, D. W. (2006). The “to err is human” report and the patient safety literature. *Quality and Safety Health Care*, 15, 174-178.
- Stone, P. W., & Gershon, R. (2006). Nurse work environments and occupational safety in intensive care units. *Policy, Politics, and Nursing Practice*, 7(4), 240-247.
- Stone, P. W., Harrison, M. I., Feldman, P., Linzer, M., Peng, T., Roblin, D. ... Williams, E. S. (2005). Organizational climate of staff working conditions and safety—an integrative model. In *Advances in patient safety: From research to implementation* (AHRQ Publication Nos. 050021, 1-4). Rockville, MD: Agency for Healthcare Research and Quality.
- Stone, P. W., Mooney-Kane, C., Larson, E., Horan, T., Glance, L., Zwanziger, J., & Dick, A. W. (2007). Nurse working conditions and patient safety outcomes. *Medical Care*, 45(6), 571-578.
- Swan, B. A., & Boruch, R. F. (2004). Quality of evidence: Usefulness in measuring the quality of health care. *Medical Care*, 42[2 supplemental], 1112-1120.
- Tabachnik, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Boston, MA: Allyn & Bacon.
- Taunton, R., Kleinbeck, S., Stafford, R., Woods, C., & Bott, M. (1994). Patient outcomes: Are they linked to registered nurse absenteeism, separation, or workload? *The Journal of Nursing Administration*, 24(4S), 48-55.

- Taylor, D. H., Whellan, D., & Sloan, F. A. (1999). Effects of admission to a teaching hospital on the cost and quality of care for Medicare beneficiaries. *The New England Journal of Medicine*, 340, 293-299.
- The Joint Commission. (2002). *National patient safety goals*. Retrieved from <http://www.jointcommission.org/PatientSafety/NationalPatientsafetyGoals>
- The Joint Commission. (2006). *National patient safety goals 2010*. Retrieved from <http://www.jointcommission.org>
- The Joint Commission. (2009). Top 10 standards compliance issues in 2009. *Joint Commission Perspectives*, 30(5), 12-18.
- The Joint Commission. (2010a). *Comprehensive Accreditation Manual for Hospitals: The Official Handbook (CAMH Update 1)*. Retrieved from http://www.jointcommission.org/assets/1/6/2011_CAMH_Update_1.pdf
- The Joint Commission. (2010b). *Hospital national patient safety goals*. Retrieved from <http://www.jointcommission.org>
- The Joint Commission. (2012). *Facts about patient safety*. Retrieved from <http://www.jointcommission.org>
- The Joint Commission Quality Check. (2013). *Facts about patient safety*. Retrieved from <http://www.qualitycheck.org>
- The Joint Commission Perspectives. (2004). Compliance data for The Joint Commission 2003 national patient safety goals. *Joint Commission Perspectives*, 24(9), 12-18.
- The Joint Commission Perspectives. (2005). Compliance data for The Joint Commission 2004 and 2005 national patient safety goals. *Joint Commission Perspectives*, 25(11), 7-8.
- The Joint Commission Perspectives. (2009). Top 10 standards compliance issues in 2009. *Joint Commission Perspectives*, 30(5), 12-18.
- Thomas, E. J., & Brennan, T. A. (2000). Incidence and types of preventable adverse events in elderly patients: Population based review of medical records. *British Medical Journal*, 320, 741-744.
- Thomas, E. J., Studdert, D., Burstin, H., Orav, E., Zeena, T., Williams, E. J., ... Brennan, T. A. (2000). Incidence and types of adverse events and negligent care in Utah and Colorado. *Medical Care*, 38(3), 261-271.

- Thornlow, D. K., & Merwin, E. (2009). Managing to improve quality: The relationship between accreditation standards, safety practices, and patient outcomes. *Health Care Management Review, 34*(4), 262-272.
- Thornlow, D. K., & Stukenborg, G. J. (2006). The association between hospital characteristics and rates of preventable complications and adverse events. *Medical Care, 44*(3), 265-269.
- Tourangeau, A. E., Giovenniti, P., Tu, J. V., & Wood, M. (2002). Nursing-related determinants of 30-day mortality for hospitalized patients. *Canadian Journal of Nursing Research, 33*(4), 71-88.
- Tourangeau, A. E., & Tu, J. V. (2003). Developing risk-adjusted 30-day hospital mortality rates. *Research in Nursing & Health, 26*(6), 483-496.
- Ulrich, B. T., Buerhaus, P. I., Donelan, K., Norman, L., & Dittus, R. (2007). Magnet status and registered nurse views of the work environment and nursing as a career. *The Journal of Nursing Administration, 37*(5), 212-220.
- Unruh, L. (2003). Licensed nurse staffing and adverse events in hospitals. *Medical Care, 41*(1), 142-152.
- U. S. Department of Health and Human Services. (2008). *Hospital-acquired conditions (HAC) and hospital outpatient healthcare-associated conditions (HOP-HAC) listening session*. Retrieved from http://www.cms.gov/HospitalAcqCond/Downloads/HAC_Listening_Session_12-18-2008_Transcript.pdf
- U. S. Department of Health and Human Services, Office of Inspector General. (2008). *Adverse events in hospitals: Case study of incidence among Medicare beneficiaries in two selected counties*. Retrieved from <http://oig.hhs.gov/oei/reports/OEI-06-08-00220.pdf>
- U.S. Department of Health and Human Services, Office of the Inspector General. (2010). *Adverse events in hospitals: National incidence among Medicare beneficiaries* (Report No. OEI-06-09-00090). Retrieved from <https://oig.hhs.gov/oei/reports/oei-06-09-00090.pdf>
- Van Den Bos, J., Rustagi, K., Gray, T., Halford, M., Ziemkiewicz, E., & Shreve, J. (2011). The \$17.1 billion problem: The annual cost of measurable medical errors. *Health Affairs, 30*(4), 596-603.

- Van Doren, E. S., Bowman, J., Landstrom, G. L., & Graves, S. Y. (2004). Structure and process variables affecting outcomes for heart failure clients. *Lippincotts Case Management*, 9(1), 21-26.
- Vartak, S., Ward, M., & Vaughn, T. (2008). Do postoperative complications vary by hospital teaching status? *Medical Care*, 46(1), 25-32.
- Vogel, T. R., Dombrowsky, N. B., Carson, J. L., Graham, A. M., & Lowry, S. F. (2010). Postoperative sepsis in the United States. *Annals of Surgery*, 6, 1065-1071.
- Wachter, R. M. (2004). The end of the beginning: Patient safety five years after to err is human. *Health Affairs*, W4, 534-545.
- Wachter, R. M. (2006). *In conversation with J. Bryan Sexton, PhD, MA: Perspectives on safety*. Retrieved from <http://www.webmm.ahrq.gov/perspective.aspx?perspectiveID=34>
- Wachter, R. M., Foster, N. E., & Dudley, R. A. (2008). Medicare's decision to withhold payment for hospital errors: The devil is in the detail. *Joint Commission Journal of Quality and Patient Safety*. 34(2), 116-123.
- Wald, H., & Shojania, K. G. (2001). Root cause analysis. In K. Shojania, B. Duncan, K. McDonald, & R. Wachter (Eds.), *Making health care safer: A critical analysis of patient safety practices*. Rockville, MD: Agency for Healthcare Research and Quality.
- Wan, T. (1992). Hospital variations in adverse patient outcomes. *Quality Assurance Utilization Review*, 7(2), 50-53.
- Waring, J. J. (2004). A qualitative study of the intra-hospital variations in incident reporting. *International Journal for Quality in Health Care*, 16(5), 347-352.
- Weingart, S., Iezzoni, L. L., Davis, R., Palmer, R., Cahalane, M., Hamel, M., ... Banks, N. J. (2000). Use of administrative data to find substandard care. *Medical Care*, 38, 796-806.
- Weissman, J. S., Annas, C. L., Epstein, A. M., Schneider, E. C., Clarridge, B., Kirle, L., ... Ridley, N. (2005). Error reporting and disclosure systems: Views from hospital leaders. *The Journal of the American Medical Association*, 293, 1359-1366.
- Weissman, J. S., Schneider, E. C., Weingart, S. N., Epstein, A. M., David-Kastan, J., Feibelman, S., ... Gatsonis, C. (2008). Comparing patient-reported hospital adverse events with medical records reviews: Do patients know something that hospitals do not? *Annals of Internal Medicine*, 149, 100-108.

- Werner, R. M., Goldman, L. E., & Dudley, R. A. (2008). Comparison of change in quality of care between safety-net and non-safety-net hospitals. *The Journal of the American Medical Association*, 299(18), 2180-2187.
- Whalen, D., Houchens, R., & Elixhauser, R. (2005). *HCUP nationwide inpatient sample (NIS) comparison report* (Report No. 2008-01). Retrieved from http://www.hcup-us.ahrq.gov/reports/methods/methods_topic.jsp
- White, P., & McGillis Hall, L. (2003). Patient safety outcomes. In D. M. Doran, *Nursing sensitive outcomes: State of the science*. Sudbury, MA: Jones and Bartlett Publishers.
- World Health Organization. (2014). 10 facts on patient safety. Retrieved from http://www.who.int/features/factfiles/patient_safety/patient_safety_facts/en
- Yuan, Z., Cooper, G. S., Einstadter, D., Cebul, R. D., & Rimm, A. A. (2000). The association between hospital type and mortality and length of stay: A study of 16.9 million hospitalized Medicare beneficiaries. *Medical Care*, 38(2), 231-245.
- Zhan, C., Kelley, E., Yang, H. P., Keyes, M., Battles, J., Borotkanics, R. J., & Stryer, D. (2005). Assessing patient safety in the United States: Challenges and opportunities. *Medical Care*, 43(3 supplement), I42-II47.
- Zhan, C., & Miller, M. (2003a). Administrative data based patient safety research: A critical review. *Quality and Safe Health Care*, 12(Supplement III), ii58-ii63.
- Zhan, C., & Miller, M. (2003b). Excess length of stay, charges and mortality attributable to medical injuries during hospitalization. *The Journal of the American Medical Association*, 290(14), 1868-1874.
- Zhang, J. (2007). What's the relative risk? A method of correcting the odds in cohort studies of common outcomes. *The Journal of the American Medical Association*, 280(19), 1690-1691.
- Zohar, D. (2002). The effects of leadership dimensions, safety climate, and assigned priorities on minor injuries in work groups. *Journal of Organizational Behavior*, 23, 75-92.

BIOGRAPHY

Phyllis Morris-Griffith is a registered nurse with more than 25 years of experience in healthcare. She has spent more than half of her career as a leader within healthcare institutions, serving in roles such as chief nursing officer, chief operating officer, and vice president of patient services. She spent more than five years working with the premier healthcare accrediting organization, The Joint Commission, as a surveyor. Her work includes the evaluation of the quality of care provided by healthcare organizations nationwide and abroad. She has been the owner and principal consultant for Kay Associates, Healthcare Consultants. In 2013, she was selected as a Carefirst BlueCross fellow to complete her dissertation work at George Mason University in Fairfax, Virginia. She also serves as an adjunct faculty member at George Mason University in the College of Health and Human Services, teaching graduate classes. Phyllis holds a bachelor's of science degree in nursing from the University of Southern Mississippi and a master's degree in health care from Mississippi College.