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High Reliability Organizational Suggestions to Reduce the Risk of Hospital-Associated Infections

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High Reliability Organizational Suggestions to Reduce the Risk of Hospital-Associated Infections

A Dissertation Presented for the

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Degree

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Sandra Catrice Affare

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DEDICATION

To one of my biggest fans; the man who knew I would do it and told everyone who would listen to him. Pa-Pa, this one is for you from "Dr. San."

In loving memory of Rev. Harry Echols, Jr.

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ABSTRACT

Over 1.7 million hospital-associated infections (HAIs), resulting in 99,000 deaths, occur each year in the United States. HAIs are defined as infections that occur within 48 hours of hospital admission without evidence of the infection being present or incubating at the time of admission. HAIs are a major concern to the medical community due to the potential loss of life and high costs. Healthcare providers should be accountable for reducing the rates of HAIs and society needs to hold them accountable for the safe implementation and outcomes of the services they provide.

A high-reliability organization (HRO) is commonly described as an organization that performs high-risk work but without rare, catastrophic events. Any industry relying heavily on human performance, such as healthcare, can benefit from emulating an HRO. Embedding high-reliability principles in a healthcare organization is a proven way to increase quality and meet the demands of higher quality expectations. The ways HROs generate and maintain high levels of safety cannot be directly applied to today's hospitals; however, a commitment to achieving zero patient harm events and the deployment of effective process improvement tools can enable hospitals to reach a safety standard comparable to HROs.

Steps to becoming an HRO are not clearly defined; characteristics are. Correlating high-reliability constructs with safety culture surveys provides an opportunity for survey developers and hospital accrediting bodies to offer better tools and guidelines pursuant to a hospital becoming an HRO. Positively responding to societal needs for safe implementation and improved hospital-associated infections outcomes will increase hospital accountability for patient safety.

PREFACE

This dissertation is primarily based on literature obtained from the review of the seminal research performed on HROs as part of the student researcher's graduate research assignment. While the literature review focused on the seminal research excluding healthcare, a conference paper was written that focused directly on healthcare and the implementation of high reliability theory. The student researcher served as the lead author and conference presenter and was responsible for the primary paper composition and data analysis. This dissertation came about as a direct interest in the healthcare system's difficult transition to become an HRO and the increasing number of patient deaths due to preventable hospital-associated errors.

The purpose of this dissertation is to provide suggestions that can be useful to hospitals, accrediting bodies, or patient safety survey developers to improve patient safety outcomes by coupling high reliability theory with hospital safety-related measures. The scope of this dissertation is limited to the avoiding infections safety measure of the *Consumer Reports* safety score composite, specifically the hospital-associated infections and the hospital patient safety culture survey. Finally, the dissertation recommendations were developed as a result of relational analyses identified in correlating HRO theory and a hospital safety-related measure.

The journey to the doctorate of philosophy has been over 8 years for the student. The shortest period was completing the coursework; the dissertation writing appeared to be the greatest part of the time. The student found that writing the dissertation was the single most focused task of her profession. She learned the importance of time management, statistical analysis techniques, and writing styles that will be useful the rest of her professional career. Most of all, she learned how to summarize and properly document the works of others and the power of persistence. *The race is truly not given to the swift, but to those who endure to the end* (Author Unknown).

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LIST OF ABBREVIATIONS

ACA	Affordable Care Act
AHA	American Hospital Association
AHRQ	Agency for Healthcare Research and Quality
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
BSC	Bed Size Code
BSI	Blood Stream Infection
CAMH	Comprehensive Accreditation Manuals for Hospitals
CAUTI	Catheter-Associated Urinary Tract Infection
CDC	Center for Disease Control and Prevention
CLABSI	Central Line-Associated Blood Stream Infection
CMS	Centers for Medicare and Medical Services
HAI	Hospital-Associated Infection
HCAHPS	Hospital Consumer Assessment of Healthcare Providers and Systems
HHH	U.S. Department of Health & Human Services
HRO	High Reliability Organization
HSOPS	Hospitals Survey on Patient Safety
ICU	Intensive Care Unit
IOM	Institute of Medicine
PSCHO	Patient Safety Climate in Healthcare Organizations
PSI	Patient Safety Indicator
SES	Socioeconomic Status
SSI	Surgical Site Infection (from colon surgery)
U.S.	United States
UTI	Urinary Tract Infection

LIST OF ATTACHMENTS

CHAPTER I
GENERAL INFORMATION

Hospital-**A**ssociated **I**nfections (HAIs) are defined as infections that occur within 48 hours of hospital admission "without evidence of the infection being present or incubating at the time of admission" (Koch, Nilsen, Dalheim, Cox & Harthug, 2014, p. 284). Three HAIs are examined in this research: Catheter-Associated Urinary Tract Infections (CAUTIs), Central Line-Associated Blood Stream Infections (CLABSIs) and Surgical Site Infections (SSIs) from colon surgery. According to the *Comprehensive Accreditation Manuals for Hospitals: The Official Handbook* (The Joint Commission, 2011), CAUTIs are urinary tract infections that are associated with the patient having an indwelling urinary catheter. CAUTIs are diagnosed based on the patients' symptomatic and asymptomatic urinary tract infections without symptoms, causing septicemia (a bloodstream infection) within 48 hours after insertion of the catheter (The Joint Commission, 2015). "An indwelling urinary catheter is a drainage tube that is inserted into the urinary bladder through the urethra, [and] is left in place" (Gould, Umscheid, Agarwal, Kuntz, & Pegues, 2009, p. 22). Infection control measures may be used to prevent many CAUTIs (Gould et al., 2009).

Central lines are catheters inserted directly into a large vein and used to deliver fluids, medication, and nutrition to patients. Central line-associated bloodstream infections (CLABSIs) are caused when bacteria collect on the line and enter the bloodstream and are the most serious type of HAI (The Joint Commission, 2015). CAUTIs and CLABSIs are among the three most common HAIs (Limaye, Mastrangelo, & Zerr, 2008). The third most common HAI is ventilator-associated pneumonia; however, this type of HAI is not used in the infection safety scoring composite. SSIs are surgery-related infections (occurring within 30 days of the surgical procedure) on or close to the skin surface or in any part of the body that is opened and manipulated during surgery (The Joint Commission, 2015).

Consumer Reports (2015) created hospital measures or ratings to help the consumer compare hospital performance based on their patient safety score and individual measures relating to patient experience, patient outcomes, and certain hospital practices. The Consumer Reports safety score composite uses the following "five major categories of safety-related measures, each with several components:

- Avoiding Infections,
- Avoiding Readmissions,
- Avoiding Mortality,
- Communication about discharge and medications, and
- Appropriate use of scanning" (*Consumer Reports*, 2015, pp. 39–40).

The five categories have equal weights in calculating the hospital safety score. The calculations for the total weight (20%) for the first category, avoiding infections, is based on a combined CLABSI, CAUTI, and SSIs (*Consumer Reports*, 2015). Again, these three HAIs are examined in this research.

1.1 Background

At least "210,000 deaths per year were [researched and] associated with preventable harm in hospitals" (James, 2013, p. 122). A 2008 Forbes article stated that out of every 200 patients who spend one night in the hospital, one will die from a medical error and 12 will contract an HAI (Stokes, 2013). HAIs are major, yet often preventable, threats to patient safety; about 1 in 25 hospital patients have at least one HAI during their hospital stay (Centers for Disease Control & Prevention [CDC], 2015). When a patient enters the hospital for one medical problem, he or she does not want to experience an additional infection during the stay. The number of patient deaths related to HAIs is costly. The last 20 years have documented healthcare costs that exceed 18% of the U.S. gross domestic product (Health Forum, 2014; Stokes, 2013). "The excess hospital cost of HAIs [alone] . . . was estimated to be between 28 and 45 billion dollars annually" (Stone et al., 2010, p. 433). The healthcare industry still needs change, despite its focus over many decades on improving patient safety errors (Blouin & McDonagh, 2011).

Nearly 80,000 bloodstream infections (BSIs) occur annually in intensive care units (ICUs) (Limaye et al., 2008), with reported mortality of 12–25% for CLABSIs ("Vital Signs," 2011). "The attributable cost per infection is estimated to be $34,000–$56,000, and the annual cost of caring for patients with BSIs ranges from $296 million to $2.3 billion" (Limaye et al., 2008, p. 404). Urinary tract infections (UTIs) account for more than 30% of the total number of HAIs in some reports and affect an estimated 600,000 patients per year (Gould et al., 2009). "The average cost of one hospital-associated UTI is estimated to be $680 to $1,875 per patient infection, and

additional hospital days per patient . . . ranges between 2 to 4 days" (Limaye et al., 2008, p. 405). It is a given that CLABSIs, CAUTIs, and SSIs are common, expensive, and—by their very nature—preventable (Stone et al., 2010). The public relies on performance and quality of care data on hospitals which provides the public a sense of institutional accountability (Richards, 2009). The popular source of such public information is often the *Consumer Reports*. While not a scholarly journal, it is widely available to the general public and thus is a source of information on hospital performance and quality of care data. The pressure is on hospital program accreditation bodies, such as the Joint Commission on Accreditation of Healthcare Organizations, (herein referred to as "the Joint Commission"), to report hospital accountability data to the American public. The Joint Commission is a private, independent, not-for-profit accreditation agency for over 20,500 healthcare organizations in the United States. It establishes guidelines for the operation of hospitals and other healthcare facilities, conducts accreditation programs and surveys, and encourages the attainment of high standards of institutional medical care. The vision of the Joint Commission (2014) is for all people to always experience the safest and highest quality health care across all settings.

The Joint Commission, in early 2000, set a goal to learn about and emulate *highly reliable organizations* (HROs) that operate safely in high-risk conditions and later adopted HRO in health care as it relates to patient safety. Joint Commission accreditation and certification is recognized nationwide as a symbol of quality that reflects an organization's commitment to meeting certain performance standards. One of the benefits of achieving the Joint Commission accreditation is that it strengthens community confidence in the quality and safety of care, treatment and services of the facility. Achieving such certification makes a strong statement to the community about an organization's efforts to provide the highest quality services.

The Joint Commission partners with accredited health care organizations (hospitals, home care providers, and nursing homes) to improve health care systems. The Joint Commission partners with the community to provide accredited organizations that are continually focused on eliminating systems failures and human errors that may cause harm to patients, families and staff. Safety is what patients, families, staff and the public expect from Joint Commission–accredited organizations. Dr. Mark R. Chassin, president and chief executive officer of the Joint Commission and the late, Dr. Jerod M. Loeb, former executive vice president of the Joint Commission, "discovered that the ways high-reliability organizations generate and maintain high

levels of safety cannot be directly applied to today's hospitals" (Chassin & Loeb, 2013, p. 459). However, a commitment to achieving zero patient harm, the organization's safety culture and the deployment of effective process improvement tools enables hospitals to reach a quality of safety comparable to HROs (Chassin & Loeb, 2013).

Given the strong interest in HROs by the Joint Commission and health care practitioners alike, in 2008, the Joint Commission Center for Transforming Health Care, an affiliate of the Joint Commission, was created to assist hospitals transforming into HROs by offering highly effective, durable solutions to healthcare's most critical safety and quality problems. "Embedding high-reliability principles in a healthcare organization is a proven way to improve quality and meet the demands of higher-quality expectations" (Stokes, 2013, p. 28). Chassin and Loeb (2013) developed an implementation framework that defines the stages of maturity they believe a hospital must pass on their journey to become an HRO. These stages are much like the lifecycle of a project in project management. Yet, no research has been found supporting the Joint Commission's expectation of the hospitals it accredits in adopting high-reliability concepts as they relate to patient safety. Without inspection criteria or requirements instituted by the primary accrediting body, what is the hospital's motivation to adopt HRO principles and practices as they relate to patient safety?

1.2 Problem Statement

There is a societal concern with the number of HAIs due to preventable and hospital-associated errors. HAIs "are major concerns to the medical community due to the potential loss of life and high costs" (Limaye et al., 2008, p. 404). "Healthcare providers should be accountable for reducing rates of infection" (Richards, 2009, p. 72). HAIs affect the lives of patients and strain hospital resources while adding to the cost of healthcare (Limaye et al., 2008).

> Increasingly, hospitals are applying lessons learned from best-in-class patient safety and patient satisfaction programs to address safety and health. Built around high reliability principles endorsed by the Joint Commission, these programs embrace a no-blame culture to de-stigmatize interventions . . . and promote high reliability behaviors to reinforce best practices and prevents patient safety events (Occupational Safety & Health Administration, 2013, p. 1).

With the increased possibility for human error that may lead to an adverse patient safety event, the healthcare industry is a primary candidate for preventing human error by emulating HROs (Tolk, Cantu, & Beruvides, 2014). "In an integrated patient safety system, staff and hospital leaders work together to learn from their patient safety events, including close calls and other system failures that have not led to patient harm" (The Joint Commission, 2015, p. PS-2).

The aim of the safety culture should be to balance learning with accountability (American College of Surgeons, 2014). One platform for becoming a highly reliable healthcare system is higher public accountability (Stokes, 2013). Chassin and Loeb (as cited in Blouin & McDonagh, 2011, p. 399) "defined accountability measures as those with a strong research basis, those where the process being measured is closely linked to the patient care outcome desired."

Steps to become an HRO are not clearly defined, though the characteristics of an HRO are. Hospitals need new process improvement tools and methods to break out of their low reliability state (Chassin & Loeb, 2013). Developing a relationship between the hospital safety-related measures and high reliability theory can help provide hospitals with information to assist them in implementing safety programs and improve patient outcomes. The primary focus of this translational healthcare services research is to provide recommendations that healthcare organizations can use to assess their own hospital safety-related outcomes and improved patient safety outcomes, which will provide public accountability.

1.2.1 Assumption

The following assumptions apply to this research:

- All safety score information obtained from the Centers for Medicare and Medical Services (CMS) website is factual and non-biased.
- HRO theory is valid and can be applied to healthcare.
- If applied to healthcare, HRO theory will improve patient safety outcomes.
- The results of the Hospital Survey on Patient Safety Culture (HSOPS) found in this research represent healthcare operations throughout the U.S.

1.2.2 Definitions

The following are definitions for the safety score rating terms used throughout this research, (CAMH Update 2, 2015):

- ***Adverse event.*** A patient safety event that resulted in harm to a patient.
- ***Catheter-associated urinary tract infections (CAUTIs).*** Symptomatic and asymptomatic urinary tract infections that are associated with the patient having an indwelling urinary catheters (tube inside the body inserted in an individual's urinary bladder) and resulting in a bloodstream infection, within 48 hours of insertion of the catheter.
- ***Central line-associated blood stream infections (CLABSIs).*** A bloodstream infection can occur when bacteria or other germs travel down a "central line" and enter the blood (CDC, 2012).
- ***Patient Safety event.*** An event, incident, or condition that could have resulted or did result in an adverse patient outcome.
- ***Surgical-site infections (SSIs).*** Surgery-related infections that occur on or near the skin surface or in any part of the body that is opened and manipulated during surgery. They are counted in the Consumer Health Ratings if they occur within 30 days of the surgical procedure. All of the states in the U.S. report data on surgical-site infections that occur after one or both of the following procedures: colon surgery and abdominal hysterectomy.

Other definitions used throughout this research are provided for clarity.

- **High Reliability Organization (HRO)** – Organizations with high quality and reliable operations that potentially can have catastrophic outcomes but consistently operate error-free for lengthy periods of time (Bourrier, 2005).
- **Mindfulness** - Focusing on and defining possible errors while creating strategies to either mitigate the error or contain its impact on operations (Weick & Sutcliffe, 2001).
- **Patient Safety Climate** – Practices, procedures or rewarded behavior that is supported and expected in organization (Alahmadi, 2010).

- **Patient Safety Culture** – The enduring beliefs and practices of an organization and its willingness to apply lessons learned.

1.2.3 Delimitation

The following limitations apply to this research:

- The analyses are based on a limited scope of patient outcomes, HAIs for CAUTI, CLABSI and SSIs from colon surgery. While the data source provided HAIs from colon surgery and hysterectomy, colon surgery was chosen because it was inclusive of both men and women.
- The avoiding infections measure is only one of the five *Consumer Reports* hospital safety related measures and is the focus of this research. Ventilator-associated pneumonia data is not used to calculate the total weight for avoiding infections and was therefore omitted from this research.
- The research is limited to Joint Commission accredited U.S. hospitals and uses analyzed HAI scores that were voluntarily reported to the accrediting body over the identified period and not the infection rate or individual performance of a single hospital or unit.
- The safety score data was obtained from the CMS Hospital Compare website, hospitalcompare.hhs.gov. The measurements collected began January 1, 2013 and ended December 31, 2013.
- The Joint Commission safety-related measures, the National Patient Safety Goals, were not analyzed as a part of this research.
- Though the HRO constructs used in this research are fluid, the coding performed in the research remains constant with the written work found in the second edition of *Managing the Unexpected* (Weick & Sutcliffe, 2007).
- The research identifies areas of improvement in the safety surveys based on analyses, but does not offer a prescription for hospital safety program interventions.
- No additional research was performed on the socioeconomic factors surrounding healthcare. Socioeconomic factors to consider with patient care may be educational level

of the patient and the care-giver, the availability of modern technology in the hospital, and the financial impact on the area on the hospital itself. The socioeconomic status of the area surrounding the hospital may be a confounding variable for the HAI hospital data and warrants future research.

1.2.4 Research Question

Does the safety cultural assessment survey, the HSOPS, measure HRO?

1.2.5 Hypothesis Statement

Coupling high reliability theory with hospital safety culture-related measures can provide predictors for patient safety outcomes.

1.2.6 Societal Contribution

The problem statement requires a translational continuum, the evolution of understanding the applications of HRO in healthcare, including the assessment of healthcare organizations' safety-related measures. The problem of increased HAIs requires hospital program evaluation, accountability, and improvement at all levels of the patient safety system. The public needs to hold hospitals responsible for the quality of services they provide.

The research recommendations were developed by correlating an existing patient safety culture survey with the characteristics, principles, and theories of HROs. The Results section provides elements for the survey developers to consider when updating the HSOPS patient safety culture survey. The research recommendations can assist accrediting bodies such as the Joint Commission in ensuring that their requirements obtain the high reliability principles they endorse for hospital programs. Finally, the research recommendations allow hospital administrators who desire their units to become an HRO to perform self-assessments and identify areas for improvement in their journey to become an HRO. These three different areas—accrediting bodies, patient safety survey developers, and hospital administrators—are the target audiences for the following research. They all have patient safety at the core of their operations.

1.3 Dissertation Organization

The following major sections of this dissertation are Literature Review; Materials and Methods; Results and Discussion; and Conclusion. The Literature Review presents an overview of HAIs and the patient safety culture in U.S. Hospitals. It highlights the seminal research on high reliability theory and its relevance to healthcare organizations. It also includes the use of patient safety surveys as the tools used to assess the hospital safety culture. Materials and Methods detail the methodology of the current research. The Research Validation confirms the method chosen in the current research. The Results and Discussions identify and discuss the proclivity of outcomes hospital administrators can expect from deploying the recommendations. The Conclusion provides a summary of the research question, hypothesis and the researched results as well as an opportunity for future work.

CHAPTER II
LITERATURE REVIEW

The current research centers on hospitals' patient safety culture and the deployment of effective process improvement tools that will enable hospitals to reach a mindset of safety comparable to HROs. The patient safety movement has placed HAIs under great "scrutiny by patients, providers, healthcare institutions, and regulatory agencies" (Yanke, Carayon, & Safdar, 2014, p. 1176). The research supports the development of a self-assessment approach that hospital administrators can use to improve the avoiding infections outcome portion of their hospital safety score composite. Healthcare organizations need more than key principles and characteristics to transition to an HRO (Tolk et al., 2015).

> "There has been an increased awareness of and interest in patient safety and improved outcomes, as well as a growing body of evidence substantiating medical error as a leading cause of death and injury in the U.S. According to The Joint Commission, U.S. hospitals demonstrate improvements in health care quality and patient safety. Although this progress is encouraging, much room for improvement remains" (Wright, 2015, p. 1).

In this vein, the translational approach developed through this research seeks to explore the discovery of HROs and their applications in healthcare.

2.1 HRO Theory and HAIs

Several databases were used to conduct the review of literature, including, Compendex, PsycINFO, PubMed, Scopus and Web of Science. The literature review began with a broad keyword search using the term "high reliability organizations" in the Scopus, Compendex, and PsycINFO databases. The purpose of the keyword search was to capture the seminal research on high reliability organizations. Particular attention was given to refereed journal articles. Scholarly books provided a foundation for HRO theory. Additional key terms in the literature search were *Hospital-Associated Infections* and *Hospital Patient Safety*. The patient safety searches excluded hospitals where the patients were not humans, i.e. veterinarian hospitals.

Using One Search on the University of Tennessee Online Libraries, a key word search on *High Reliability Organizations* yielded 665 peer-reviewed journals. The number reduced to one peer

reviewed article when adding *Hospital-Associated Infections* to the query. Likewise, a key word search on *Hospital-Associated Infections* yielded more than fifteen thousand (15,717) peer reviewed journals; however, once adding *High Reliability Organizations* to this search, the peer-reviewed journals reduced to the same article. After further investigation, it was discovered that the article found in the *Official Journal of the International League Against Epilepsy* was on neither topic. A similar basic search was performed in the Web of Science database using a wildcard character (*) to find plurals and word variants and using the topics separately by adding a field. The search found no records. An advanced search in PsycINFO, PubMed and Scopus was performed using the same key words and no records were found in either. Although a research paper exists linking HROs to infections in general, to date, no published research has been found linking HROs and HAIs specifically.

2.2 HAIs and Patient Safety Culture in US Hospitals

In response to patient safety concerns from the public, many states have adopted individual regulations for hospitals to report patient safety events (Weinberg, Hilborne, & Nguyen, 2005). The 2005 Patient Safety and Quality Improvement Act, implemented by the Agency for Healthcare Research and Quality (AHRQ), created a national database on medical errors and addressed patient safety issues. The Patient Safety and Quality Improvement Act does not affect state laws requiring hospitals to voluntarily report patient safety items, but encourages providers by creating an incentive to do so (Smith & Stratton, 2006). Not reporting the required information could be damaging to the hospital's reputation, potentially cause the hospital to incur a financial penalty and possibly affect the state licenses of the practitioners involved.

Patient safety is a concern of healthcare practitioners, hospital administrators, as well as the larger population—particularly patients and their families (Affare, Tolk, & Cantu, 2015). "To achieve the best outcomes, patients and families must be more actively engaged in decisions about their health care and must have broader access to information and support" (The Joint Commission, 2015, p. PS-15). An informed patient relies on consumer health reports such as patient safety ratings, which are found in Consumer Reports. HealthGrades (2015), a hospital rating company based in Golden, Colorado, suggested that consumers look for hospitals that are rated better than average in an effort to reduce their risk of experiencing adverse patient safety

events. “Patient safety performance data may be used in support of many efforts aimed at improving patient safety: regulators may use the data for accountability purposes such as licensure and certification programs…” (Aspden, Corrigen, Wolcott, & Erickson, 2004, p. 250).

Of interest to this research are the policy changes in payments for Medicare patients acquiring HAIs and/or HAIs constituting hospital readmission. Effective, October 1, 2008, the CMS instituted a policy that requires hospitals to assume financial responsibility for HAIs (Stone et al., 2010). “An additional estimated $103 million in payments would be withheld if Medicare expands the policy to include non-payment for [HAI] related readmissions” (McNair & Luft, 2012, p. E1). Tools provided by the Affordable Care Act (ACA) such as tying hospital Medicare reimbursements to readmission rates are among the ACA’s aims and initiatives that led to the prevention of nearly 15,000 deaths in hospitals and prevented 560,000 patient harms in 2011 and 2012 (U.S. Department of Health & Human Services [HHS], 2014). A revision to the national strategy for quality improvement in health care—Title III of the ACA (2015) calls for an adjustment in hospital medical payments based on the fates of HAIs.

Participants in a CMS policy study involving 33 senior researchers with national expertise in HAIs and patient safety questioned whether financial incentives would influence clinical practice (Stone et al., 2010). The research revealed that financial incentives act as the motivator for “mindfulness” in patient safety. “In this adapted behavioral model of incentive serves as the stimulus while the environmental, organizational provider and patient characteristics present mediating variables, which affect the outcomes” (Stone et al., 2010, p. 435). “Public and private payers will hold providers increasingly accountable for costs and quality across the continuum and success will depend on hospitals’ ability to . . . achieve both greater efficiency and improved outcomes” (Health Forum, 2012, p. xiv). The concern is that, over time, the financial incentive becomes the norm and the expected behavior is soon forgotten. Furthermore, the policy was for Medicare payments and did not affect payments from non-Medicare insurance carriers; private-pay insurance carriers were not included in the policy.

Another tool offered by the ACA (2010) was the Partnership for Patients initiative. In April 2011, the HHS (2014) joined hospital leaders, other health professionals, along with state and federal governments to launch the Partnership for Patients. One of the primary goals of this nationwide, public-private initiative was to reduce preventable hospital-acquired conditions by

40% (HHS, 2014). Among the preventable hospital-acquired conditions identified by the Partnership for Patients are the HAIs that are the subject of this research: CAUTIs, CLASBIs, and SSIs. These HAIs make up 30% of the initial focus for the Partnership for Patients' identified patient safety areas (HHS, 2014). Preliminary data reported by two different hospital engagement networks, Health Association of New York and Dignity Health, showed a reduction in CAUTIs, CLABSIs, and SSIs from 2010 to 2013 (HHS, 2014). Although there are noted, historic improvements in patient harm in hospitals, there is more to do to improve patient safety (HHS, 2014). The Joint Commission, an agency that accredits more than 20,500 healthcare organizations in the United States, has "few proven tools or methods that can guide hospital leaders to achieve a fully functional patient safety culture" (Chassin & Loeb, 2013, p.469).

The *National Action Plan to Prevent Health Care-Associated Infections: Road Map to Elimination* (U.S. Department of Health & Human Services, Office of Disease Prevention and Health Promotion, accessed August 30, 2015) produced a status report on the efforts of the five-year healthcare-associated infection prevention goals which were developed as a result the HHS action plan in 2009. The national report found:

- a 46% decrease in CLABSI between 2008 and 2013;
- a 19% decrease in SSIs related to the 10 select procedures tracked in the report between 2008 and 2013; and
- a 6% increase in CAUTI between 2009 and 2013; although initial data from 2014 seem to indicate that these infections have started to decrease.

The national report was based on 2013 data. "Despite progress, the nation did not reach the 2013 goals. More action is needed at every level of public health and health care to improve patient safety and eliminate infections that commonly threaten hospital patients" (CDC, 2015, para. 9).

2.3 High Reliability Organization Theory

In his book, *Normal Accidents: Living with High Risk Technologies* (1984), Yale sociologist, Charles Perrow, argued that the conventional engineering approach to ensuring safety-building in more warnings and safeguards-fails because systems complexity makes failures inevitable. He concluded that in highly complex organizations in which processes are tightly coupled,

catastrophic accidents are bound to happen. The April 1986 disaster at the Chernobyl nuclear power plant in Ukraine suggested that society cannot wait to study after-action catastrophic events; it is too costly (Roberts and Rousseau, 1989). "This set the stage for a research group at the University of California at Berkeley to study organizations in which errors can have catastrophic consequences. The research group focused initially on organizations that seemed to behave very reliably, which they called *high reliability organizations*" (Roberts, 2003, p. 13).

An Interview with Karlene Roberts (Bourrier, 2005) states Roberts's definition of an HRO as an "organizations that can have catastrophic outcomes but which conduct relatively error free operations over long periods of time and make consistently good decisions that result in high quality and reliability operations" (p. 93). The original HRO research investigated processes in nuclear-powered aircraft carriers in the U.S. Navy (Rochlin, LaPorte, & Roberts, 1987). The Federal Aviation Administration had HRO research performed on air traffic control operations (Schulman, 1993). Commercial aviation was the first to develop HRO-like principles after a deadly United Airlines accident in Portland in 1978 (Roberts, 2003). Industries such as nuclear power and air traffic control are highly regulated organizations with a very tight command and control structure within their operations. Other industries that became interested in HROs include firefighting, mining, and health care (Weick & Sutcliffe, 2007). Healthcare is not considered as regulated as the previously mentioned industries. Early research defined the theory of HROs as embodying a minimum of eight primary characteristics that must occur simultaneously (Roberts & Rousseau, 1989):

- **Hyper complexity** – having an variety of components, subsystems and organizational levels;
- **Tightly coupled systems** – having non-sequential, time-dependent processes across multiple units or organizational levels;
- **Hierarchical differentiation** – multiple organizational levels with individual regulations and controls;
- **Multiple decisions and immediate feedback** – quick operational decisions and feedback on those decisions are imperative to the safe implementation of the decisions;

- **Degree of accountability** – severe consequences for poor performance or not following procedures;
- **Large amount of immediate feedback about decisions** – duplicate information systems and redundant controls;
- **Compressed time factors** – cycle time (measured in seconds); and
- **More than one critical outcome that must happen simultaneously** – eliminate the ability to withdraw or modify complex operations.

Another research group at the University of Michigan began addressing similar issues (e.g., Weick, 1987; Weick, Sutcliffe, & Obsfeld, 1999). While this group represented different disciplines (psychology, political science and physics), they came together with an organizational perspective. "These researchers took a different perspective than most of those who preceded them" (Roberts, 2003, p. 13); they were initially concerned with understanding success in organizations in which errors can result in catastrophe (Roberts, 2003). "HROs have developed ways of acting [mindful] that provide a template for all organizations that want to be more reliable in managing the unexpected" (Weick & Sutcliffe, 2001, inside jacket). *Managing the Unexpected* (2001) details the importance of and practical guidelines on how to manage unexpected events. After carefully studying organizations identified as HROs, the authors determined that good management of unexpected events requires a *mindful* approach (Weick & Sutcliffe, 2001). Weick and Sutcliffe (2001) identified the following five key high reliability constructs, which are believed to be essential for any successful improvement initiatives:

- "**Sensitivity to operations.** Preserving constant awareness by leaders and staff of the state of the systems and processes that affect patient care. This awareness is key to noting risks and preventing them.
- **Reluctance to simplify.** Simple processes are good, but simplistic explanations for why things work or fail are risky. Avoiding overly simple explanations of failure (unqualified staff, inadequate training, communication failure, etc.) is essential in order to understand the true reasons patients are placed at risk.
- **Preoccupation with failure.** When near-misses occur, these are viewed as evidence of systems that should be improved to reduce potential harm to patients. Rather than

viewing near-misses as proof that the system has effective safeguards, they are viewed as symptomatic of areas in need of more attention.

- **Deference to expertise.** If leaders and supervisors are not willing to listen and respond to the insights of staff who know how processes really work and the risks patients really face, [the organization] will not have a culture in which high reliability is possible.
- **Commitment to Resilience.** Leaders and staff need to be trained and prepared to know how to respond when system failures do occur" (Hines, et al., 2008, p. 1).

"Research shows that HROs pursue two competing approaches to achieve reliable performance: the prevention (anticipation) approach and the resilience (containment) approach" (Sutcliffe, 2011, p. 136). Categorically, the concepts are subdivided into two parts: principles of anticipation and principles of containment, as shown in Figure 1. Anticipation is waiting for something to occur, while containment is maintaining a level of support throughout adverse situations. An organization's unique ability to prepare for and prevent the unexpected or recover quickly from failure while learning from both options is resilient- a concept clearly understood by high reliability organizations (Sutcliffe, 2011).

2.4 Summary of HRO Theory in Healthcare

Hospital emergency rooms were omitted from seminal HRO research efforts because they did not involve compressed time frames, simultaneous outcomes, and complex technologies that may lead to unpredictable results (Roberts & Rousseau, 1989). The healthcare industry became interested in HROs after the historical IOM (1999) report, To Err Is Human: Building a Safer Health System. The 98,000 patient deaths due to hospital errors have increased in the last 10 years due to HAIs (Yanke et al., 2014). James (2013) later suggested that the number ranges from 210,000 to 400,000 patient deaths annually. "HAIs are among the leading causes of death in the U.S." (Yanke et al., 2014, p. 1176).

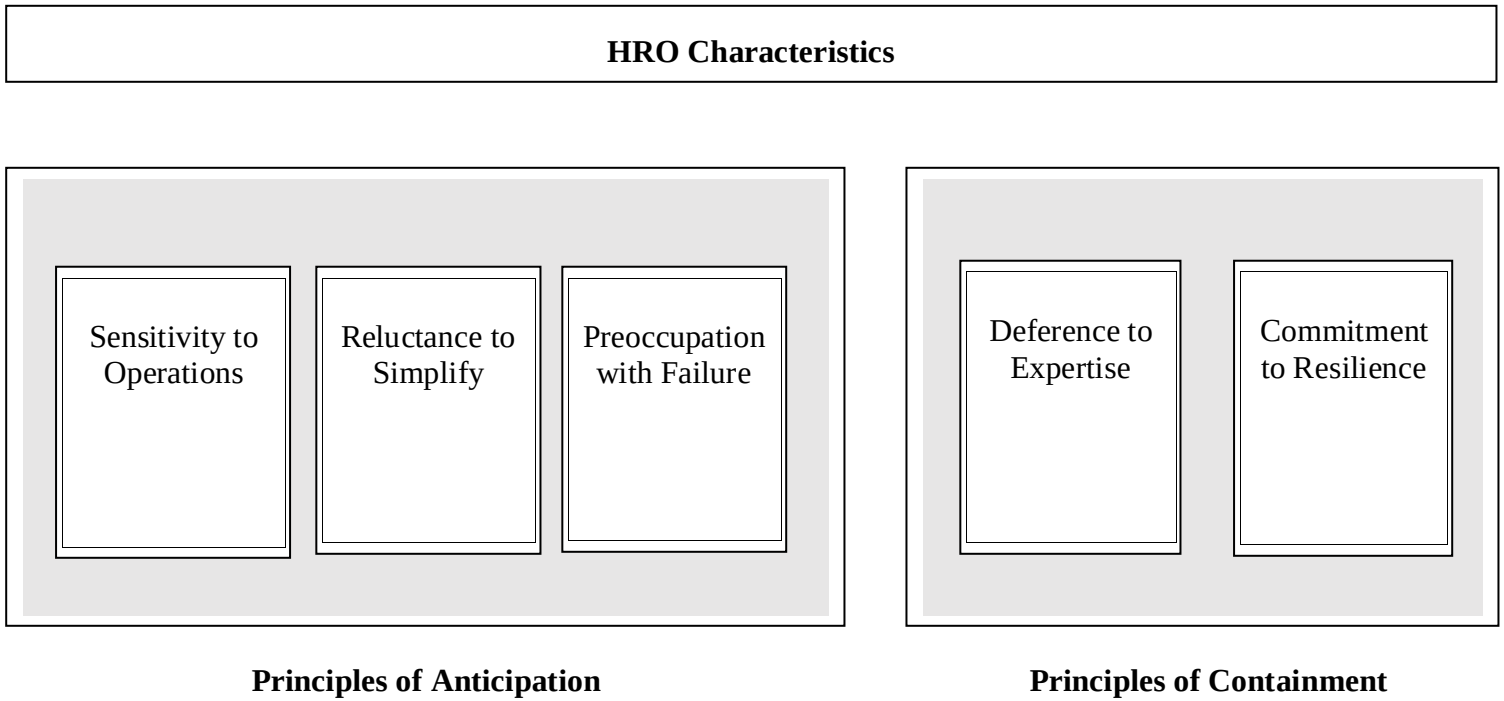

Figure 1: HRO Characteristics Subdivided

Tolk, Cantu, and Beruvides (2013) evaluated the healthcare industry related to HROs. They conducted a literature review and determined that the healthcare industry had not modified the initial theory of HROs, but instead concentrated on applying it. In a subsequent study, Tolk et al. (2013) conducted a literature review that showed the healthcare industry has the largest body of publications on applying HRO theory in practice. Although high-reliability science has greatly increased the understanding of how HROs function, it does not provide much practical insight into how organizations can move from low to high reliability (Blouin & McDonagh, 2011). "An industry that relies heavily on human performance, such as healthcare, can benefit from emulating an HRO by establishing human error-preventing methods" (Affare et al., 2015).

Hospitals need a concise process for separating human errors from recklessness (The Joint Committee, 2015). *Mindfulness* focuses on and identifies possible errors while creating strategies to either mitigate the error or contain its impact (Weick & Sutcliffe, 2001). "A classical human factors engineering approach [would] establish a work environment that is designed to make safe behaviors intuitive and to prevent errors of omission by providing visual cues as reminders" (Sax & Clack, 2014, p. 338). Research into and management of organizational errors has its social science roots in human factors engineering. The human factors movement began during World War II and was aimed at both improving equipment design and maximizing human effectiveness. Massoumi (2015) argued, "Healthcare is a combination of multiple systems united . . . to serve the population. . . [Researching] human factors can identify safety, quality, and reliability challenges by understanding how humans interact [in] processes" (Massoumi, 2015, *Abstract*). Healthcare is an industry which humans are the process. With regard to the HAIs in this research, central line, urinary tract, and surgical site infections, they all involve heavy human interaction. Prevention of HAIs requires not only reliability, but high reliability

2.5 HRO and Patient Safety Culture

High-reliability concepts can help focus attention on the local mindset and patient safety culture that is essential for quality improvements (Hines et al., 2008). Safety culture refers to the enduring beliefs and practices of an organization and its willingness to apply lessons learned (Singer et al., 2009). Increasingly, hospitals are applying such lessons learned to address safety and health. While culture may be the foundation for organizational vision, safety must be the

overarching organizational strategy (Blouin & McDonagh, 2011). Americans have had trouble in the last half of century understanding the healthcare system and did not see it as putting patients first (HHS, 2014). Developing a culture of safety has become a core element of many efforts to improve patient safety (Hamdan, 2013).

Since 2009, the Joint Commission has required the leadership of all healthcare organizations it accredits to "create and maintain a culture of safety" (Chassin & Loeb, 2013, p. 469). A strong safety culture is a healthcare's central tenet to becoming an HRO (Singer et al., 2009). One component in valuing organizational learning is a focus on improving system performance (*Institute of Medicine*, 2004). "Patient safety climate, or culture, shapes expected behaviors related to patient safety" (Affare, et al., 2015) and is often measured by using a culture survey (Weaver et al., 2013). Given that the culture of safety influences the outcomes in patient care by shaping staff behavior, such surveys are widely being implemented (Weaver et al., 2013).

Since 2011, patient safety has improved, "saving an estimated 50,000 lives and $12 billion dollars" (HHS, 2014). "*Quality* in health care is the degree to which [provider] processes and results meet or exceed the needs and desires of the people it serves" (The Joint Committee, 2015, p. PS-1). Consumers are now empowered with more available healthcare data. One of the platforms for becoming a highly reliable health care system is greater public accountability (Stokes, 2013).

2.6 Healthcare Organizations and Patient Safety Surveys

In 2004, AHRQ tested, revised and released the HSOPS. The HSOPS is a staff survey designed to help hospitals assess staff perceptions about the culture of safety (including patient safety issues, medical errors and event reporting) in their institutions. The survey measures 12 patient safety culture composites with 42 questions. Multiple regression analyses were performed to examine relationships between 15 safety culture variables and a measure based on patient safety indicators (PSIs) (Mardon, Khanna, Sorra, Dyer & Famolaro, 2010). "The AHRQ PSIs underwent validation through a clinical panel review process, which provided the basis for selecting the indicators expected to be most useful for screening potentially preventable adverse events" (Mardon et al., 2010, pp. 227-228). The findings of the limited research revealed a direct relationship between patient safety culture and adverse hospital events. *Adverse events* are those

that result in harm to a patient. The survey results provided validation of assessing the safety culture as an indicator of patient safety (Mardon, et al., 2010).

The Patient Safety Climate in Healthcare Organizations (PSCHO) survey was developed by the Patient Safety Culture Institute at the Veteran Affairs Palo Alto Health Care System under the direction of Dr. David Gaba and Stanford University (Hartman et al., 2008; Singer et al., 2007). The PSCHO survey captures 38 safety climate items (Singer et al., 2007) and measures eight distinct dimensions of safety climate covering organizational, work-unit, and interpersonal contributions to a hospital's overall safety climate (Singer et al., 2003). The PSCHO survey "exhibits strong psychometric properties, is optimized for hospital-wide implementation, [and] covers more topics with fewer items than other safety climate surveys" (Singer et al., 2007, p. 24). The psychometric properties were tested by surveying personnel from 105 U.S. hospitals representing all disciplines and hierarchy levels (Singer et al., 2007). The data were analyzed using an exploratory factor and multi-trait analyses and several constructs; three organizational factors, two units, and three individual factors were identified (Singer et al., 2007). The constructs demonstrated the possibility of measuring key features of safety climate when using the appropriate sample size (Singer et al., 2007). A separate research using the 2004 PSCHO survey applied systematic sampling measuring patient safety climate in 92 U.S. hospitals (Singer et al., 2009). The results highlighted differences in attitudes and perceptions among work areas and within the emergency departments, which offered a better safety climate than other areas (Singer et al., 2009).

Hospital Consumer Assessment of Healthcare Providers and Systems "(HCAHPS) is a national survey that asks patients about their experiences during a recent hospital stay" (Medicare.gov, assessed June 29, 2015). Such surveys are comparable to a customer restaurant rating or review of a hotel stay. Although HCAHPS, a federally mandated survey instrument, is a component of quality health care, the average patient experience is ubiquitous—either relying upon unmet patient expectations or a utopian hospital experience. An unfriendly admittance clerk, a nervous phlebotomist or a "dry" (nonchalant) physician can shape the entire patient experience (Kerfoot, 2008). The volatility of such a survey, though potentially damaging to the hospital's reputation, provides little evidence-based support and is of no interest to this research.

A commitment to safety at the highest level of the organization, as well as openness toward reporting errors, is of paramount importance (*Institute of Medicine*, 2004). The result of the HRO literature analysis by Tolk et al. (2014) found that, in essence, all of the journal articles that were based upon case studies of high-reliability cultures used a survey methodology to measure safety culture (Tolk et al., 2014). The authors reviewed "over 500 journal articles, books, essays, manuals, and conference papers" using the search term *high-reliability organizations* and key words relevant to healthcare and patient safety cultures to compare recommendations for managers of HROs against actual implementations (Tolk, Cantu & Beruvides, 2015, p. 222). While many hospitals conduct staff surveys to assess their safety culture, few have moved beyond tabulating survey results to take effective actions that have resulted in creating a patient safety culture supportive of high reliability (Chassin & Loeb, 2013). Moreover, surveys measure the employee's perception of the local safety culture (Weaver et al., 2013) and other characteristics as provided by hospital personnel.

2.7 Research Justification

PSI are measures that identify preventable, adverse events. When a consumer seeks treatment at a hospital for one medical problem, they don't want to experience an additional injury, infection, or serious condition during their stay. Patient safety ratings show consumers how well a hospital safeguards patients from serious, potentially preventable complications, such as infections and adverse events which can occur during their hospital stay. The problem of increased HAIs requires improvement at all levels of the patient safety system.

In response to the Joint Commission's requirement for hospitals to maintain a safety culture and the existing research gap in prescriptive steps to become an HRO, this research conducts correlations between high reliability constructs and an existing safety-related cultural assessment tool. Although twelve patient safety climate factors are presented in the HSOPS survey, it was developed to assess safety culture (Haugen et. al, 2010). Patient safety culture is determined by an organization's management of and commitment to safety (Bonner, Castle, Perera, & Handler, 2008). In this vein, the HSOPS responses will be used as a measurement of the staff's perception of the safety culture in the responding hospitals.

There is no evidence stating that the AHRQ designed the HSOPS tool that is supportive of HRO theory. The Literature Review noted that the validation process of the survey included a clinical review panel which provided the most useful safety indicators to possibly screen adverse events. This research proposes that by coupling high reliability theory with the HSOPS tool, AHRQ will arm the end user with a stronger tool to assess their culture of safety and potentially improve their hospital infection outcome.

CHAPTER III
MATERIALS AND METHODS

How does a hospital transition into an HRO? No universal method exists to help guide hospitals transitioning to an HRO. The literature review reveals how an industry outside of academia such as healthcare can value the characteristics of an HRO enough to justify organizational improvements toward becoming an HRO. The Literature Review documented the use of safety culture surveys as a valid representation of patient safety culture in hospitals. The HSOPS survey results represent an internal, hospital-specific safety culture assessment. Relational analyses will be used to test the existence of high-reliability theory in the hospital safety-related cultural assessment tool. In this vein, the HSOPS questions will be coded against all five HRO constructs.

The research plan also involves analyzing the safety score data obtained from the Center for Medicare and Medicaid Services (CMS), an agency of the Federal government. Works of the U.S. government are in the public domain and permission is not required to reuse them. The research collected information from publicly available sources and thus no patient consent was required. The data reported by CMS is reported to the Centers for Disease Control (CDC), and then publically reported on CMS's Hospital Compare website, hospitalcompare.hhs.gov. If CMS does not report data for one or more of the measures, it is because the hospital either did not have sufficient data or because there were discrepancies in data collection.

3.1 Research Plan

3.1.1 Coding Hospital Safety Culture Survey Questions Against HRO Constructs

The methods used in the initial part of this research were designed to answer the research question, *Does the safety cultural assessment survey, the HSOPS, measure HRO?* The correlation of high-reliability constructs and a hospital's safety-related measure was difficult because the characteristics of an HRO are not quantitative measurements. Despite this challenge, a quantitative approach with qualitative elements was established. Qualitative data were readily available for the HRO constructs, the mindful assessment questions in Exhibits 4.5 to 4.9 of

Managing the Unexpected (Weick & Sutcliffe, 2007) found in Appendix 1. In this vein, the HSOPS culture survey was coded against high-reliability constructs using the mindfulness assessment questions as a guide. The coding was performed to transform qualitative data into quantitative data. Questions from the HSOPS survey were coded with a 1, 2, 3, 4, or 5 corresponding to the numerical code assigned to the HRO constructs, as listed in Table 1. To reduce bias, the researcher obtained coding consensus with two fellow researchers; each coded individually then compared and discussed their results until consensus was reached. The HRO constructs correlated with 33 of the 42 survey questions (78.57%). A copy of the HSOPS survey is found in Appendix 2.

Table 1: Coding for HRO Constructs

Numerical Code Assigned	HRO Construct
1	Sensitivity to Operations
2	Reluctance to Simplify
3	Preoccupation with Failure
4	Deference to Expertise
5	Commitment to Resilience

The primary work area or unit in the hospital; Sections: G (Number of Events Reported), H (Background Information) and I (Comments) were omitted from the coding as they did not provide questions that could be coded against HRO constructs. Some of these sections will be used later in the research discussion. Reverse coding was assigned to survey questions that would negatively correlate to the HRO constructs. An example is question number seven on the HSOPS which says *We use more agency/temporary staff than is best for patient care*. While being sensitive to operations does involve management monitoring workload and obtaining agency/temporary staff as needed, the best care for patients has to be the primary focus of any

operation. One hundred percent of the survey questions that were reverse coded in this research were also reverse coded in the 2014 HSOPS Comparative Database.

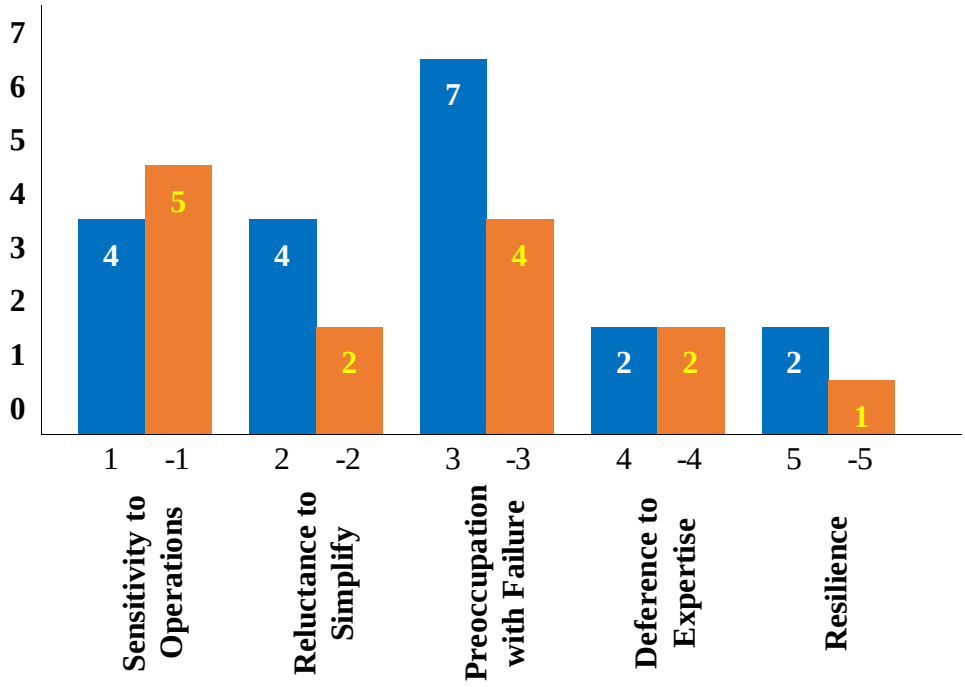

Figure 2: Summary of HSOPS Coding

Table 2: HSOPS Coding Tally

HRO Constructs	Total Number of Correlated Questions
Sensitivity to Operations	**9**
Reluctance to Simplify	**6**
Preoccupation with Failure	**11**
Deference to Expertise	**4**
Commitment to Resilience	**3**

Table 3 shows the results of the coding consensus per HSOPS question. The green shaded areas are questions coded with the HRO constructs that are listed as the column titles. Approximately twenty-one percent (21.43%) of the survey questions did not correlate with HRO constructs. The middle of Figure 3 shows the grouped or clustered questions coded to each HRO construct. The first three constructs (rectangular boxes) are Principles of Anticipation and the last two are Principles of Containment. On the right side of Figure 3, we see the sections of the survey and the HRO construct gaps in each section. For example, none of the questions in Section A (Your Work Area/ Unit) were coded to the Deference to Expertise construct. The left side of Figure 3 rank orders the HRO constructs as a result of the HRO coding.

3.1.2 Assigning a HRO Score

The HSOPS responses from 612 unidentified U.S. hospitals were obtained from Westat. The HSOPS data used in this analysis was provided by the HSOPS Comparative Database. The HSPOS Comparative Database is funded by AHRQ and administered by Westat under contract with AHRQ. The complete file obtained from Westat is uploaded into the Tennessee Research and Creative Exchange (TRACE) as Attachment 1, HSOPS Responses Data File, along with the Code Book for HSOPS Response, Attachment 2. The Comparative Database Report provides initial results to hospitals so that they can use to the results to compare their patient safety culture to other US hospitals (AHRQ, 2014).

The coding consensus confirmed a relationship between the HRO constructs and the HSOPS survey. In order to assess the existing relationship against hospital infection outcomes, a HRO Scoring System was created using the questions clustered for each of the HRO constructs as coded previously. The percent positive HSOPS responses greater than or equal to 0.5 were given a 1 and the rest were 0. The positive responses are said to be actionable data because they are reported to the hospitals and used by Westat for national benchmarks (S. Smith, personal communication, September 15, 2015).

Table 3: Coding Consensus Result

		Sensitivity to Operations	Reluctance to Simplify	Preoccupation with Failure	Deference to Expertise	Commitment to Resilience
Your Work Area/ Unit	A1					■
	A2	■				
	A4		■			
	A5	■				
	A6					■
	A7	■				
	A8			■		
	A9			■		
	A10					■
	A12		■			
	A14	■				
	A15		■			
	A16			■		
	A18			■		
Manager	B1				■	
	B2				■	
	B3	■				
	B4			■		
Communication	C1	■				
	C2		■			
	C3			■		
	C4		■			
	C5			■		
	C6		■			
Events	D1			■		
	D2			■		
	D3			■		
Hospital	F1	■				
	F2				■	
	F6				■	
	F8	■				
	F9			■		
	F11	■				

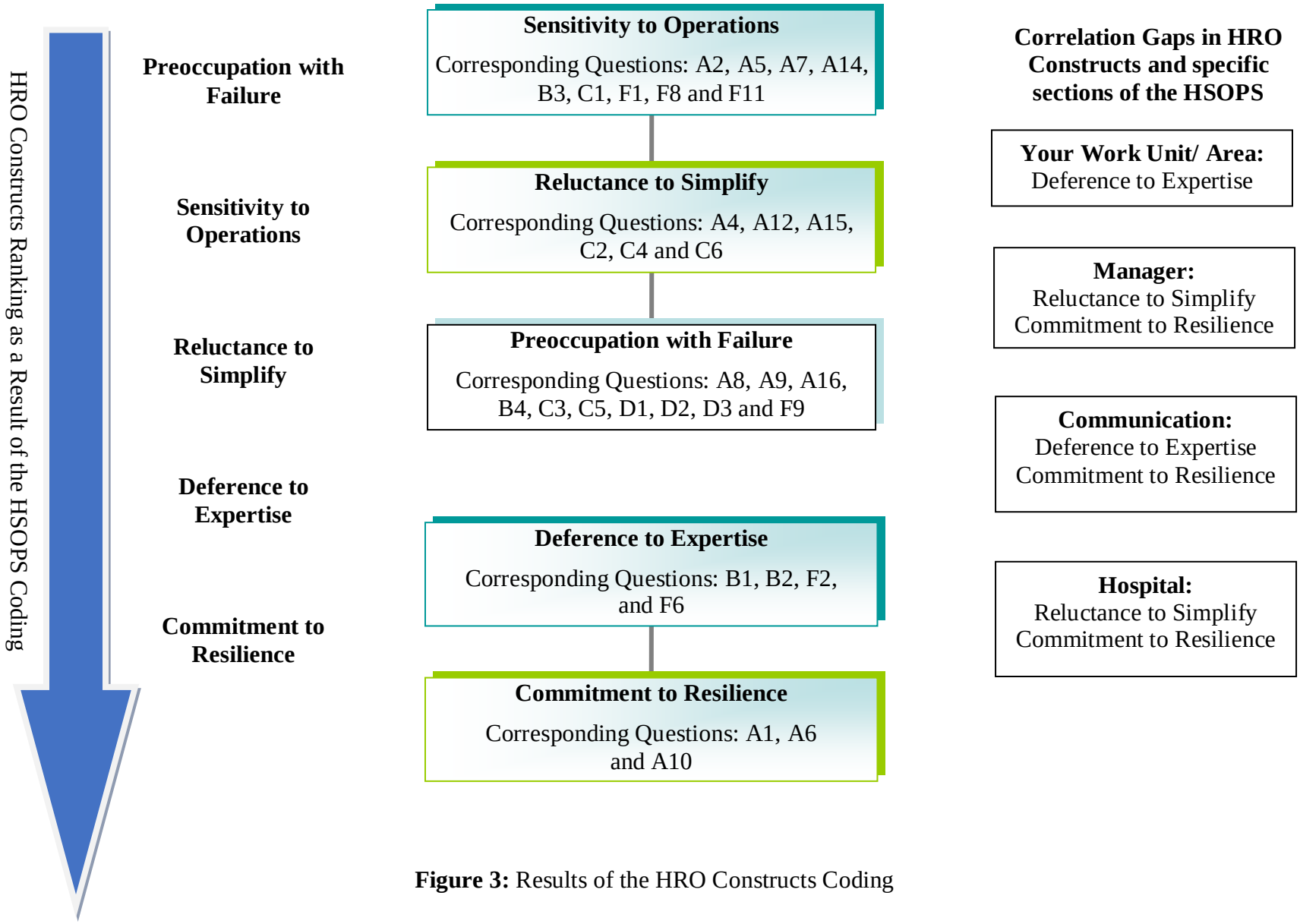

Figure 3: Results of the HRO Constructs Coding

The HSOPS survey had 380,612 valid (positive and negative) responses. By totaling the number of positive responses per hospital, the researcher was able to calculate an HRO Score for each of the 612 hospitals. The results of the HRO Scoring System are found in Appendix 3. Table 4 shows the total number positive responses from the 612 hospital survey responses and the weight of each construct on the HRO Score. The average HRO score for all of the 612 hospitals was 25.97 with a standard deviation of 3.825. Figure 4 is a histogram of the HRO scores.

Table 4: HRO Percentages by Construct

HRO Constructs	Positive Responses	Percent
Sensitivity to Operations (S2O)	4190	26.36%
Reluctance to Simplify (R2S)	2849	17.92%
Preoccupation with Failure (PwF)	5024	31.61%
Deference to Expertise (D2E)	2042	12.85%
Commitment to Resilience (C2R)	1790	11.26%
Total	15895	**100%**

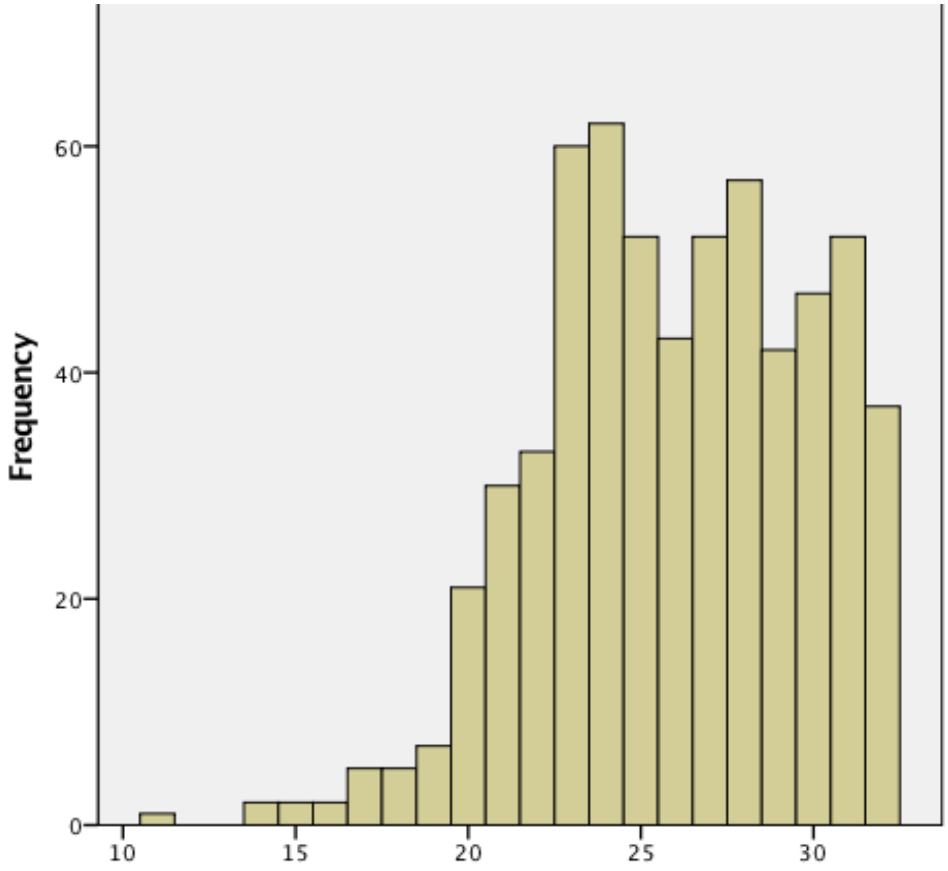

Figure 4: Histogram of HRO Scores

3.1.3 HAI Safety Score Information

The HAI data used in this research was downloaded from the Hospital Compare database, (hospitalcompare.hhs.gov) during the months of January through March 2015. The HAI raw data file for 2013 contained 166,284 lines of data and was uploaded as Attachment 1. The raw data collected from the Hospital Compare database were filtered to reveal the HAIs (with measure IDs) specific to this research: CLASBI (HAI_1_SIR), CAUTI (HAI_2_SIR), and SSI from colon surgery (HAI_3_SIR). The SSI data are collected for hysterectomy and colon surgery. In order to reduce gender bias, this research chose SSIs from colon surgery only. The sample obtained for this part of the research was 2,411 hospitals. Figures 5, 6, and 7 are histograms of the HAI CLABSI, CAUTI, and SSI scores, respectively. The average safety composite score for CLABSI is 0.51, 1.14 for CAUTI, and 0.90 for SSI.

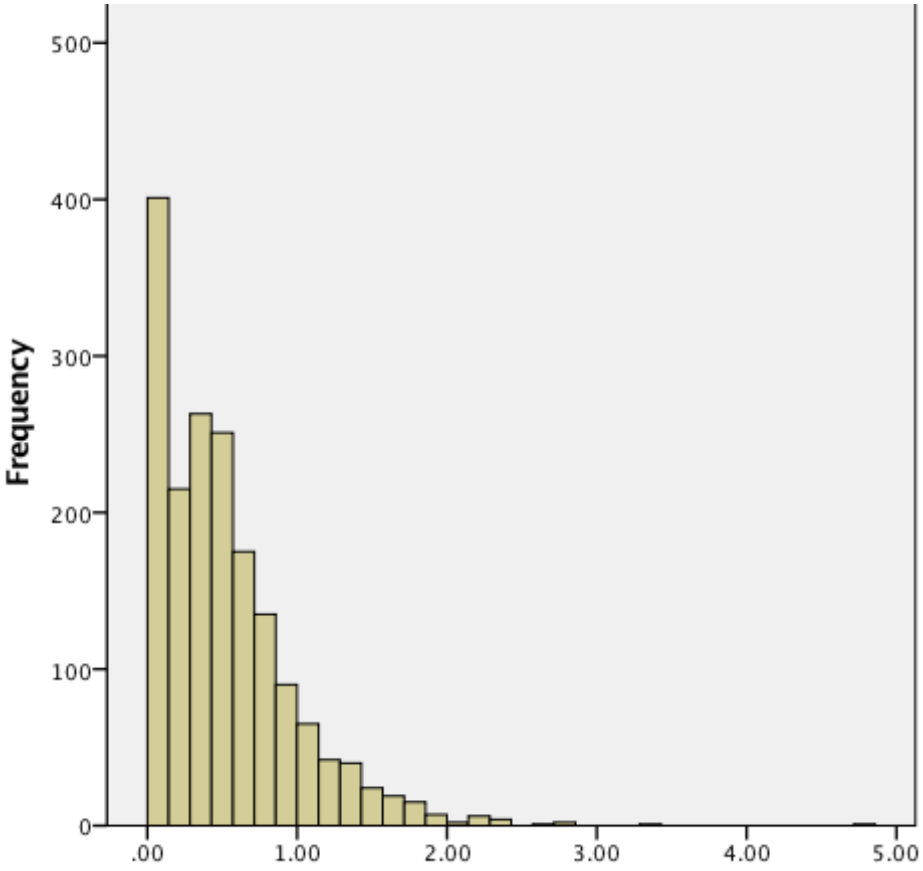

Figure 5: Histogram of CLABSI Scores

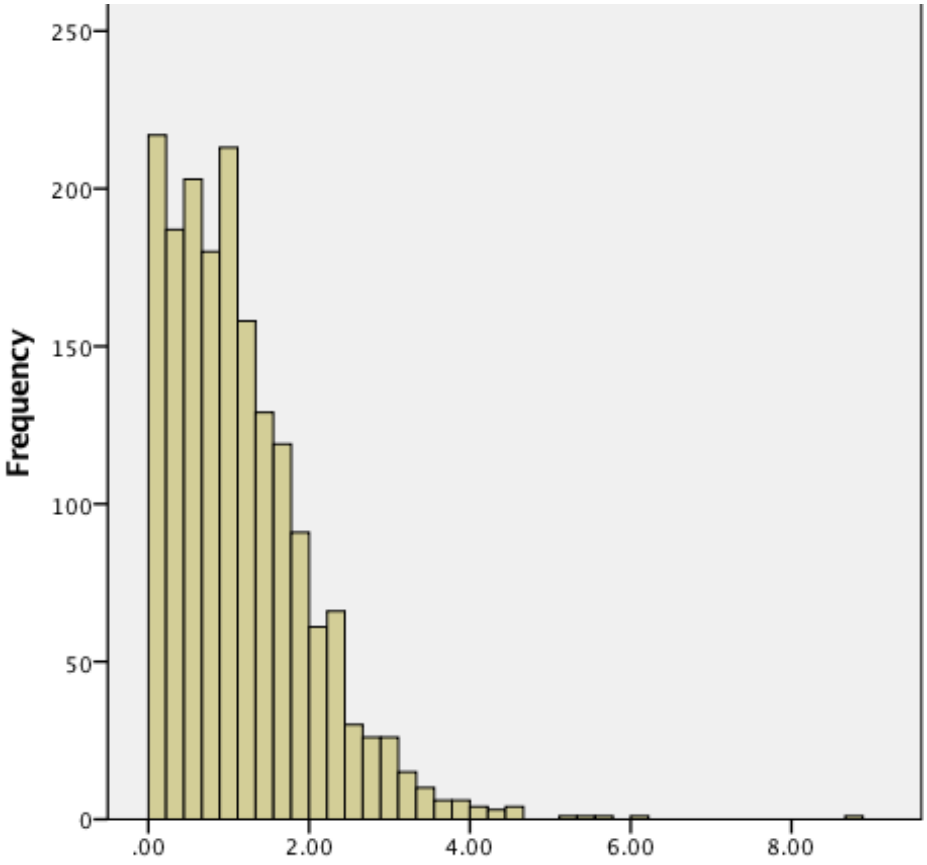

Figure 6: Histogram of CAUTI Scores

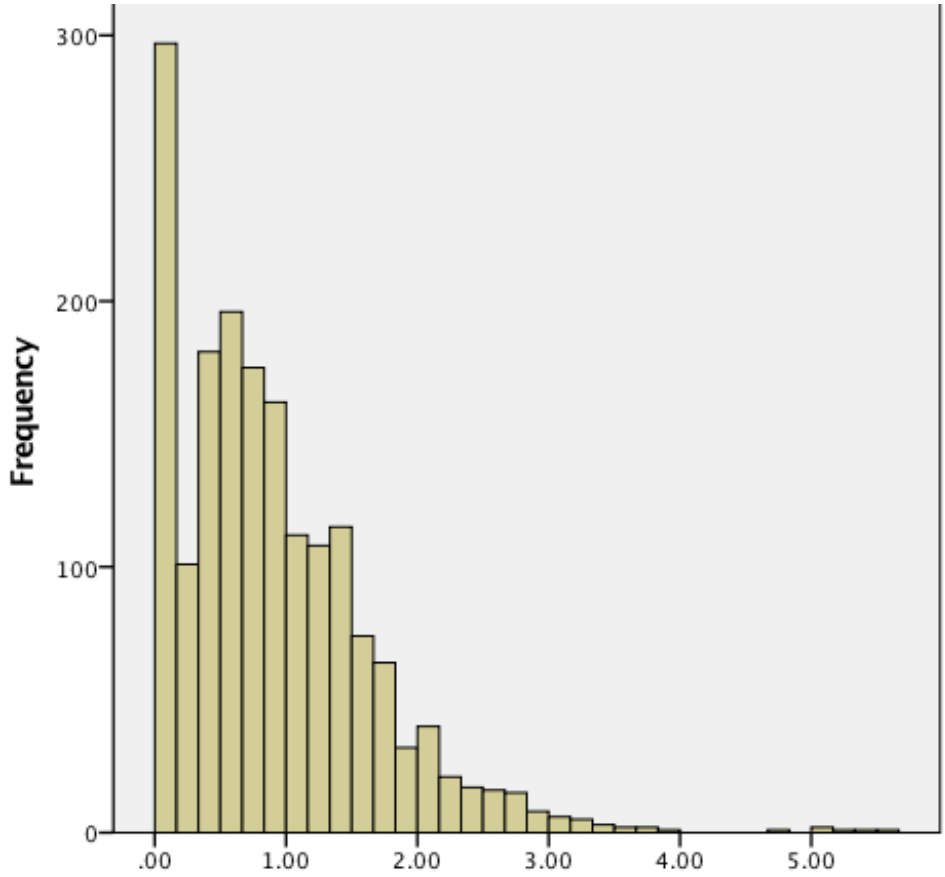

Figure 7: Histogram of SSI (colon) Scores

3.1.5 Analyzing the Two Datasets

The average HRO Score and its standard deviation per region are found in Table 5 along with a distribution of hospitals participating in the HSOPS by region. The New England and Mid-Atlantic regions were combined in the HSOPS data set and are therefore combined in Table 5. The Mountain and Pacific regions were also combined in the HSOPS data set and are therefore combined in Table 5. The means found in Table 5 show that the combined New England/ Mid-Atlantic Region has the lower average HRO scores compared to hospitals in the East South Central Region, which show the highest average HRO score. The average HRO score for government-controlled hospitals is 26.20 and the average HRO score for non-government hospitals is 25.93. The average HRO score for teaching hospitals is 24.66 and the average HRO score for non-teaching hospitals is 26.68.

Table 5: Distribution of Hospitals by Region

	Region	Participating Hospitals HSOPS		Mean HRO Score	Standard Deviation
		N	%		
1	New England/Mid-Atlantic	93	15%	23.69	3.612
3	South Atlantic	121	20%	26.96	3.677
4	E. North Central	161	26%	25.70	3.432
5	E. South Central	52	8%	27.83	3.777
6	W. North Central	46	8%	27.00	4.000
7	W. South Central	65	11%	26.29	3.413
9	Mountain/Pacific	74	12%	25.61	4.020
	Total	612	100%	25.97	3.825

Table 6: Distribution of HAIs by Region

	Region	Number of Hospitals Reporting Each Score in 2013			
		N	CLABSI	CAUTI	SSI
1	New England/Mid-Atlantic	417	224	92	101
3	South Atlantic	470	218	126	126
4	E. North Central	419	215	101	103
5	E. South Central	181	66	58	57
6	W. North Central	132	67	23	42
7	W. South Central	297	244	86	66
9	Mountain/Pacific	495	277	100	118
	Total	2411	1311	586	613

Table 7 provides a distribution of hospitals by size (number of staff beds) for both datasets. The average HRO Score per BSC is also found in Table 7. An inverse relationship is seen between the number of staffed beds in the participating hospitals and the average HRO scores. The means found in Table 7 show that the overall largest hospitals have the lower average HRO scores compared to the overall smallest hospitals which show the highest average HRO score.

Table 7: Distribution of Hospitals by Size

BSC	Number of Staff Beds	Participating Hospitals in HSOPS Responses		Mean HRO Score	Participating Hospitals HAI Scores	
		N	%		n	%
2	6-49 beds*	33	15.8%	27.91	49	2.03%
3	50-99 beds	88	14.4%	27.21	269	11.16%
4	100-199 beds	96	15.7%	26.09	768	31.85%
5	200-299 beds	140	22.9%	25.18	535	22.19%
6	300-399 beds	93	15.2%	24.63	315	13.07%
7	400-499 beds	63	10.3%	24.17	171	7.09%
8	500+ beds	35	5.7%	23.66	281	11.66%
	Total	612	100%	25.97	2388	99.05%

*Bed Size Code (BSC) 1 and 2 were combined for the hospital size as there were only 4 hospitals with less than 25 beds in the dataset.

To compare the means in the datasets across control type and teaching status, the Student's T-test and the Mann-Whitney U test, which is the nonparametric equivalent to the T test, were used. The Student's T-test is also an appropriate tool to use with numerical values as those found in both the control type and teaching status of the hospital. "The Mann-Whitney test is a non-parametric test that allows two groups . . . to be compared without making the assumption that values are normally distributed" (Stangroom, accessed November 17, 2015, para. 1). The two groups being compared are the control type and the teaching status. The independent results of each of these tests are found in Appendix 5.

3.1.4 Common Elements

The common elements in both sets of data, the HSOPS survey results and the HAI safety scores, were the Region, Hospital Size which is indicated by Number of Staff Beds, whether the hospital is government or non-government controlled and the teaching status of the hospital. Armed with this information, the researcher created a Hospital Type, RHGT, using the four common elements in each data set: **R**egion (7 options), **H**ospital Size (8 options), **G**overnment (2 options), and **T**eaching (2 options). The result was a dataset with 121 observations where each observation is a type of hospital that obtained data in the common elements from both data sets. Twenty-three hospitals (0.95%) from the HAI data set did not provide these four common elements.

For each Hospital Type, the mean for the HRO scores and the mean of the three measures of the HAI scores were presented and are found in Appendix 4. The bed size, control type and teaching status data was obtained from the American Hospital Directory, www.ahd.com. The numerical values assigned for the control type were either 1 for government-controlled hospitals and 0 for non-government. Government-controlled hospitals may be under the authority of the city, county, or state government. There were a total of 309 (12.82%) government-controlled hospitals in the HAI data set and 99 (16.2%) government-controlled hospitals in the HSOPS responses. Likewise, the numerical value assigned for the hospital's teaching status was either 1 for teaching hospitals and 0 for non-teaching hospitals. There were a total of 1,330 teaching hospitals in the HAI data set and 215 (35.1%) teaching hospitals in the HSOPS responses. Teaching hospitals includes hospitals that are actively involved as major participant in the Accreditation Council for Graduate Medical Education specialty and subspecialty programs.

Figure 8 is a histogram of the aggregated HRO Scores. Figures 9, 10 and 11 are histograms of the aggregated CLABSI, CAUTI and SSI Scores, respectively.

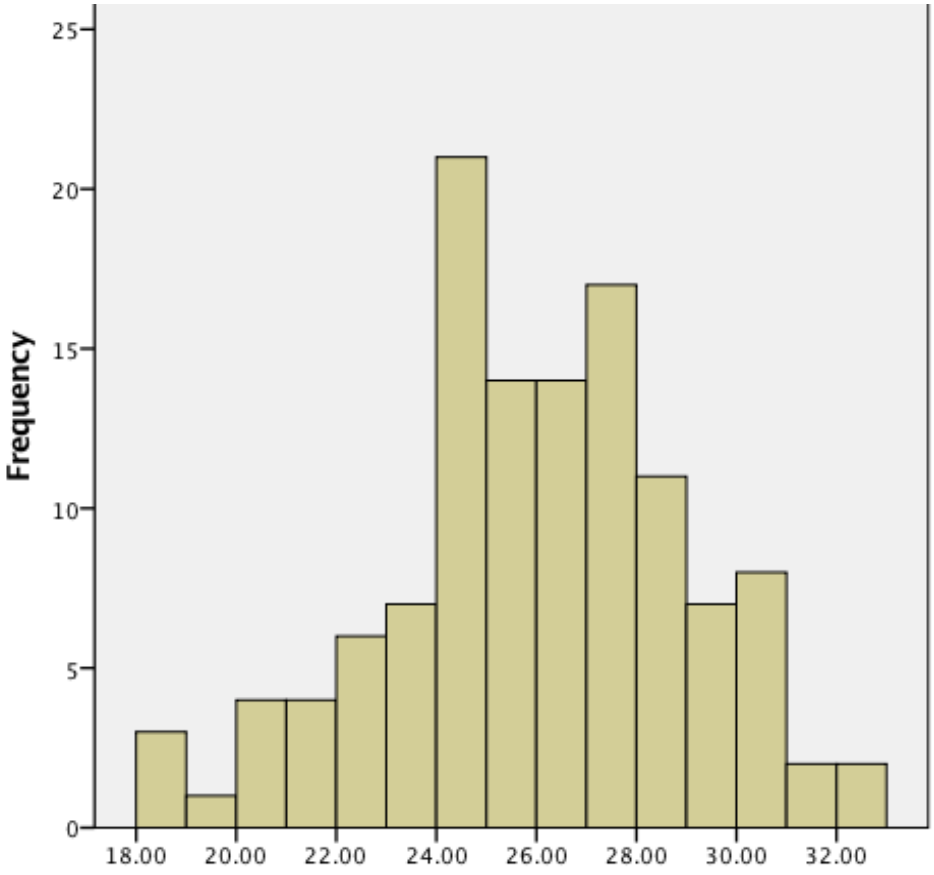

Figure 8: Histogram of Aggregated HRO Data

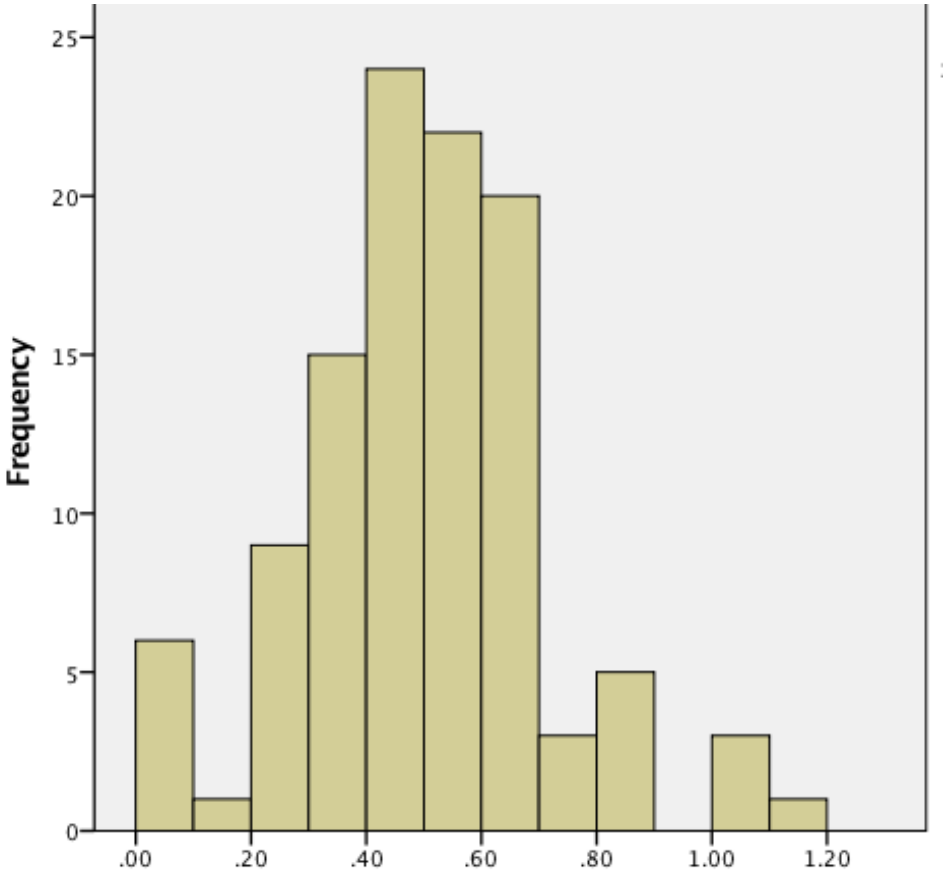

Figure 9: Histogram of Aggregated CLABSI Data

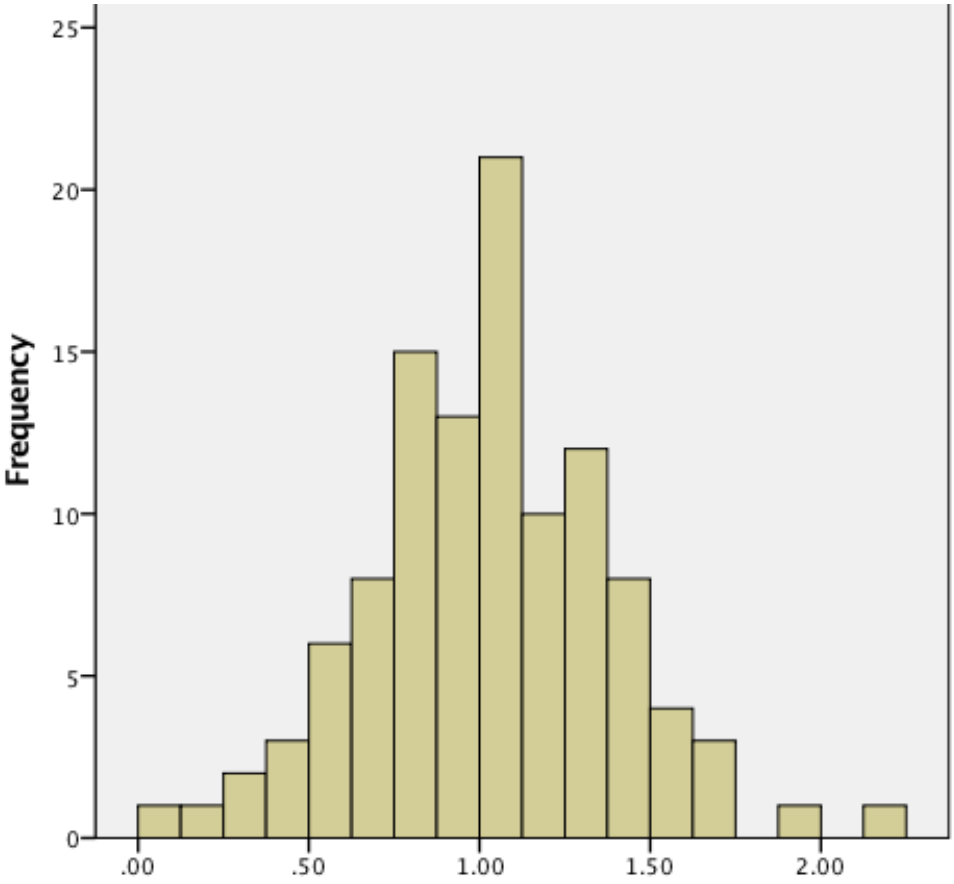

Figure 10: Histogram of Aggregated CAUTI Data

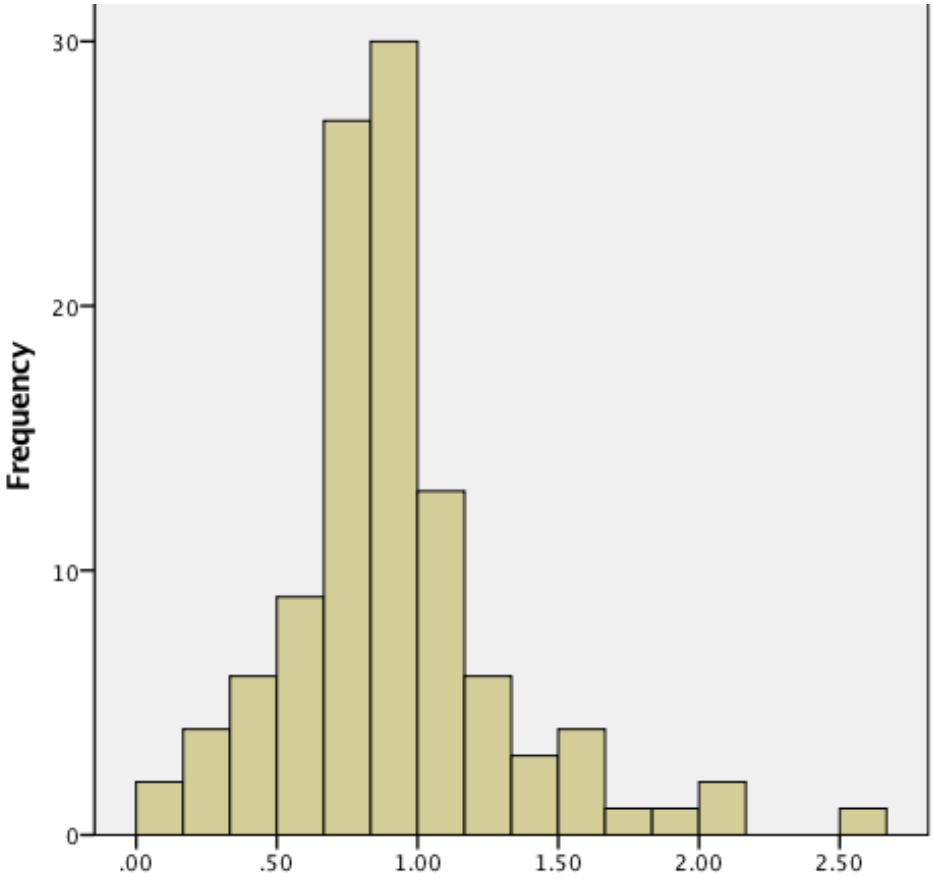

Figure 11: Histogram of Aggregated SSI Data

The histograms show that by taking the means, the distributions resemble more of a normal distribution compared to the distribution of the original HAI scores (before aggregating data). Nevertheless, non-parametric correlations will be used to assess the relationship of the HRO score with each of the HAI scores. The non-parametric correlations include the Spearman's Rho and the Pearson Correlation Coefficient. These methods were selected because of the various sizes of the two datasets with the four common elements. "Spearman's Rho is a non-parametric test used to measure the strength of association between two variables, where the value $r = 1$ means a perfect positive correlation and the value $r = -1$ means a perfect negative correlation" (Stangroom, accessed November 17, 2015, para. 1). The summary of the results will be presented in Chapter 4.

3.2 Research Validation

The analyses performed in this research rely heavily on the coded results of the HRO constructs against the HSOPS survey questions. In this vein, a correlation analysis was performed to validate the HSOPS questions that were grouped or clustered as a result of the coding consensus. The correlations were performed the using the student MATLAB version R2014a software package. A data matrix ($\mathbf{X}_D$) was established using the hospital responses for each of the 612 hospitals and the percent positive responses for the 42 coded questions from the survey. The data matrix has the dimension 42 x 612. The covariance matrix, **S**, of the data sample is

$$\mathbf{S} = \frac{1}{n-1}\mathbf{X}_D^T\mathbf{X}_D \tag{3.1}$$

where T is the transpose of the matrix, $\mathbf{X}_D$ (Martinez, Martinez, & Solka, 2011). From the covariance matrix, the correlation coefficients between each pair of the questions were obtained using the MATLAB corrcoef() function. The value of the correlation coefficient should be between -1 and 1, where zero means that there is absolutely no correlation; the two questions are totally independent. A correlation coefficient of 1 means the observations (questions) is the same, and a -1 means that there is a negative correlation; the responses are reverse. The corrcoef() function "includes matrices containing lower and upper bounds for a 95% confidence interval for each coefficient" (MathWorks, accessed October 15, 2015, para. 4).

The response set of each hospital was considered as one observation. Tables 8 show snapshots of the correlation coefficients. For example, Table 3 and Figure 3 show that questions A1, A6 and A10 were all coded to the HRO construct Commitment to Resilience. The MATLAB Coefficient Table in Attachment 3 contains the entire file. The correlation coefficients are found by selecting one of the questions on the X axis and the other on the Y axis or vice versa in the coefficient matrix.

Table 8: Snapshots of the Covariance Coefficients

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
A1	1	0.47987	0.892319	0.888479	0.413537	0.412711	0.463373	0.561588	0.370584	0.465328
A2	0.47987	1	0.554966	0.492184	0.605391	0.520667	0.459743	0.598129	0.534085	0.668788
A3	0.892319	0.554966	1	0.82594	0.520061	0.454212	0.553343	0.597942	0.402072	0.558959
A4	0.888479	0.492184	0.82594	1	0.40971	0.448103	0.384744	0.587233	0.42329	0.481791
A5	0.413537	0.605391	0.520061	0.40971	1	0.416704	0.584739	0.583933	0.396998	0.668493
A6	0.412711	0.520667	0.454212	0.448103	0.416704	1	0.382346	0.501497	0.720934	0.648516
A7	0.463373	0.459743	0.553343	0.384744	0.584739	0.382346	1	0.502062	0.344609	0.585471
A8	0.561588	0.598129	0.597942	0.587233	0.583933	0.501497	0.502062	1	0.604113	0.712913
A9	0.370584	0.534085	0.402072	0.42329	0.396998	0.720934	0.344609	0.604113	1	0.635306
A10	0.465328	0.668788	0.558959	0.481791	0.668493	0.648516	0.585471	0.712913	0.635306	1

Table 8: Snapshot of the Covariance Coefficients (continued)

	B1	B2	B3	B4	C1	C2	C3	C4	C5	C6
B1	1	0.856819	0.597288	0.579022	0.71692	0.656562	0.585679	0.668944	0.649777	0.646337
B2	0.856819	1	0.745075	0.722903	0.72529	0.745782	0.550519	0.692936	0.719466	0.745166
B3	0.597288	0.745075	1	0.815959	0.526094	0.650748	0.448506	0.527812	0.609021	0.671216
B4	0.579022	0.722903	0.815959	1	0.513942	0.623573	0.411573	0.452286	0.569536	0.648298
C1	0.71692	0.72529	0.526094	0.513942	1	0.70396	0.775218	0.69568	0.828822	0.589911
C2	0.656562	0.745782	0.650748	0.623573	0.70396	1	0.591495	0.742193	0.741395	0.77656
C3	0.585679	0.550519	0.448506	0.411573	0.775218	0.591495	1	0.603026	0.798511	0.48723
C4	0.668944	0.692936	0.527812	0.452286	0.69568	0.742193	0.603026	1	0.6611	0.703995
C5	0.649777	0.719466	0.609021	0.569536	0.828822	0.741395	0.798511	0.6611	1	0.636444
C6	0.646337	0.745166	0.671216	0.648298	0.589911	0.77656	0.48723	0.703995	0.636444	1

As shown in the yellow and blue highlights in Table 8, the response is the same, no matter which of the two questions you select first. Table 8 shows a correlation coefficient of 0.412711 between question A1 and question A6, a correlation coefficient of 0.465328 between question A1 and question A10, and the correlation coefficient between question A6 and question A10 is 0.648516. The correlation coefficients not seen in the snapshots of covariance coefficients in Table 8 are found in some of the Deference to Expertise questions, B1, B2, F2 and F6; and the Sensitivity to Operations and Preoccupation with Failure questions. Table 8 shows a correlation of 0.856819 between B1 and B2, but the correlation between the remaining pairs are not shown.

The correlation between B1 and F2 is 0.602162 and the correlation between B2 and F2 is 0.640409. The correlation between B1 and F6 is 0.519655 and the correlation between B2 and F6 is 0.573063. Finally, the correlation between F2 and F6 is 0.848038. The corresponding questions coded against each HRO construct as shown in Figure 3 all positively correlate with the questions they were grouped. Table 9 shows the correlation coefficients for the HRO construct, Sensitivity to Operations, questions. The remaining correlation coefficients for each pairs are found in Tables A.1 and A.2 for Reluctance to Simplify and Preoccupation with Failure, respectively.

Table 9: Coefficients for Questions Coded to Sensitivity to Operations

X-Axis	Y-Axis	Coefficient	X-Axis	Y-Axis	Coefficient
A2	A5	0.605391	A14	B3	0.792797
A2	A7	0.459743	A14	C1	0.57745
A2	A14	0.823387	A14	F1	0.736047
A2	B3	0.63883	A14	F8	0.688638
A2	C1	0.462973	A14	F11	0.691514
A2	F1	0.709164			
A2	F8	0.608224	B3	C1	0.526094
A2	F11	0.57724	B3	F1	0.692462
			B3	F8	0.652236
A5	A7	0.584739	B3	F11	0.602528
A5	A14	0.706673			
A5	B3	0.59332	C1	F1	0.627891
A5	C1	0.378197	C1	F8	0.66571
A5	F1	0.437231	C1	F11	0.52217
A5	F8	0.388048			
A5	F11	0.508786	F1	F8	0.897979
			F1	F11	0.647881
A7	A14	0.545886			
A7	B3	0.457924	F8	F11	0.661128
A7	C1	0.335819			
A7	F1	0.340791			
A7	F8	0.299602			
A7	F11	0.384912			

CHAPTER IV
RESULTS AND DISCUSSION

What would a hospital administrator do if he or she were given the responsibility to assess their organization's safety culture and develop ways to improve their hospital infection outcome? The literature review noted a direct relationship between patient safety culture and adverse hospital events; indicating that an improved safety culture reduces the number of adverse hospital events. High reliability concepts help focus attention on the mindset and safety culture that is essential for quality improvement (Hines et al., 2008). Deploying effective process improvement tools can enable hospitals to reach a safety standard comparable to HROs. Embedding high-reliability principles in a healthcare organization is a proven way to meet the demands of higher-quality expectations. The results of this research are discussed herein.

4.1 Results

4.1.1 Hypothesis Testing Methods

The Kruskal Wallis test was used to determine the significant difference in the HRO Score and the region and hospital size. The Mann-Whitney U was used to determine the significant difference in HRO Score and the control type and teaching status of the hospitals. The *p*-values range between 0 and 1, and the values closest to 0 are more significant (MathWorks, accessed October 17, 2015). If the *p*-value "is smaller than the significance level (default is 0.05), then the corresponding correlation is considered significant" (MathWorks, accessed October 15, 2015, para. 3).

4.1.2 ANOVA Results

An independent, one-way Analysis of Variance (ANOVA) was run for each HAI score against the region and hospital size. The ANOVA output for the region is found in Table 10. The descriptive results for each region are found in Table A.11. The numbers indicating the region in Table A.11 correspond to the regions as they are listed in both datasets. The ANOVA results show that there are significant differences in CAUTI and SSI scores across hospitals in different

regions, (p = 0.001 and p = 0.000). The descriptive outputs show the average HAI Score for each region. The East North Central region had the lowest average CLABSI score, (0.4711); the West South Central region had the lowest average CAUTI Score, (0.9189) and the East South Central had the lowest average SSI score, (0.6765). On the contrary, the East South Central had the highest average CLASBI score (0.5980) and the combined New England/Mid-Atlantic region had the highest average CAUTI Score, (1.1911), and the highest average SSI score, (1.0672).

Table 10: HAI ANOVA for Hospitals by Region

		Sum of Squares	df	Mean Square	F	Sig.
CLABSI	Between Groups	2.406	6	.401	1.572	.151
	Within Groups	503.493	1974	.255		
	Total	505.899	1980			
CAUTI	Between Groups	18.580	6	3.097	3.685	.001
	Within Groups	1890.702	2250	.840		
	Total	1909.282	2256			
SSI	Between Groups	23.895	6	3.983	6.311	.000
	Within Groups	1279.703	2028	.631		
	Total	1303.599	2034			

The ANOVA output for HAI scores by bed size are found in Table 11. The descriptive results are found in Table A.12. The descriptive outputs show the average HAI Score for each BSC. The numbers for BSC in Table A.12 correspond to the bed sizes as they are listed in both datasets. Again, the ANOVA results show that there are significant differences in CAUTI and SSI scores across hospitals with different bed size, (p = 0.000 and p = 0.002). The means found in Table A.15 suggests that the hospitals with larger bed size have larger CAUTI scores. The same is suggested for SSI with the exemption of the smallest hospitals which has the largest HAI score for SSI.

Table 11: HAI ANOVA for Hospitals by Size

		Sum of Squares	df	Mean Square	F	Sig.
CLABSI	Between Groups	1.428	6	.238	.926	.475
	Within Groups	497.587	1936	.257		
	Total	499.015	1942			
CAUTI	Between Groups	98.260	6	16.377	20.347	.000
	Within Groups	1798.902	2235	.805		
	Total	1897.162	2241			
SSI	Between Groups	12.305	6	2.051	3.445	.002
	Within Groups	1116.341	1875	.595		
	Total	1128.646	1881			

4.1.3 Kruskal Wallis Test Results

Because the ANOVA is sensitive to deviations from normality and the distribution shown in the histograms found in Chapter 3 were not normal, a non-parametric equivalent, the Kruskal Wallis was performed. The *p*-values (asymptotic significance) shown in Table 12 provide a test of the significance in HAI scores in regions and the HRO Score result by region. The HRO Score and hospital infection rate, HAI composite score, were the dependent variables and the regions are the grouped independent variables.

Table 12: Kruskal Wallis Test Results Summary by Region

	Chi-Square	df	Asymptotic Significance
HRO Score	61.872	6	0.000
CLABSI	13.872	6	0.031
CAUTI	27.046	6	0.000
SSI	32.613	6	0.000

The Kruskal Wallis results in Table 12 show that there are significant differences in HRO scores across hospitals in different regions (Chi-square = 61.872, p = 0.000). The Kruskal Wallis test results also indicate that there are significant differences in HAI scores in hospitals from different regions for all HAI scores. The Kruskal Wallis results in Table 13 show that there are significant differences in HRO scores across hospitals of different sizes. There are also significant differences in hospitals of all sizes and all three HAI scores.

Table 13: Kruskal Wallis Test Results Summary by Hospital Size

	Chi-Square	df	Asymptotic Significance
HRO Score	92.8111	7	0.000
CLABSI	21.963	6	0.001
CAUTI	230.571	6	0.000
SSI	44.940	6	0.000

4.1.4 Mann-Whitney U Results

The results of the Mann-Whitney U for correlating the three HAI scores and the government-controlled hospitals are found in Table 14. The Mann-Whitney U results show that there are no significant differences between the hospital control type for any of the three HAI composite

scores, (p = 0.059, p = 0.073, p = 0.316) nor the HRO Score, (p = 0.534). These findings are consistent with the Student T-test, which also finds that there are no significant differences in the hospital control type for any of the three HAI composite scores, (p = 0.278, p = 0.123, p = 0.087). The Student T-test results in Table A.13. The Group Statistic provided the average HAI composite scores for government controlled hospitals as 0.5529 for CLABSI, 1.1123 for CAUTI and 0.9850 for SSI.

Table 14: Mann-Whitney U Test Results Summary by Control Type

	CLABSI	CAUTI	SSI	HRO Score
Mann-Whitney U	188784.500	266237.500	215343.500	24395.000
Wilcoxon W	1686099.500	2168462.500	1772073.500	156236.000
Z	-1.887	-1.794	-1.004	-.622
Asymp. Sig. (2-tailed)	.059	.073	.316	.534

a. Grouping Variable: Gov

The results of the Mann-Whitney-U for correlating the three HAI scores and the hospital's teaching status are found in Table 15. The Group Statistic provided the average HAI composite scores for teaching hospitals as 0.5043 for CLABSI, 1.1346 for CAUTI and 0.9541 for SSI. There are statistically significant differences between teaching and non-teaching hospitals for CAUTI and SSI measures. These findings are consistent with the Student T-test, which also finds significant differences for CAUTI and SSI Scores. The results of the Student T-test for correlating the three HAI scores and the hospital's teaching status are found in Table A.14. Additionally, non-teaching hospitals have larger average HRO scores compared to teaching hospitals.

Table 15: Mann-Whitney U Test Results Summary by Teaching Status

	CLABSI	CAUTI	SSI	HRO Score
Mann-Whitney U	443895.500	486832.500	432573.500	29337.500
Wilcoxon W	718065.500	947152.500	758601.500	52557.500
Z	-.802	-8.486	-4.416	-6.409
Asymp. Sig. (2-tailed)	.423	.000	.000	.000

a. Grouping Variable: Teaching

4.1.5 Analyzing the Common Elements in Both Data Sets

In order to analyze the relationship between the two scores, the HRO Score and HAI composite scores, the data was aggregated based on the common elements in both data sets. The previous two subsections in Chapter 4 have demonstrated the statistical significance in the four common elements in each data set, separately. Though the hospital's control type had no significant difference on either dataset, conservatively, the control type remains in the analysis of the common elements because the data was included in the aggregation. The aggregated data for the HRO Score and the aggregated data for each of the hospital infection score composites were entered into a Spearman's Rho Correlation Calculator. The Spearman's Rho Correlation output is found in Table 16.

Table 16: Spearman's Rho Correlation Results

		(mean) CLABSI	(mean) CAUTI	(mean) SSI	(mean) HRO Score
(mean) CLABSI	Correlation Coefficient	1.000	.190*	.061	.178
	Sig. (2-tailed)	.	.047	.527	.062
	N	110	110	109	110
(mean) CAUTI	Correlation Coefficient		1.000	.261**	-.311**
	Sig. (2-tailed)	.047	.	.005	.001
	N	110	117	114	117
(mean) SSI	Correlation Coefficient	.178	.261**	1.000	-.103
	Sig. (2-tailed)	.527	.005	.	.265
	N	109	114	118	118
(mean) HRO Score	Correlation Coefficient	.178	-.311**	-.103	1.000
	Sig. (2-tailed)	.062	.001	.265	.
	N	110	117	118	121

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

**. Correlation is significant at the 0.01 level (2-tailed).

The only significant correlation as shown in the results in Table 16 is the negative correlation between the HRO Score and CAUTI, (r = -0.311 and p = 0.001). The scatter plot in Figure 12 is provided as a further visual of the relationship between the HRO Score and CAUTI. CAUTI is the dependent variable and the HRO Score is the independent variable. There is a clear outlier. After revisiting the data, this outlier corresponds to BSC 1.

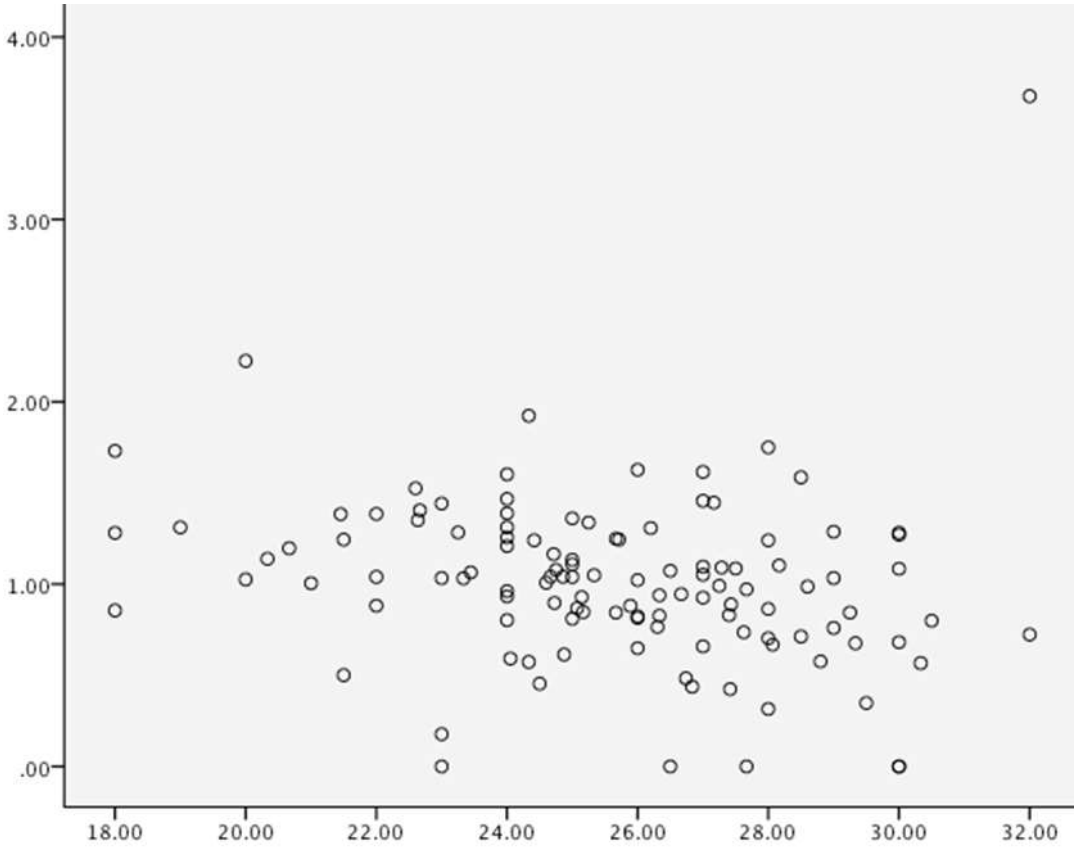

Figure 12. Scatter Plot of CAUTI vs. HRO Score

As a result, BSC 1 was removed from the data set. The Pearson Correlation Coefficient was used to measures the strength of a linear relationship between the HRO Score and CAUTI. The result of the Pearson Correlation Coefficient is found in Table 17. Figure 13 is the scatter plot of the HRO Score and CAUTI with the outlier removed and the adjusted simple regression line added.

Table 17: Pearson Correlation Coefficient Results

		(mean) CAUTI	(mean) HRO Score
(mean) CAUTI	Pearson Correlation	1.	-.338**
	Sig. (2-tailed)	.	.000
	N	116	116
(mean) HRO Score	Pearson Correlation	-.338**	1
	Sig. (2-tailed)	.000	
	N	116	116

**. Correlation is significant at the 0.01 level (2-tailed).

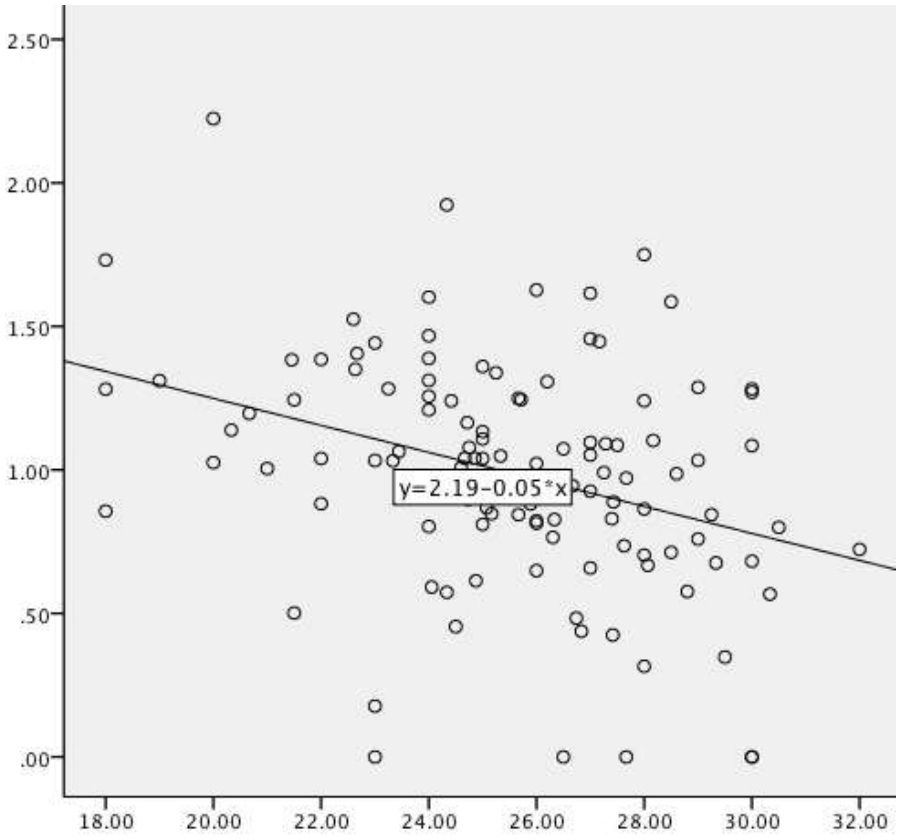

Figure 13. Updated Scatter Plot of CAUTI vs. HRO Score with Regression Line

The adjusted simple regression line shows a negative linear relationship between the HRO Score and the CAUTI score. The regression equation is

$$CAUTI = 2.19 - 0.05x \quad (4.1)$$

where x = average HRO score. The R-squared (R^2) = 11.5% is low and suggests that this linear relationship is weak. An Analysis of Covariance (ANCOVA), a combined regression and ANOVA, was performed to determine the predictors for CAUTI, if any. The CAUTI score was the dependent variable and the HRO Score was the covariate and the four common elements, RHGT, were added as factors. The results of the ANCOVA are found in Table 18.

Table 18: ANCOVA for CAUTI by Common Elements

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9.847[a]	15	.656	7.509	.000
Intercept	.731	1	.731	8.362	.005
Region	1.153	6	.192	2.198	.049
Hospital Size	5.658	6	.943	10.787	.000
Control Type	.004	1	.004	0.44	.834
Teaching Status	.009	1	.009	.104	.748
HRO Score	.003	1	.003	.031	.861
Error	8.742	100	.087		
Total	131.846	116			
Corrected Total	18.589	115			

The predictors that emerged as a result of the ANCOVA are Region and Hospital Size. Particularly, the hospital size is the most significant predictor for catheter-associated urinary tract infections. The researcher reviewed the estimated marginal means for both Region and Hospital Size to understand and discuss the differences. Tables 19 and 20 show the results of the estimated marginal means for Region and Hospital Size, respectively. The average CAUTI score was the dependent variable for each. The regions associated with the largest CAUTI scores are the combined New England/ Mid-Atlantic region, the South Atlantic and the West North Central regions. On the other hand, East North Central shows the smallest CAUTI average score. Larger hospitals are also associated with larger CAUTI scores.

Table 19: Estimated Marginal Means for Region

			95% Confidence Interval	
Region	Mean	Std. Error	Lower Bound	Upper Bound
New England/Mid-Atlantic	1.120[a]	.083	.954	1.285
South Atlantic	1.044[a]	.076	.894	1.195
E. North Central	.796[a]	.075	.647	.944
E. South Central	.875[a]	.085	.707	1.044
W. North Central	1.041[a]	.083	.876	1.206
W. South Central	.899[a]	.071	.757	1.041
Mountain/Pacific	.998[a]	.066	.867	1.129

a. Covariates appearing in the model are evaluated at the following values: (mean) HRO_Score = 25.5473.

Table 20: Estimated Marginal Means for Hospital Size

Number of Staff Beds	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
6-49 beds	.656a	.112	.434	.879
50-99 beds	.549a	.077	.396	.701
100-199 beds	.831a	.066	.699	.962
200-299 beds	1.120a	.068	.985	1.254
300-399 beds	1.101a	.070	.962	1.240
400-499 beds	1.301a	.081	1.141	1.462
500+ beds	1.215a	.082	1.053	1.377

a. Covariates appearing in the model are evaluated at the following values: (mean) HRO_Score = 25.5473.

4.1.6 Hypothesis Testing for the Common Elements in Both Data Sets

Hypothesis Statement: Coupling high reliability theory with hospital safety culture-related measures can provide predictors for patient safety outcomes.

Hypothesis$_1$: H_0: There is no significant correlation in CLABSI rates and HRO scores.

Hypothesis$_1$: H_a: There is a significant correlation in CLABSI rates and HRO scores.

Hypothesis$_2$: H_0: There is no significant correlation in CAUTI rates and HRO scores.

Hypothesis$_2$: H_a: There is a significant correlation in CAUTI rates and HRO scores.

Hypothesis$_3$: H_0: There is no significant correlation in SSI (colon) rates and HRO scores.

Hypothesis$_3$: H_a: There is a significant correlation in SSI (colon) rates and HRO scores.

Test: α (alpha) = 0.05

Table 21 shows a summary of the relationship between the two scores, the HRO Score and each of the HAI composite scores. The null hypothesis, H_0, is rejected for any HAI score with an alpha or *p*-value (yellow) < 0.05. H_0 is rejected for CAUTI.

Table 21: Combined Analytical Results

		Spearman Rho	
HRO vs	Chi-Square	*p*-value	Decision
CLABSI	21.963	.062	Fail to Reject H_0
CAUTI	230.571	.001	Reject H_0
SSI	44.940	.265	Fail to Reject H_0

4.2 Discussion

In early 2000, the Joint Commission set a goal for hospitals to learn about and emulate HROs. As discovered from the Literature Review, high reliability concepts can help hospitals focus attention on a mindful patient safety culture, which is the central tenet to becoming an HRO. The research first examined the correlation between a hospital safety-related measure, the HSOPS, and HRO constructs. The coded HRO constructs against the hospital patient safety culture survey represents the existence of high reliability theory in the safety-related culture measure. High reliability theory is present in 78.57% of the patient safety culture surveys questions.

Next, the researched assigned an HRO Score to the 612 unidentified U.S. hospitals using the percent positive HSOPS responses obtained from each. The HAI data downloaded from the Hospital Compare database provided a method for testing the hypothesis. Both datasets were aggregated and analyzed for predictors in coupling high reliability theory with hospital safety culture-related measures. The research recommendations are based on the lessons learned from the analyses herein.

By coupling high reliability theory with hospital safety culture-related measures, hospital administrators can provide predictors for their CAUTI outcomes. Based on the findings herein, it is recommended that hospitals with bed sizes greater than 500 beds perform a self-assessment on their mindfulness using the assessment questions found in Exhibits 4.5 to 4.9 of *Managing the Unexpected* (Weick & Sutcliffe, 2007). It is also recommended that the hospital administrators administer the HSOPS and obtain a copy of the Comparative Data Analysis from AHRQ.

The coding of the HRO constructs and the safety related measure, HSOPS, is listed in Tables 2 and 3 of this document. The least present HRO constructs in the HSOPS coding are Deference to Expertise and Commitment to Resilience. Deference to Expertise represents less than 10% of the HSOPS questions. Other uses for the information provided herein would include AHRQ considering strengthening their HSOPS tool by ensuring that its future edition is equally supportive of all five HRO constructs.

Finally, it is recommended that the Joint Commission continues to work on a prescription for the hospitals it accredits to transfer to an HRO. The prescription should be followed by safety-related measures that are included in the accreditation requirements because what gets measured, gets managed. The recommended suggestions are useful for hospital safety programs, patient safety survey developers, and hospital accrediting bodies- all have patient safety at the core of their operations.

CHAPTER V
CONCLUSION

The purpose of this research was to provide suggestions that can be useful to hospitals, accrediting bodies, or patient safety survey developers to improve patient safety outcomes by coupling high reliability theory with hospital safety-related measures. The research confirmed that though the HSOPS was not developed in support of HRO theory, 78.57% of its questions were coded against HRO constructs. Through analysis that was limited to the avoiding infections safety measure of the *Consumer Reports* safety score composite, this research proved that coupling high reliability theory with the HSOPS can provide predictors for CAUTI outcomes in large hospitals. Future research is warranted for either or all of the remaining four components of the Hospital Safety Score.

Opportunity for Future Research

The literature review noted a direct relationship between patient safety culture and adverse hospital events; indicating that an improved safety culture reduces the number of adverse hospital events. "HROs accept cultural, social, organizational, cognitive and technological challenges that are likely to hamper system safety and transform them in[to] opportunities for safety improvement" (Bagnara, Parlangeli, & Tartaglia, 2010, p. 713). There is an immediate opportunity for researchers to partner with health care practitioners to further understand how HRO theory can be implemented within health care operations.

Application of this research was discussed with the safety administrator of a large hospital in the East North Central region. The recommendations herein can be developed as a screening and diagnostic tool to identify the organizational units or microsystems that operate with HRO tendencies. System quality and safety leaders could use this screening information to develop an intervention to accelerate HRO development throughout an organization (J. Simmons, personal communication, December 9, 2015).

The analysis of the HSOPS survey coupled with high reliability theory can provide insight into the *mindful* state necessary for the organization to successfully emulate an HRO. Hospital administrators will be able to make decisions on the best way to leverage the output from the

HSOPS and assess their organization's mindful capabilities at the same time. The elements of a sustainable safety culture must be measured using a survey that results in focused interventions based on areas of improvement identified through analysis and evaluations (American College of Surgeons, 2014). As a result of these recommendations, hospital administrators can identify areas of improvement based on analysis of their HSOPS survey results and develop focused interventions that would improve their CAUTI outcome accordingly.

In future studies, deploying an intervention with relevant criteria to evaluate the patient safety measures used by the hospital is ideal. "Research undertaken to understand and improve high-reliability organizations must involve… various stakeholders to obtain their [many] perspectives and to better identify the boundary conditions… under which these systems operate" (Roberts & Rousseau, 1989, p. 134). It is suggested that an expert panel consisting, at a minimum, of practitioners, hospital administrators, and safety professionals construct an applicable set of criteria for the said intervention.

REFERENCES

Affare, S. C., Tolk, J. N. & Cantu, J. (2015, June), *Analyzing Healthcare Tools Practitioners Use to Implement HRO Theory.* S. Cetinkaya and J. K. Ryan, (Eds.), Proceedings of the 2015 Industrial and Systems Engineering Research Conference, Nashville, TN.

Alahmadi, H. A. (2010). *Assessment of Patient Safety Culture in Saudi Arabian Hospitals*. Quality of Safety in Health Care, 19(5): e17.

American College of Surgeons. (2014). *Blameless or blameworthy errors: Does your organization make a distinction?* Available at: http://bulletin.facs.org/2014/03/ blameless-or-blameworthy-errors/. Accessed August 07, 2015.

Aspden, P., Corrigan, J. M., Wilcott, J., Erickson, S. M. & Committee on Data Standards for Patient Safety. (2004). Patient Safety: Achieving a New Standard for Care in Aspden, P., Corrigan, J. M., Wilcott, J., & Erickson, S. M. (Eds.), *8 Patient Safety Reporting Systems and Applications*, 250-278. Washington, DC: The National Academies Press.

Bagnara, S., Parlangeli, O., & Tartaglia, R. (2010). Are Hospitals Becoming High Reliability Organizations? Applied Ergonomics, 41, 713-718.

Baker, D. P., Day, R., & Salas, E. (2006). Teamwork as an essential component of high-reliability organizations. Health Services Research, 41(4), 1576-1598. doi: 10.1111/j.1475-6773.2006.00566.x

Blouin, A. S. & McDonagh, K. J. (2011). Framework for patient safety, Part 1: culture as an imperative. *The Journal of Nursing Administration, 41*(*10*), 397–400. doi:10.1097/NNA.0b013e31822edb4d

Bonner, A. F., Castle, N. G., Perera, S., & Handler, S. M. (2008). Patient Safety Culture: A Review of the Nursing Home Literature and Recommendations for Practice. *Annals of Long Term Care* 16(3), 18-22.

Bourrier, M. (2005). An interview with Karlene Roberts. *European Management Journal, 23,* 93–97. http://dx.doi.org/10.1016/j.emj.2004.12.013

Chassin, M. R. & Loeb, J. M. (2011). The Ongoing Quality Improvement Journey: Next Stop, High Reliability. *Health Affairs* 30(4), 559-568. doi: 10.1377/hlthaff.2011. 0076

Chassin, M. R. & Loeb, J. M. (2013). High-Reliability Health Care: Getting There from Here. The Milbank Quarterly, 91(3), 459-490.

Centers for Disease Control & Prevention (CDC). (2012). Central line-associated bloodstream infection (CLABSI). Retrieved from http://www.cdc.gov/HAI/bsi/bsi.html

Centers for Disease Control & Prevention (CDC). (2015). Healthcare-associated infections. Retrieved from http://www.cdc.gov/hai/index.html

Centers for Medicare & Medicaid Services (CMS). (2015). Hospital care star ratings fact sheet. Retrieved from http://www.cms.gov/Newsroom/MediaReleaseDatabase/Fact-sheets/2015-Fact-sheets-items/2015-04-16.html

Consumer Reports. (2015). *How we rate hospitals.* Retrieved from http://static3.consumerreportscdn.org/content/dam/cro/news_articles/health/PDFs/Hospital_Ratings_Technical_Report.pdf

Gould, C. V., Umscheid, C. A., Agarwal, R. K., Kuntz, G., Pegues, D. A. and the Healthcare Infection Control Practices Advisory Committee (HICPAC), (2009). Guideline for prevention of catheter-associated urinary tract infections, Center for Disease Control and Prevention. http://www.cdc.gov/hicpac/pdf/CAUTI/CAUTI guideline2009final.pdf, accessed March 2015.

Hamdan, M. (2013). Measuring Safety Culture in Palestinian Neonatal Intensive Care Units Using the Safety Attitude Questionnaire. *Journal of Critical Care, 28*, 886.e7 – 886.e14.

Hartmann, C. W., Rosen, A. K., Meterko, M., Shokeen, P., Zhao, S., Singer, S., . . . & Gaba, D. M. (2008). An Overview of Patient Safety Climate in the VA. *Health Research and Educational Trust,* 1263-1284. doi:10.1111/j.1475-6773.2008.00839x.

Haugen, A., Søfteland, E., Eide, G. E., Nortvedt, M. W., Aase, K. & Harthug, S., (2010). Patient Safety in Surgical Environments: Cross Countries Comparison of Psychometric Properties and Results of the Norwegian Version of the Hospital Survey on Patient Safety. BMW Health Services Research 10:279.

HealthGrades. (2015). *The right hospital.* Retrieved from http://www.healthgrades.com/find-a-hospital

Health Forum. (2012). *AHA Hospital Statistics 2012: A comprehensive reference for analysis and comparison of hospital trends.* Washington, DC: American Hospital Association Press.

Health Forum. (2014). *AHA Hospital Statistics 2014: A comprehensive reference for analysis and comparison of hospital trends.* Washington, DC: American Hospital Association Press.

Hines S., Luna, K., Lofthus J., Marquardt, M. & Stelmokas, D., (2008). Becoming a High Reliability Organization: Operational Advice for Hospital Leaders. (Prepared by the Lewin Group under Contract No. 290-04-0011.) Agency for Healthcare Research and Quality [Publication No. 08-0022]. Retrieved from http://www.ahrq.gov/

Institute of Medicine (IOM) Committee on Quality of Health Care in America, (1999). *To Err is Human: Building a Safer Health System*. Washington DC: National Academies Press.

Institute of Medicine, (2004). *Patient Safety: Achieving a New Standard of Care*. Washington DC: National Academies Press.

James, J. T. (2013). A New, Evidence-based Estimate of Patient Harm Associated with Hospital Care. *Journal of Patient Safety*, 9(3), 122-128. http://dx.doi.org/10.1097/PTS.0b013e3182948a69

The Joint Commission. (2014). *About the Joint Commission.* Retrieved from http://www.jointcommission.org/about_us/about_the_joint_commission_main.aspx

The Joint Commission. (2011). *Comprehensive accreditation manuals for hospitals: The official handbook [CAMH]*. Oak Brook, IL: Author.

The Joint Commission. (2015). *Comprehensive accreditation manuals for hospitals: The official handbook [CAMH], Update 2.* Oak Brook, IL: Author.

The Joint Commission Center for Transforming Healthcare. (2014). Retrieved from http://www.centerfortransforminghealthcare.org/

Kerfoot, K. (2008). Patient Satisfaction and High-Reliability Organizations: What's the connection? *MEDSURG Nursing*, *17*(5), 357-358.

Koch, A., Nilsen, R. M., Dalheim, A., Cox, R. J., & Harthug, S. (2014). Need for more targeted measures: Only less severe hospital-associated infections declined after introduction of an infection control program. *Journal of Infection and Public Health*, *7*, 282–290. http://dx.doi.org/10.1013/j. jiph.2014.11.001.

Limaye, S. S., Mastrangelo, C. M., & Zerr, D. M. (2008). A Case Study in Monitoring Hospital-Associated Infections with Count Control Charts. Quality Engineering 20(4), 404-413. doi: 10.1080/08982110802334120

Mardon, R. E., Khanna, K., Sorra, J., Dyer, N. & Famolaro, T., (2010). Exploring Relationships Between Hospital Patient Safety Culture and Adverse Events. *Journal of Patient Safety* 6(4), 226-232. http://dx.doi.org/10.1097/PTS.0b013e3181fd1a00

Martinez, W. L., Martinez, A. R., & Solka, J. L. (2011). *Exploratory Data Analysis with MATLAB®*. (2nd ed.). Boca Raton: CRC Press.

Massoumi, S., (2015, June), *A Healthcare Delivery Model Enhanced by High Reliability, Patient Safety, and Human Factors*. S. Cetinkaya and J. K. Ryan, (Eds.). Proceedings of the 2015 Industrial and Systems Engineering Research Conference, Nashville, TN.

MathWorks. (2015). *Corrcoef.* Retrieved from http://www.mathworks.com/help/matlab/ ref/corrcoef.html

McNair, P. D., & Luft, H. S. (2012). Enhancing Medicare's hospital-acquired conditions policy to encompass readmissions. *Medicare & Medicaid Research Review, 2*(2), E1–E15. http://dx.doi.org/10.5600/mmrr.002.02.a03

Medicare.gov. (2015). *Hospital Compare.* Retrieved from https://www.medicare.gov/ hospitalcompare/search.html

Occupational Safety & Health Administration (OSHA). (2013). *Integrating patient and workplace safety programs* (Publication No. 3730). Retrieved from https://www.osha.gov/ Publications/OSHA3730.pdf

Patient Protection and Affordable Care Act of 2010 (ACA), Pub. L. No. 111-148, 124 Stat. 119 through 124 Stat. 1025 (2010).

Perrow, C. (1984). *Normal accidents: Living with high-risk technologies* (rev. ed.). Princeton, NJ: Princeton University Press.

Richards, C. (2009). Getting to Zero: An Emerging Policy Framework for the Elimination of Hospital-Associated Infections. Infection Control and Hospital Epidemiology, 30(1), 71-73.

Roberts, K. H. & Rousseau, D. M. (1989). Research in nearly failure free, high reliability organizations: having the bubble, IEEE Transactions on Engineering Management, 36(2), 132-139. Retrieved from http://www.apsf.org/resources.php

Roberts, K. H. (2003, Spring). "HRO Has Prominent History," Anesthesia Patient Safety Foundation Newsletter. (The Official Journal of the Anesthesia Patient Safety Foundation) 18, 13-14.

Rochlin, G. I., LaPorte, T. R., & Roberts, K. H. (1987, Autumn). The self-designing high-reliability organization: Aircraft carrier flight operations at sea. *Naval War College Review,* 76–90. Retrieved from https://www.usnwc.edu/Publications/Naval-War-College-Review.aspx

Sax, H. & Clack, L. (2015). Medical models: a basic concept for human factors design in infection prevention. *Journal of Hospital Infections*, *89*(4), 335–339.

Schulman, P. R. (1993). The analysis of high reliability organizations: A comparative framework. In K. H. Roberts (Ed.), *New challenges to understanding organizations* (pp. 33–53). New York, NY: Macmillan.

Singer, S. J., Gaba; David M., Falwell, Alyson; Lin, S.; Haynes, J. & Baker, L. C. (2009). Patient Safety Climate in 92 US Hospitals: Differences by Work Area and Discipline. *Medical Care*, *47*(1), 23-31.

Singer, S. J., Gaba, D. M., Geppert, J. J., Sinaiko, A. D., Howard, S. K. and Park, K. C. (2003). The Culture of Safety: Results of an Organization-Wide Survey in 15 California Hospitals. *Quality & Safety in Health Care*, (12), 112-118.

Singer, S., Meterko, M., Baker, L., Gaba, D., Falwell, A., & Rosen, A. (2007). Workforce Perceptions of Hospital Safety Culture: Development and validation of the patient safety climate in healthcare organizations survey. *Health Services Research*, 42(5), 1999-2021. doi: 10.1111/j.1475-6773.2007.00706.x

Smith, S. R. & Stratton, C. E. (2006, Spring). New Law Creates National Patient Safety Database. *Health Law Alert*. Retrieved from http://www.ober.com/publications/3074-health-law-alert

Stangroom, J. (2015). *Mann-Whitney U-value calculator*. Retrieved from http://www.socscistatistics.com/tests/mannwhitney/Default.aspx

Stangroom, J. (2015). *Spearman's Rho calculator.* Retrieved from http://www.socscistatistics.com/tests/spearman/Default.aspx/

Stokes, C. D. (2013). Healthcare Reform and the Journey to High Reliability. Nurse Leader, *11*(6), 28-30. http://dx.doi.org/10.1016/j.mnl.2013.09.012

Stone, P. W., Glied, S. A., McNair, P. D., Matthes, N., Cohen, B., Landers, T. F., & Larson E. L. (2010). CMS changes in reimbursement for HAIs: setting a research agenda. *Med Care, 48*(5), 433-439. doi: 10.1097/MLR.0b013e3181d5fb3f

Sutcliffe, K. M. (2011). High reliability organizations (HROs). *Best Practice & Research Clinical Anesthesiology*, 25, 133–144. http://dx.doi.org/10.1016/j.bpa.2011.03.001

Tolk, J. N., Cantu, J., & Beruvides, M. G. (2013, October). *High Reliability Organization Research: Transforming Theory Into Practice, A Literature Review for Healthcare,* Paper presented at the 2013 International Annual Conference of the American Society of Engineering Management, Minneapolis, MN.

Tolk, J. N., Cantu, J., & Beruvides, M. G. (2015). High Reliability Organization Research: A Literature Review for Health Care. *Engineering Management Journal, 27,* 218–237. http://dx.doi.org/10.1080/10429247.2015.1105087

U.S. Department of Health & Human Services (HHS). (2014). *The Affordable Care Act is working.* Retrieved from http://www.hhs.gov/healthcare/facts/factsheets/2014/10/affordable-care-act-is-working.html

U.S. Department of Health & Human Services, Office of Disease Prevention and Health Promotion (ODPHP). (2015). *National action plan to prevent health care-associated infections: Road map to elimination.* Retrieved from http://health.gov/hcq/prevent-hai.asp

Vital signs: Central line-associated blood stream infections—United States, 2001, 2008, and 2009. (2011, March 4). *Morbidity and Mortality Weekly Report*, 243–248. Retrieved from http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6008a4.htm

Weaver, S. J., Lubomski, L. H., Wilson, R. F., Pfoh, E. R., Martinez, K. A., & Dy, S. M. (2013). Promoting a culture of safety as a patient safety strategy: A systematic review. *Annals of Internal Medicine, 158*(5 Pt. 2), 369–374. http://dx.doi.org/10.7326/0003-4819-158-5-201303051-00002

Weick, K. E. (1987). Organizational culture as a source of high reliability. *California Management Review, 29,* 112–127. Retrieved from http://cmr.berkeley.edu

Weick, K. E., & Sutcliffe, K. M. (2001). *Managing the unexpected: Assuring high performance in an age of complexity.* San Francisco, CA: Jossey-Bass.

Weick, K. E., & Sutcliffe, K. M. (2007). *Managing the unexpected: Resilient Performance in an age of uncertainty* (2nd ed.). San Francisco, CA: Wiley.

Weick, K. E., Sutcliffe, K. M., & Obsfeld, D. (1999). Organizing for high reliability: Processes of collective mindfulness. *Research in Organizational Behavior, 21,* 81–123. Retrieved from http://www.sciencedirect.com/science/journal/01913085

Weinberg, J., Hilborne, L. H., & Nguyen, Q. (2005). Regulation of health policy: Patient safety and the states. In K. Henriksen, J. B. Battles, E. S. Marks, & D. I. Lewin (Eds)., *Advances in patient safety: From research to implementation (Vol. 1: Research findings*; pp. 405–422). Rockville, MD: Agency for Healthcare Research and Quality.

Wright, S. M. (2015). Patient safety in anesthesia: Learning from the culture of high-reliability organizations. *Critical Care Nursing Clinics of North America, 27*(1), 1–16. http://dx.doi.org/10.1016/j.cnc.2014.10.010

Yanke, E., Carayon, P., & Safdar, N. (2014). Translating evidence into practice using a systems engineering framework for infection prevention. *Infection Control & Hospital Epidemiology, 35*, 1176–1182. http://dx.doi.org/10.1086/677638

APPENDICES

Table A.1 Coefficients for Questions Coded to Reluctance to Simplify

X-Axis	Y-Axis	Coefficient	X-Axis	Y-Axis	Coefficient
A4	A12	0.62549	A16	C2	0.459562
A4	A16	0.421788	A16	C4	0.428192
A4	C2	0.571315	A16	C6	0.584087
A4	C4	0.441572			
A4	C6	0.570973	C2	C4	0.742193
			C2	C6	0.77656
A12	A16	0.753864			
A12	C2	0.672066	C4	C6	0.703995
A12	C4	0.628572			
A12	C6	0.731402			

Table A.2 Coefficients for Questions Coded to Preoccupation with Failure

X-Axis	Y-Axis	Coefficient	X-Axis	Y-Axis	Coefficient
A8	A9	0.6041125	B4	C3	0.4115735
A8	A16	0.4580463	B4	C5	0.5695356
A8	B4	0.6034181	B4	D1	0.3363502
A8	C3	0.5300965	B4	D2	0.4204205
A8	C5	0.6587573	B4	D3	0.4925162
A8	D1	0.3991658	B4	F9	0.6803925
A8	D2	0.4460813			
A8	D3	0.5896806	C3	C5	0.7985111
A8	F9	0.6475353	C3	D1	0.7099581
			C3	D2	0.6923399
A9	A16	0.4580463	C3	D3	0.6733731
A9	B4	0.5818209	C3	F9	0.5475101
A9	C3	0.5006080			
A9	C5	0.6245891	C5	D1	0.6688573
A9	D1	0.4319155	C5	D2	0.6778338
A9	D2	0.4556826	C5	D3	0.7317541
A9	D3	0.4603364	C5	F9	0.6530289
A9	F9	0.6770250			
			D1	D2	0.87450189
A16	B4	0.4842124	D1	D3	0.71224343
A16	C3	0.3523088	D1	F9	0.54077941
A16	C5	0.4314146			
A16	D1	0.2484403	D2	D3	0.83932775
A16	D2	0.2994367	D2	F9	0.55449554
A16	D3	0.3605529			
A16	F9	0.5180008	D3	F9	0.56192076

Appendix 1: Assessing an Organization's Capabilities for Assured Performance

The following reference is found in the second edition of *Managing the Unexpected* (Weick & Sutcliffe, 2007, pp. 102-110).

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Assessing your Firm's Preoccupation with Failure.

How well do each of the following statements describe your work unit, department, or organization? Enter next to each item below the number that corresponds with your conclusion:

1 = not at all, 2 = to some extent, 3 = a great deal

1 We focus more on our failures than our successes. _____

2 We regard close calls and near misses as a kind of failure that reveals potential danger rather than as evidence of our success and ability to avoid disaster. _____

3 We treat near misses and errors as information about the health of our system and try to learn from them. _____

4 We often update our procedures after experiencing a close call or near miss to incorporate our new experience and enrich understanding. _____

5 We make it hard for people to hide mistakes of any kind. _____

6 People are inclined to report mistakes that have significant consequences even if nobody notices. _____

7 Managers seek out and encourage bad news. _____

8 People feel free to talk to superiors about problems. _____

9 People are reward if they spot problems, mistakes, errors, or failures. _____

Scoring: Add the numbers. If you score lower than eleven, you are preoccupied with *success* and should be actively considering how you can immediately improve your focus on *failure*. If you score between eleven and eighteen, you have a moderate preoccupation with success rather than a fully mindful preoccupation with failure. Scores higher than eighteen suggest a healthy preoccupation with failure and a strong capacity for mindfulness.

Assessing Your Firm's Reluctance to Simplify.

How well do each of the following statements describe your work unit, department, or organization? Enter next to each item below the number that corresponds with your conclusion:

1 = not at all, 2 = to some extent, 3 = a great deal

1	People around here take nothing for granted.	_____
2	Questioning is encouraged.	_____
3	We strive to challenge the status quo.	_____
4	People in this organization feel free to bring up problems and tough issues.	_____
5	People generally prolong their analysis to better grasp the nature of the problem that come up.	_____
6	People are encouraged to express different views of the world.	_____
7	People listen carefully; it is rare that anyone's view is dismissed.	_____
8	People are not shot down for surfacing information that could interrupt operations.	_____
9	When something unexpected happens, people are more concerned with listening and conducting a complete analysis of the situation than with advocating for their view.	_____
10	We appreciate skeptics.	_____
11	People demonstrate trust for each other.	_____
12	People show a great deal of mutual respect for each other.	_____

Scoring: Add the numbers. If you score higher than twenty-four, the potential to *avoid simplification* is strong. If you score between fourteen and twenty-four, the potential to avoid simplification is moderate. Scores lower than fourteen suggest that you should be actively considering how you can immediately improve your capabilities to prevent simplification in order to improve your firm's capacity for mindfulness.

Assessing Your Firm's Sensitivity to Operations.

Respond *agree* or *disagree* with the following statements about your work, unit, department or organization.

1 On a day-to-day basis, there is an ongoing presence of someone who is paying attention to what is happening and is readily available for consultation of something unexpected arises. _____

2 Should problems occur, someone with authority to act is always accessible and available, especially to people on the front lines. _____

3 Supervisors readily pitch in whenever necessary. _____

4 During an average day, people come into enough contact with each other to build a clear picture of the current situation. _____

5 People are always looking for feedback about things that aren't going right. _____

6 People are familiar with operations beyond one's own job. _____

7 We have access to resources if unexpected surprises crop up. _____

8 Managers constantly monitor workloads and are able to obtain additional resources if the workload starts to become excessive. _____

Scoring: Count the numbers of *agree* and *disagree* responses. The greater the number of *disagree* responses, the less the *sensitivity to operations*. Use these questions to begin thinking of ways to improve your sensitivity to operations and capacity for mindfulness.

Assessing Your Firm's Commitment to Resilience

How well do each of the following statements describe your work unit, department, or organization? Enter next to each item below the number that corresponds with your conclusion:

1 = not at all, 2 = to some extent, 3 = a great deal

1	Forecasting and predicting the future is not that important here.	_____
2	Resources are continually devoted to training and retraining people on the properties of the technical system.	_____
3	People have more than enough training and experience for the kind of work they have to do.	_____
4	This organization is actively concerned with developing people's skill and knowledge.	_____
5	This organization encourages challenging stretch assignments.	_____
6	People around here are known for their ability to use their knowledge in novel ways.	_____
7	There is a concern with building people's competence and response repertoires.	_____
8	People have a number of informal contacts that they sometimes use to solve problems.	_____
9	People learn from their mistakes.	_____
10	People are able to rely on others.	_____

Scoring: Add the numbers. If you score higher than twenty, the *commitment to resilience* is strong. If you score between twelve and twenty, the commitment to resilience is moderate. Scores lower than twelve suggest that you should be actively considering how you can immediately begin building resilience and the capacity for mindfulness.

Assessing the Dereference to Expertise in Your Firm.

How well do each of the following statements describe your work unit, department, or organization? Enter next to each item below the number that corresponds with your conclusion:

1 = not at all, 2 = to some extent, 3 = a great deal

1 People are committed to doing their job well. _____

2 People respect the nature of one another's job activities. _____

3 If something out of the ordinary happens, people know who has the expertise to respond. _____

4 People in this organization value expertise and experience over hierarchical rank. _____

5 In this organization, the people most qualified to make decisions make them. _____

6 If something unexpected occurs, the most highly qualified people, regardless of rank, make the decisions. _____

7 People typically "own" a problem until it is resolved. _____

8 It is generally easy for us to obtain expert assistance when something comes up that we don't know how to handle. _____

Scoring: Add the numbers. If you score higher than sixteen, the *deference to expertise* is strong. If you score between ten and sixteen, the deference to expertise is moderate. Scores lower than ten suggest that you should actively think of ways to improve the deference to expertise and the capacity for mindfulness.

Appendix 2: Hospital Survey on Patient Safety

Instructions

This survey asks for your opinions about patient safety issues, medical error, and event reporting in your hospital and will take about 10 to 15 minutes to complete.

If you do not wish to answer a question, or if a question does not apply to you, you may leave your answer blank.

- *An **"event"** is defined as any type of error, mistake, incident, accident, or deviation, regardless of whether or not it results in patient harm.*
- ***"Patient safety"** is defined as the avoidance and prevention of patient injuries or adverse events resulting from the processes of health care delivery.*

SECTION A: Your Work Area/Unit

In this survey, think of your "unit" as the work area, department, or clinical area of the hospital where you spend *most* of your work time or provide *most* of your clinical services.

What is your primary work area or unit in this hospital? Select ONE answer.

- ☐ a. Many different hospital units/No specific unit
- ☐ b. Medicine (non-surgical)
- ☐ c. Surgery
- ☐ d. Obstetrics
- ☐ e. Pediatrics
- ☐ f. Emergency department
- ☐ g. Intensive care unit (any type)
- ☐ h. Psychiatry/mental health
- ☐ i. Rehabilitation
- ☐ j. Pharmacy
- ☐ k. Laboratory
- ☐ l. Radiology
- ☐ m. Anesthesiology
- ☐ n. Other, please specify:

Please indicate your agreement or disagreement with the following statements about your work area/unit.

Think about your hospital work area/unit…	**Disagree Strongly Disagree**		**Neither**	**Agree**	**Strongly Agree**
1. People support one another in this unit	□ 1	□ 2	□ 3	□ 4	□ 5
2. We have enough staff to handle the workload	□ 1	□ 2	□ 3	□ 4	□ 5
3. When a lot of work needs to be done quickly, we work together as a team to get the work done	□ 1	□ 2	□ 3	□ 4	□ 5
4. In this unit, people treat each other with respect	□ 1	□ 2	□ 3	□ 4	□ 5
5. Staff in this unit work longer hours than is best for patient care	□ 1	□ 2	□ 3	□ 4	□ 5
6. We are actively doing things to improve patient safety	□ 1	□ 2	□ 3	□ 4	□ 5
7. We use more agency/temporary staff than is best for patient care	□ 1	□ 2	□ 3	□ 4	□ 5
8. Staff feel like their mistakes are held against them	□ 1	□ 2	□ 3	□ 4	□ 5
9. Mistakes have led to positive changes here	□ 1	□ 2	□ 3	□ 4	□ 5
10. It is just by chance that more serious mistakes don't happen around here	□ 1	□ 2	□ 3	□ 4	□ 5
11. When one area in this unit gets really busy, others help out	□ 1	□ 2	□ 3	□ 4	□ 5
12. When an event is reported, it feels like the person is being written up, not the problem	□ 1	□ 2	□ 3	□ 4	□ 5
13. After we make changes to improve patient safety, we evaluate their effectiveness	□ 1	□ 2	□ 3	□ 4	□ 5
14. We work in "crisis mode" trying to do too much, too quickly	□ 1	□ 2	□ 3	□ 4	□ 5
15. Patient safety is never sacrificed to get more work done	□ 1	□ 2	□ 3	□ 4	□ 5
16. Staff worry that mistakes they make are kept in their personnel file	□ 1	□ 2	□ 3	□ 4	□ 5
17. We have patient safety problems in this unit	□ 1	□ 2	□ 3	□ 4	□ 5
18. Our procedures and systems are good at preventing errors from happening	□ 1	□ 2	□ 3	□ 4	□ 5

SECTION B: Your Supervisor/ Manager

Please indicate your agreement or disagreement with the following statements about your immediate supervisor/manager or person to whom you directly report.

Think about your hospital work area/unit…	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1. My supervisor/manager says a good word when he/she sees a job done according to established patient safety procedures	□ 1	□ 2	□ 3	□ 4	□ 5
2. My supervisor/manager seriously considers staff suggestions for improving patient safety	□ 1	□ 2	□ 3	□ 4	□ 5
3. Whenever pressure builds up, my supervisor/manager wants us to work faster, even if it means taking shortcuts	□ 1	□ 2	□ 3	□ 4	□ 5
4. My supervisor/manager overlooks patient safety problems that happen over and over	□ 1	□ 2	□ 3	□ 4	□ 5

SECTION C: Communications

How often do the following things happen in your work area/unit?

Think about your hospital work area/unit…	Never	Rarely	Sometimes	Most of the time	Always
1. We are given feedback about changes put into place based on event reports	□ 1	□ 2	□ 3	□ 4	□ 5
2. Staff will freely speak up if they see something that may negatively affect patient care	□ 1	□ 2	□ 3	□ 4	□ 5
3. We are informed about errors that happen in this unit	□ 1	□ 2	□ 3	□ 4	□ 5
4. Staff feel free to question the decisions or actions of those with more authority	□ 1	□ 2	□ 3	□ 4	□ 5
5. In this unit, we discuss ways to prevent errors from happening again	□ 1	□ 2	□ 3	□ 4	□ 5
6. Staff are afraid to ask questions when something does not seem right	□ 1	□ 2	□ 3	□ 4	□ 5

SECTION D: Frequency of Events Reported

In your hospital work area/unit, when the following mistakes happen, *how often are they reported?*

	Never	Rarely	Sometimes	Most of the time	Always
1. When a mistake is made, but is *caught and corrected before affecting the patient*, how often is this reported?	□ 1	□ 2	□ 3	□ 4	□ 5
2. When a mistake is made, but has *no potential to harm the patient*, how often is this reported?	□ 1	□ 2	□ 3	□ 4	□ 5
3. When a mistake is made that *could harm the patient*, but does not, how often is this reported?	□ 1	□ 2	□ 3	□ 4	□ 5

SECTION E: Patient Safety Grade

Please give your work area/unit in this hospital an overall grade on patient safety.

□	□	□	□	□
A	**B**	**C**	**D**	**E**
Excellent	Very Good	Acceptable	Poor	Failing

SECTION F: Your Hospital

Please indicate your agreement or disagreement with the following statements about your hospital.

Think about your hospital…	Disagree Strongly Disagree	Neither	Agree	Strongly Agree
1. Hospital management provides a work climate that promotes patient safety	□ 1	□ 2	□ 3	□ 4	□ 5
2. Hospital units do not coordinate well with each other	□ 1	□ 2	□ 3	□ 4	□ 5
3. Things "fall between the cracks" when transferring patients from one unit to another	□ 1	□ 2	□ 3	□ 4	□ 5
4. There is good cooperation among hospital units that need to work together	□ 1	□ 2	□ 3	□ 4	□ 5

SECTION F: Your Hospital (continued)

Think about your hospital…	Disagree Strongly	Disagree	Neither	Agree	Strongly Agree
5. Important patient care information is often lost during shift changes	□ 1	□ 2	□ 3	□ 4	□ 5
6. It is often unpleasant to work with staff from other hospital units	□ 1	□ 2	□ 3	□ 4	□ 5
7. Problems often occur in the exchange of information across hospital units	□ 1	□ 2	□ 3	□ 4	□ 5
8. The actions of hospital management show that patient safety is a top priority	□ 1	□ 2	□ 3	□ 4	□ 5
9. Hospital management seems interested in patient safety only after an adverse event happens	□ 1	□ 2	□ 3	□ 4	□ 5
10. Hospital units work well together to provide the best care for patients	□ 1	□ 2	□ 3	□ 4	□ 5
11. Shift changes are problematic for patients in this hospital	□ 1	□ 2	□ 3	□ 4	□ 5

SECTION G: Number of Events Reported

<u>In the past 12 months</u>, how many event reports have you filled out and submitted?

□ a. No event reports
□ b. 1 to 2 event reports
□ c. 3 to 5 event reports
□ d. 6 to 10 event reports
□ e. 11 to 20 event reports
□ f. 21 event reports or more

SECTION H: Background Information

This information will help in the analysis of the survey results.

1. How long have you worked in this <u>hospital</u>?

□ a. Less than 1 year
□ b. 1 to 5 years
□ c. 6 to 10 years
□ d. 11 to 15 years
□ e. 16 to 20 years
□ f. 21 years or more

SECTION H: Background Information (continued)

2. How long have you worked in your current hospital <u>work area/unit</u>?

- □ a. Less than 1 year
- □ b. 1 to 5 years
- □ c. 6 to 10 years
- □ d. 11 to 15 years
- □ e. 16 to 20 years
- □ f. 21 years or more

3. Typically, how many <u>hours per week</u> do you work in this hospital?

- □ a. Less than 20 hours per week
- □ b. 20 to 39 hours per week
- □ c. 40 to 59 hours per week
- □ d. 60 to 79 hours per week
- □ e. 80 to 99 hours per week
- □ f. 100 hours per week or more

4. What is your staff position in this hospital? Select ONE answer that best describes your staff position.

- □ a. Physician Assistant/ Nurse Practitioner
- □ b. Registered Nurse
- □ c. LVN/ LPN
- □ d. Patient Care Asst/ Hospital Aide/Care Partner
- □ e. Attending/Staff Physician
- □ f. Resident Physician/Physician in Training
- □ g. Pharmacist
- □ h. Dietician
- □ i. Unit Assistant/Clerk/Secretary
- □ j. Respiratory Therapist
- □ k. Physical, Occupational, or Speech Therapist
- □ l. Technician (e.g., EKG, Lab, Radiology)
- □ m. Administration/Management
- □ n. Other, please specify:

5. In your staff position, do you typically have direct interaction or contact with patients?

□ a. YES, I typically have direct interaction or contact with patients.

□ b. NO, I typically do NOT have direct interaction or contact with patients.

6. How long have you worked in your current specialty or profession?

□ a. Less than 1 year

□ b. 1 to 5 years

□ c. 6 to 10 years

□ d. 11 to 15 years

□ e. 16 to 20 years

□ f. 21 years or more

SECTION I: Your Comments

Please feel free to write any comments about patient safety, error, or event reporting in your hospital.

THANK YOU FOR COMPLETING THIS SURVEY.

Appendix 3: HRO Scoring System Results

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
8	7	5	8	4	3	27	9	3	0	0
12	5	3	4	3	3	18	6	8	0	1
17	7	4	7	3	3	24	1	6	0	1
19	7	5	9	3	3	27	4	3	0	0
47	6	4	8	3	3	24	4	6	0	0
49	4	4	8	3	2	21	1	6	1	1
70	5	4	6	3	3	21	4	8	0	1
71	5	4	7	2	3	21	4	5	0	0
81	8	5	9	4	3	29	9	5	0	0
85	9	5	9	4	3	30	4	4	0	0
97	8	4	9	4	3	28	4	2	0	0
99	8	6	10	4	3	31	9	6	0	1
109	8	6	9	4	3	30	3	8	0	1
112	4	5	7	3	3	22	3	2	0	0
123	9	6	9	4	3	31	4	2	1	0
142	6	6	9	4	3	28	3	6	0	0
146	9	6	10	4	3	32	3	2	1	0
169	8	5	9	4	3	29	7	7	0	0
174	9	4	8	4	3	28	7	4	0	0
176	5	5	8	3	3	24	4	5	0	1
180	7	4	9	3	3	26	6	2	0	0
190	9	4	9	4	3	29	3	4	1	0
205	7	4	9	2	3	25	1	6	0	0
206	7	4	8	3	3	25	3	5	0	1
215	8	6	9	3	3	29	9	6	0	1

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
220	7	5	8	4	3	27	3	2	0	0
243	5	4	8	3	3	23	7	7	1	1
253	8	6	9	4	3	30	4	4	0	0
291	5	6	9	3	3	26	3	3	0	0
293	8	6	9	3	3	29	3	3	0	0
302	7	6	9	3	3	28	4	3	0	0
319	8	6	9	4	3	30	9	7	0	0
321	8	4	8	4	3	27	6	4	0	0
323	4	4	6	2	3	19	1	4	0	0
339	8	5	9	3	3	28	4	4	0	0
356	7	4	9	3	3	26	7	8	0	1
372	8	4	8	3	3	26	5	5	0	1
374	6	4	8	3	3	24	5	5	0	0
377	5	3	6	3	3	20	9	5	0	1
378	7	5	9	3	3	27	3	2	0	0
395	9	5	9	4	3	30	6	7	0	1
400	5	4	8	3	3	23	7	8	0	1
404	9	6	9	4	3	31	9	2	0	0
416	9	5	9	4	3	30	7	2	0	0
458	9	6	9	4	3	31	7	4	0	0
473	5	4	8	3	3	23	1	5	0	0
490	5	4	7	3	2	21	4	7	0	1
504	6	4	8	3	3	24	9	7	0	1
523	9	5	9	4	3	30	7	2	0	0
543	8	4	9	3	3	27	7	4	0	0
578	5	4	7	2	3	21	1	4	0	1
591	5	4	7	2	2	20	4	7	0	1

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
602	6	5	8	3	3	25	9	3	0	0
609	5	4	8	2	3	22	1	4	0	1
624	9	6	10	4	3	32	3	4	0	0
634	7	4	9	3	3	26	4	8	0	1
642	3	3	6	3	2	17	3	4	0	0
661	6	4	8	3	3	24	1	6	0	1
668	9	5	9	4	3	30	5	3	0	0
675	4	4	6	2	3	19	4	4	0	0
689	9	5	9	3	3	29	4	6	0	0
692	6	5	9	3	3	26	3	3	0	0
693	7	5	8	3	3	26	3	8	1	0
728	6	4	7	3	3	23	4	5	0	0
739	6	5	8	3	3	25	9	4	0	0
751	6	4	7	3	2	22	4	7	0	0
760	6	4	7	3	3	23	4	4	0	1
766	9	5	8	4	3	29	6	3	0	0
772	4	4	5	3	3	19	4	4	0	0
776	7	4	8	3	3	25	3	6	1	0
794	6	4	6	3	3	22	4	5	0	1
796	9	6	9	4	3	31	1	2	0	0
809	9	4	8	3	3	27	3	2	0	0
810	5	4	9	3	3	24	4	4	0	0
813	9	5	9	4	3	30	6	2	0	0
828	6	6	9	4	3	28	5	3	0	0
837	5	4	8	2	2	21	1	6	0	1
848	7	6	9	4	3	29	1	5	0	1
853	9	6	10	4	3	32	6	2	0	0

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
866	9	6	9	4	3	31	3	5	1	0
881	8	4	9	3	3	27	3	4	0	0
896	6	5	8	3	3	25	3	6	0	0
915	8	5	8	4	3	28	3	3	0	0
919	6	4	9	4	3	26	4	4	0	0
933	5	4	8	3	3	23	3	8	0	0
957	5	3	7	2	2	19	4	7	0	1
970	5	4	8	3	3	23	4	5	0	1
1019	9	6	9	4	3	31	3	2	0	0
1053	9	6	9	4	3	31	7	3	0	0
1057	8	5	9	4	3	29	1	3	0	1
1060	9	6	9	4	3	31	3	4	0	0
1074	5	4	7	3	3	22	4	4	0	0
1080	5	4	9	3	3	24	1	4	0	1
1101	6	5	9	4	3	27	3	2	0	0
1119	9	6	9	4	3	31	3	5	0	0
1132	9	6	9	4	3	31	3	7	0	0
1133	5	4	6	2	3	20	3	4	0	1
1150	7	6	8	4	3	28	7	2	1	0
1164	7	5	8	4	3	27	3	6	0	1
1221	6	5	8	4	3	26	3	5	0	1
1230	9	4	5	3	3	24	3	8	0	1
1234	5	4	8	3	3	23	3	8	0	0
1239	7	6	8	3	3	27	1	6	0	1
1258	5	4	7	3	3	22	1	4	0	0
1264	7	5	9	3	3	27	4	7	0	1
1267	6	4	8	3	3	24	1	8	0	1

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
1280	7	5	8	4	3	27	9	5	0	1
1283	8	6	8	3	3	28	9	5	0	1
1284	4	4	7	3	2	20	3	8	0	1
1289	9	5	9	4	3	30	4	3	1	1
1303	8	5	8	4	3	28	4	4	0	1
1306	9	6	10	4	3	32	5	4	0	0
1312	5	4	8	4	3	24	7	1	0	0
1318	9	6	9	4	3	31	4	2	0	0
1329	9	6	9	4	3	31	9	2	0	1
1347	9	4	7	4	3	27	3	4	0	1
1349	8	3	8	3	3	25	9	1	0	1
1354	5	4	8	4	3	24	7	4	0	0
1412	6	5	8	4	3	26	9	1	0	0
1424	6	4	7	3	3	23	5	4	0	1
1449	6	4	7	3	3	23	1	5	0	1
1475	8	6	10	4	3	31	4	1	0	0
1477	8	6	9	4	3	30	3	6	0	0
1490	9	5	7	4	3	28	5	3	0	1
1553	5	5	7	4	3	24	1	3	0	0
1566	7	4	8	3	3	25	1	5	0	0
1570	9	6	9	4	3	31	5	3	0	0
1572	5	4	8	3	3	23	1	8	0	1
1582	5	4	8	3	3	23	3	5	0	1
1588	8	4	9	3	3	27	4	2	0	0
1601	5	4	8	3	3	23	3	4	0	0
1619	9	6	10	4	3	32	3	3	0	0
1627	6	4	9	4	3	26	5	8	0	1

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
1637	6	5	8	3	3	25	4	3	0	0
1644	8	6	9	4	3	30	1	4	0	1
1655	5	4	6	3	3	21	4	7	0	1
1666	4	4	8	3	3	22	1	7	1	1
1670	9	6	10	4	3	32	4	2	0	0
1705	9	4	9	3	3	28	9	2	0	0
1809	9	5	7	4	3	28	4	3	0	0
1810	5	4	6	2	3	20	4	5	0	0
1818	8	5	8	4	3	28	7	4	0	0
1820	9	5	9	4	3	30	3	8	0	0
1821	5	4	7	3	3	22	9	7	0	0
1836	9	5	9	4	3	30	7	2	0	0
1840	7	5	9	4	3	28	4	5	0	1
1841	8	4	8	3	3	26	4	2	0	0
1867	6	4	8	3	3	24	5	6	1	0
1871	7	4	7	3	3	24	9	6	0	0
1890	4	4	7	3	3	21	6	2	0	0
1891	9	6	9	4	3	31	4	5	0	0
1901	9	6	9	4	3	31	3	2	0	0
1904	9	6	9	4	3	31	7	1	1	0
1909	6	5	6	3	3	23	3	6	0	1
1935	6	4	7	2	3	22	4	5	0	1
1957	5	4	8	3	3	23	1	5	1	1
1972	7	5	9	3	3	27	5	8	1	1
1986	5	4	8	3	3	23	4	7	0	0
1996	9	6	9	4	3	31	3	2	0	0
1997	5	4	8	2	3	22	5	5	0	0

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
2002	5	5	8	3	3	24	9	6	0	0
2008	9	6	9	4	3	31	3	6	1	0
2016	9	4	8	4	3	28	7	6	0	1
2058	7	4	7	3	3	24	3	2	0	1
2059	9	4	9	3	3	28	6	1	1	0
2062	9	6	9	4	3	31	3	1	0	0
2076	9	6	10	4	3	32	5	5	0	0
2089	5	6	8	3	3	25	1	4	0	1
2101	6	4	7	3	3	23	4	3	0	0
2131	7	5	8	4	3	27	6	3	1	1
2158	7	5	9	3	3	27	4	4	0	0
2161	6	4	7	3	3	23	3	6	0	0
2183	4	4	8	3	3	22	4	5	0	0
2187	7	4	8	3	3	25	3	5	0	0
2196	7	6	10	4	3	30	9	2	0	0
2232	7	6	10	3	3	29	4	2	0	0
2249	6	5	9	3	3	26	1	6	0	1
2257	9	6	9	4	3	31	3	4	0	1
2283	8	5	9	3	3	28	9	2	1	0
2287	8	5	9	4	3	29	4	5	0	1
2298	8	6	9	3	3	29	1	4	0	0
2309	3	4	3	3	2	15	3	4	0	0
2319	9	5	8	3	3	28	7	4	0	1
2326	6	5	8	4	3	26	4	2	0	0
2333	7	4	8	4	3	26	3	5	0	1
2340	7	5	8	3	3	26	7	5	0	1
2346	7	4	8	3	3	25	4	8	0	1

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
2356	9	6	9	4	3	31	3	4	0	0
2361	7	4	7	4	3	25	9	1	1	0
2365	8	5	8	4	3	28	5	2	1	0
2367	5	3	7	3	3	21	9	7	0	0
2377	7	4	7	3	3	24	9	2	1	0
2381	8	5	8	3	3	27	3	4	0	0
2385	8	5	8	4	2	27	7	1	0	0
2392	4	4	6	3	3	20	4	5	0	0
2405	8	5	9	3	3	28	6	5	0	1
2406	5	5	8	3	3	24	4	6	0	1
2407	6	3	8	3	3	23	6	3	0	0
2411	7	4	8	3	3	25	4	5	0	1
2454	8	5	9	4	3	29	3	4	0	1
2471	6	6	7	4	3	26	4	3	0	0
2480	4	1	6	1	2	14	3	2	0	0
2504	5	4	8	3	3	23	9	5	1	1
2525	7	5	8	4	3	27	4	4	0	0
2540	6	5	8	3	3	25	3	8	1	1
2548	5	4	8	3	3	23	3	8	0	0
2552	7	4	8	3	3	25	4	8	0	1
2556	5	4	8	3	3	23	1	5	0	1
2585	9	6	9	4	3	31	9	2	0	1
2595	6	5	8	3	3	25	3	4	0	1
2614	7	4	7	3	3	24	1	3	0	0
2621	9	5	9	4	3	30	7	4	0	0
2633	8	4	8	3	3	26	4	4	0	0
2662	9	5	9	4	3	30	5	5	0	0

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
2666	6	4	8	3	3	24	1	5	0	0
2673	8	5	9	4	3	29	9	8	0	0
2679	7	4	9	2	3	25	3	3	0	0
2682	8	4	9	4	3	28	4	2	0	0
2702	9	5	9	4	3	30	4	2	0	1
2710	9	5	9	4	3	30	7	4	0	0
2737	9	6	9	4	3	31	4	2	0	0
2738	6	4	8	3	3	24	9	8	0	1
2773	6	5	9	4	3	27	9	4	0	1
2774	9	6	9	4	3	31	5	3	0	0
2776	6	4	8	3	3	24	9	4	0	0
2784	6	4	8	3	3	24	3	4	0	0
2795	9	6	10	4	3	32	5	2	0	0
2801	8	4	8	3	3	26	4	4	0	0
2811	5	4	8	3	3	23	1	8	0	1
2813	7	5	9	4	3	28	4	2	0	0
2821	7	4	6	3	3	23	4	5	0	1
2829	4	4	6	3	3	20	1	7	0	0
2836	6	4	5	3	3	21	1	4	0	1
2842	7	3	8	3	3	24	7	6	1	0
2854	6	5	9	4	3	27	7	7	0	1
2856	6	5	9	4	3	27	4	5	0	0
2857	1	2	3	3	2	11	1	6	0	1
2866	7	3	6	2	3	21	6	2	0	0
2869	7	3	9	4	3	26	7	6	0	1
2873	5	5	8	3	3	24	3	8	0	1
2874	9	6	10	4	3	32	5	3	0	0

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
2875	6	4	8	2	3	23	4	3	0	0
2893	4	4	6	2	2	18	1	8	0	0
2910	6	5	9	4	3	27	3	4	0	0
2918	5	4	8	3	3	23	1	6	0	0
2930	6	4	8	3	3	24	7	4	0	0
2937	4	4	8	2	2	20	9	8	1	1
2949	4	4	6	3	3	20	5	4	0	1
2962	6	3	8	3	3	23	9	4	1	0
2979	9	5	8	4	3	29	7	8	0	1
2990	5	3	7	3	2	20	7	4	0	0
2997	9	6	10	4	3	32	4	3	1	0
3011	9	4	9	3	3	28	4	3	0	0
3080	7	6	9	4	3	29	9	3	0	0
3094	9	5	9	3	3	29	6	1	0	0
3115	9	6	9	4	3	31	3	3	0	0
3131	8	6	10	4	3	31	6	2	1	0
3134	6	5	8	3	3	25	7	4	0	1
3142	5	3	7	3	3	21	5	2	0	0
3144	8	6	9	3	3	29	3	8	1	1
3174	6	4	8	4	3	25	1	6	1	1
3178	6	3	8	3	3	23	7	5	1	0
3179	8	5	9	3	3	28	1	3	0	0
3193	7	5	8	3	3	26	3	5	1	0
3200	9	6	9	4	3	31	5	2	1	0
3231	5	4	8	3	3	23	5	8	0	1
3232	4	4	8	3	2	21	1	8	1	1
3240	8	4	9	3	3	27	7	4	0	1

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
3262	5	4	7	3	3	22	1	8	0	1
3275	9	6	10	4	3	32	1	3	0	0
3293	9	5	8	4	3	29	3	8	1	0
3297	5	5	8	3	3	24	4	4	0	1
3306	5	4	8	3	3	23	3	4	0	0
3316	8	6	9	4	3	30	3	4	0	0
3364	6	4	9	3	3	25	4	5	0	1
3383	6	4	8	3	3	24	5	5	0	0
3393	9	6	10	4	3	32	4	2	0	0
3417	9	6	10	4	3	32	3	1	0	0
3450	3	4	4	3	2	16	7	3	0	0
3455	7	6	9	3	3	28	3	4	0	1
3468	7	6	10	4	3	30	4	5	0	0
3474	7	5	9	4	3	28	6	2	0	1
3476	9	6	10	3	3	31	1	4	0	1
3482	4	3	8	3	2	20	1	5	1	1
3490	7	4	7	3	3	24	3	3	0	1
3502	6	5	7	3	3	24	3	7	0	1
3514	7	4	8	3	3	25	4	2	1	0
3528	5	3	7	3	2	20	9	4	0	0
3529	8	6	9	3	3	29	9	3	0	0
3564	7	6	9	3	3	28	7	4	1	1
3568	7	4	8	3	3	25	1	4	0	0
3589	9	5	9	4	3	30	5	5	1	0
3593	9	6	9	4	3	31	3	3	0	0
3613	4	2	6	2	3	17	4	5	0	0
3620	3	4	7	2	2	18	9	7	1	1

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
3634	8	6	9	4	3	30	9	4	0	0
3637	5	4	6	2	2	19	1	4	0	0
3657	5	4	8	2	3	22	4	4	0	1
3660	6	4	8	3	2	23	1	6	1	1
3672	7	4	8	3	3	25	3	6	0	0
3683	8	5	9	3	3	28	4	6	0	1
3695	9	6	9	4	3	31	5	5	0	0
3703	6	4	8	3	3	24	4	4	0	0
3710	6	4	8	3	3	24	1	7	0	1
3717	9	4	8	4	3	28	6	4	0	0
3726	9	5	9	4	3	30	7	3	1	0
3756	5	4	8	2	3	22	1	8	0	1
3757	9	4	9	3	3	28	4	4	0	0
3762	7	5	9	3	3	27	5	4	0	0
3798	6	3	7	2	2	20	4	5	0	0
3799	6	4	9	3	3	25	4	6	0	1
3807	9	5	9	3	3	29	5	3	0	0
3821	5	5	9	3	3	25	3	4	0	0
3832	6	4	9	3	3	25	4	4	0	0
3850	9	6	10	4	3	32	4	3	0	0
3854	5	4	8	4	3	24	7	6	0	1
3876	8	4	9	4	3	28	9	2	0	0
3892	5	4	8	3	3	23	5	3	1	0
3901	7	6	9	4	3	29	3	3	0	0
3909	7	5	8	3	3	26	3	6	1	0
3930	7	4	8	3	3	25	5	8	0	1
3931	8	4	8	3	3	26	1	5	0	0

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
3937	4	4	4	3	3	18	9	6	0	1
3950	8	4	8	3	3	26	7	6	0	1
3963	9	6	10	4	3	32	5	1	0	0
3965	9	6	9	4	3	31	3	5	0	0
3972	6	5	8	3	3	25	4	5	0	0
3973	5	6	9	3	3	26	4	5	0	0
3986	9	5	9	4	3	30	6	2	1	0
3997	8	4	9	3	3	27	4	2	0	0
4005	9	6	9	4	3	31	3	7	0	0
4010	8	6	9	3	3	29	1	3	0	1
4017	7	3	8	4	3	25	7	2	0	0
4018	5	4	9	2	3	23	7	4	1	0
4028	9	6	10	4	3	32	4	4	0	1
4062	9	6	10	4	3	32	5	1	1	0
4074	7	5	8	3	3	26	3	8	1	0
4113	7	5	9	4	3	28	3	5	0	1
4124	6	5	8	4	3	26	5	2	0	0
4126	6	4	9	3	3	25	4	3	0	0
4132	9	6	10	4	3	32	6	3	0	1
4137	8	4	9	3	3	27	1	4	0	0
4153	4	2	7	3	2	18	7	3	0	0
4157	4	4	8	3	2	21	5	3	0	0
4215	9	6	9	4	3	31	3	7	0	0
4229	8	5	10	4	3	30	6	2	1	0
4232	5	3	4	2	2	16	6	2	1	1
4240	8	4	9	3	3	27	5	4	0	0
4261	9	6	10	4	3	32	6	2	0	0

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
4270	5	4	8	4	2	23	7	4	1	0
4283	6	4	8	3	3	24	1	6	0	0
4291	8	4	8	4	3	27	9	6	0	1
4303	8	5	9	4	3	29	5	4	1	0
4312	8	6	10	4	3	31	6	3	1	0
4348	7	5	9	4	3	28	6	4	0	0
4373	4	4	9	3	3	23	1	2	0	0
4395	6	4	7	3	3	23	9	2	0	0
4408	8	6	9	4	3	30	6	5	0	1
4443	9	6	9	4	3	31	4	3	0	0
4452	6	5	8	4	3	26	1	3	0	0
4462	9	6	10	4	3	32	5	4	0	0
4471	6	5	8	3	3	25	4	5	0	1
4481	8	5	9	3	3	28	4	5	0	0
4492	8	5	8	4	3	28	7	2	0	0
4512	8	6	9	4	3	30	9	4	0	1
4526	9	6	10	4	3	32	3	1	0	0
4582	8	4	8	3	3	26	3	3	0	0
4598	7	5	8	4	3	27	3	8	1	0
4607	5	5	8	2	3	23	4	4	0	0
4639	8	5	9	3	3	28	1	3	0	0
4666	4	4	7	3	2	20	9	8	1	1
4671	5	4	7	3	3	22	1	7	0	1
4678	3	3	6	3	2	17	9	4	0	0
4698	5	4	8	3	3	23	4	5	0	1
4716	6	4	8	3	3	24	9	2	0	0
4718	8	4	8	3	3	26	4	5	0	0

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
4734	3	4	8	3	2	20	1	6	1	1
4749	9	5	9	4	3	30	7	3	1	0
4764	4	4	5	3	3	19	6	8	1	1
4768	7	5	8	3	3	26	4	4	0	0
4820	7	4	8	3	3	25	9	5	1	1
4850	5	5	9	3	3	25	6	5	0	1
4853	4	4	7	3	3	21	1	3	0	1
4861	6	5	8	3	3	25	4	4	0	0
4877	9	6	9	4	3	31	6	1	1	0
4920	6	4	8	3	3	24	4	6	0	0
4925	8	4	8	4	3	27	4	4	1	0
4936	6	4	8	3	3	24	3	5	0	0
4937	5	3	7	3	2	20	4	8	0	1
4944	9	6	10	4	3	32	3	2	1	0
4949	8	4	9	4	3	28	1	5	0	0
4967	9	6	10	4	3	32	9	2	0	0
4969	5	5	6	2	3	21	6	3	0	0
5007	8	6	9	4	3	30	3	4	1	0
5019	8	5	8	4	3	28	1	4	0	0
5020	9	6	9	4	3	31	3	5	0	0
5043	4	4	8	3	3	22	6	1	1	0
5045	9	6	10	4	3	32	5	3	0	0
5052	4	3	5	2	3	17	4	7	0	1
5084	7	6	8	4	3	28	4	2	0	0
5091	4	4	7	3	3	21	1	6	0	1
5103	6	4	9	3	3	25	6	5	0	1
5183	3	3	8	3	3	20	1	8	1	1

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
5188	8	6	8	4	3	29	7	5	0	0
5222	8	6	9	4	3	30	4	8	0	1
5230	9	6	10	4	3	32	9	2	0	0
5239	5	4	5	3	3	20	4	3	0	0
5260	9	6	9	4	3	31	7	2	0	0
5265	7	3	5	4	3	22	3	4	1	0
5273	4	4	8	3	3	22	4	6	0	1
5279	5	4	8	3	2	22	1	5	0	1
5281	5	4	8	3	3	23	4	4	0	1
5289	9	6	9	4	3	31	9	2	0	0
5311	5	4	8	3	3	23	3	7	0	0
5318	9	6	10	4	3	32	5	4	1	0
5344	6	4	6	3	3	22	1	8	0	1
5349	9	4	9	4	3	29	6	3	1	0
5357	4	4	7	3	3	21	1	6	0	1
5363	8	5	9	3	3	28	4	8	0	1
5377	7	4	8	4	2	25	4	4	0	0
5396	8	4	8	4	3	27	4	1	0	0
5403	7	4	7	3	3	24	6	7	0	0
5405	7	4	8	4	3	26	7	3	0	0
5409	8	5	7	3	3	26	4	3	0	0
5415	7	4	8	4	3	26	7	2	0	0
5422	8	5	9	3	3	28	4	1	0	0
5423	9	6	9	4	3	31	7	2	0	0
5425	7	5	9	4	3	28	6	5	0	0
5438	7	4	8	4	3	26	9	4	1	0
5439	9	6	10	4	3	32	4	3	0	0

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
5476	5	4	8	3	2	22	4	2	0	0
5514	5	4	8	4	2	23	6	3	1	0
5523	8	6	9	4	3	30	4	3	0	0
5527	8	5	8	3	3	27	1	2	0	0
5547	6	4	7	4	3	24	4	2	0	0
5558	7	5	8	4	3	27	5	2	0	0
5575	5	4	8	3	3	23	7	8	0	1
5576	7	5	9	4	3	28	3	1	0	1
5604	5	4	7	3	3	22	4	4	0	0
5607	9	4	9	4	3	29	4	1	0	0
5613	8	6	9	4	3	30	9	3	0	1
5623	7	5	9	4	3	28	4	1	0	0
5643	8	6	9	4	3	30	9	4	0	0
5649	6	5	9	3	3	26	4	5	0	1
5660	7	4	9	3	3	26	6	6	0	0
5688	7	4	9	3	3	26	9	6	0	1
5709	6	4	8	3	3	24	9	3	0	0
5763	9	6	10	4	3	32	3	3	0	0
5804	8	5	10	4	3	30	6	1	0	0
5807	6	3	7	3	3	22	4	5	0	0
5813	7	3	6	3	3	22	6	1	0	0
5829	5	5	8	2	3	23	4	7	0	1
5844	9	5	9	4	3	30	9	4	0	0
5849	6	4	8	3	3	24	5	6	0	1
5875	7	5	9	3	3	27	3	7	0	0
5881	9	6	10	4	3	32	4	1	0	0
5889	6	5	9	3	3	26	4	4	0	0

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
5895	5	4	9	2	3	23	1	3	0	0
5896	8	5	9	4	3	29	4	3	0	0
5898	9	6	10	4	3	32	5	6	1	0
5899	5	4	8	4	3	24	3	4	0	0
5910	9	5	9	4	3	30	5	3	0	0
5925	8	5	9	3	3	28	4	3	0	0
5928	7	4	9	3	3	26	9	6	0	1
5939	5	3	8	3	2	21	1	5	0	0
5969	8	5	9	4	3	29	7	2	0	0
5990	6	4	7	3	3	23	1	5	0	1
6003	9	5	9	4	3	30	3	4	0	0
6017	5	4	8	3	3	23	1	5	0	0
6024	6	5	6	3	3	23	9	2	0	0
6048	6	5	9	3	3	26	1	6	0	1
6059	6	3	6	3	3	21	5	3	0	1
6066	5	4	7	3	3	22	4	8	0	1
6076	5	4	9	3	3	24	7	5	0	0
6102	5	4	8	4	3	24	1	6	1	1
6124	7	3	8	3	3	24	7	6	0	0
6131	7	6	9	4	3	29	3	3	0	0
6149	6	4	8	3	3	24	1	5	0	0
6172	8	5	8	4	3	28	1	4	0	0
6181	5	4	8	3	3	23	1	8	0	1
6216	7	5	9	4	3	28	6	6	0	1
6221	8	5	9	4	3	29	9	3	0	1
6222	6	4	7	3	3	23	9	5	1	0
6231	9	6	9	4	3	31	5	4	0	0

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
6234	5	4	9	3	3	24	4	5	0	0
6235	9	6	10	4	3	32	7	4	0	0
6236	9	6	7	4	3	29	4	4	1	1
6237	8	3	8	3	2	24	9	4	0	1
6243	7	4	8	3	3	25	1	4	0	0
6259	7	6	9	3	3	28	3	4	0	0
6262	7	3	8	4	3	25	7	8	1	1
6271	6	4	8	3	3	24	4	3	0	0
6291	5	4	7	3	2	21	9	6	1	0
6310	7	4	8	3	3	25	4	4	1	1
6314	9	5	8	4	3	29	5	1	1	0
6328	6	4	7	4	3	24	3	3	0	0
6372	6	4	8	4	3	25	5	4	0	0
6389	9	4	9	4	3	29	3	2	1	0
6419	9	6	9	4	3	31	9	7	0	1
6425	5	4	9	3	3	24	4	3	0	0
6428	9	5	9	3	3	29	4	2	0	0
6437	5	4	7	3	3	22	3	4	0	0
6453	7	5	9	3	3	27	4	3	0	0
6455	7	6	9	3	3	28	9	4	0	1
6456	9	6	10	4	3	32	5	4	0	0
6489	5	4	8	3	3	23	3	4	1	0
6495	8	5	9	4	3	29	6	2	1	1
6510	6	4	8	3	3	24	4	8	0	1
6514	8	4	9	3	3	27	7	1	0	0
6542	6	4	9	3	3	25	7	5	1	0
6564	6	5	8	3	3	25	3	8	0	1

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
6614	9	5	9	3	3	29	4	3	1	0
6622	8	4	9	3	3	27	9	2	0	0
6665	4	4	7	3	2	20	9	6	1	1
6688	9	5	10	4	3	31	6	2	1	0
6729	6	4	8	3	3	24	4	7	0	1
6732	5	4	7	2	3	21	1	6	0	0
6759	9	6	9	4	3	31	4	2	0	0
6772	5	4	7	2	3	21	9	8	1	1
6813	8	6	10	3	3	30	4	4	0	0
6816	8	6	8	4	3	29	6	2	0	0
6852	8	4	8	4	3	27	3	5	0	0
6854	4	4	4	2	3	17	1	5	0	0
6855	6	4	8	4	3	25	3	4	0	0
6868	4	4	8	3	3	22	7	3	0	0
6872	5	4	7	3	3	22	1	3	0	0
6873	8	6	8	4	3	29	5	2	1	0
6905	7	3	7	2	3	22	7	2	1	0
6924	7	5	7	3	3	25	4	2	0	0
6929	5	4	8	3	3	23	9	6	0	1
6930	8	6	9	4	3	30	6	4	0	1
6934	4	4	7	3	2	20	9	8	0	1
6949	8	6	9	4	3	30	4	3	1	0
6953	9	6	10	4	3	32	5	1	1	0
6966	8	5	8	3	3	27	1	2	0	0
6968	9	4	7	4	3	27	9	3	0	0
6975	8	4	8	4	3	27	6	1	1	0
6981	5	4	8	3	3	23	1	5	0	1

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
6984	3	4	3	2	2	14	1	8	0	1
7027	5	4	8	3	3	23	3	3	0	0
7060	7	4	6	3	3	23	3	5	0	1
7074	8	6	9	4	3	30	1	5	0	1
7083	3	3	5	2	2	15	9	4	0	1
7103	8	6	9	4	3	30	3	3	0	0
7107	7	5	9	3	3	27	6	1	0	0
7129	6	3	7	3	3	22	4	4	0	0
7144	7	4	7	3	3	24	3	6	0	1
7172	9	6	10	4	3	32	3	4	0	0
7186	5	5	9	3	3	25	4	4	0	0
7239	8	5	8	3	3	27	1	6	0	1
7240	6	4	8	2	3	23	4	8	0	1
7249	9	4	8	4	3	28	4	2	0	0
7263	6	3	6	4	2	21	7	1	0	0
7274	6	4	8	3	3	24	4	4	0	0
7297	8	5	8	4	3	28	9	6	0	0
7316	6	4	8	3	3	24	4	8	0	1
7344	7	5	8	4	3	27	3	6	1	0
7366	6	4	8	3	3	24	4	6	0	1
7374	9	6	10	4	3	32	4	3	0	1
7378	9	6	9	4	3	31	4	3	0	0
7390	8	6	9	3	3	29	3	4	1	0
7395	6	4	8	3	3	24	4	3	0	0
7400	7	4	8	3	3	25	4	7	0	1
7413	9	6	10	4	3	32	5	3	0	1
7420	4	4	5	3	3	19	1	8	0	1

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
7434	7	5	9	3	3	27	4	5	0	0
7450	7	4	8	3	3	25	4	5	0	0
7454	9	5	10	4	3	31	6	1	0	0
7459	6	5	9	3	3	26	1	3	0	0
7463	6	4	7	3	3	23	4	7	0	1
7467	4	4	7	3	3	21	1	4	0	0
7472	6	4	8	3	3	24	4	3	0	0
7495	5	4	8	3	3	23	4	4	0	1
7496	8	6	9	2	3	28	5	4	0	0
7504	5	4	7	3	2	21	7	8	1	0
7545	9	5	9	4	3	30	3	4	0	0
7568	7	4	8	3	3	25	4	7	0	0
7569	5	4	8	3	3	23	1	8	0	1
7583	5	4	8	3	3	23	3	4	0	0
7593	9	6	9	4	3	31	3	8	0	1
7602	7	4	8	3	3	25	4	3	0	1
7614	9	6	10	4	3	32	4	1	0	0
7618	8	6	9	4	3	30	7	3	0	0
7639	6	4	9	3	3	25	7	8	0	1
7658	9	5	9	4	3	30	7	3	0	0
7660	9	6	9	4	3	31	3	4	1	0
7677	8	6	9	3	3	29	1	5	0	1
7678	5	4	8	2	3	22	1	7	0	1
7679	8	4	9	3	3	27	4	4	0	0
7689	7	5	9	3	3	27	9	4	0	1
7718	8	4	9	4	3	28	7	2	0	0
7719	4	4	7	3	2	20	9	2	0	0

PUBLIC ID	HRO S2O Score	HRO R2S Score	HRO PwF Score	HRO D2E Score	HRO C2R Score	HRO Score	Region	BSC	Gov	Teach
7724	8	6	9	4	3	30	3	4	0	1
7742	5	4	8	3	3	23	4	5	0	0
7748	7	5	9	3	3	27	4	5	0	1
7769	8	5	8	4	3	28	3	4	1	0
7784	6	5	8	3	3	25	4	8	0	1
7786	5	4	6	3	3	21	4	4	0	0
7821	6	4	8	3	3	24	4	5	0	1
7840	4	4	8	3	2	21	1	8	1	1
7853	5	5	8	3	3	24	7	8	0	1
7859	6	6	9	3	3	27	3	5	0	1
7873	6	4	7	2	3	22	3	5	0	1
7900	8	4	9	4	3	28	3	4	0	0
7910	5	4	7	2	3	21	1	8	0	1
7911	5	4	7	2	3	21	1	6	0	1
7923	8	6	9	3	3	29	1	4	0	0
7959	9	6	9	4	3	31	3	4	0	0
7963	9	4	9	3	3	28	9	1	1	0
7967	8	3	8	4	3	26	7	3	0	0
7968	9	6	9	4	3	31	3	4	0	1
7976	5	4	7	3	3	22	5	8	0	1

Appendix 4: Aggregated HAI Data and HRO Score

Hospital Type	Region	BSC	Gov	Teaching Status	CLASBI	CAUTI	SSI	HRO Score
1200	1	2	0	0			2.2160	27
1300	1	3	0	0	0.2037	0.8811	0.9735	25.889
1301	1	3	0	1	0.0463	0.8270	2.6470	26.333
1400	1	4	0	0	0.5257	0.8974	1.0513	24.727
1401	1	4	0	1	0.6505	1.0407	0.9659	24.857
1500	1	5	0	0	0.4749	1.0640	0.9395	23.444
1501	1	5	0	1	0.5865	1.3382	0.9971	25.250
1511	1	5	1	1	0.0613	1.2443	1.6150	21.50
1600	1	6	0	0	0.2523	1.2830	0.6233	23.250
1601	1	6	0	1	0.6254	1.3505	0.9845	22.636
1611	1	6	1	1	1.0822	1.5252	2.1033	22.60
1700	1	7	0	0	1.0110	2.2240	0.6930	20
1701	1	7	0	1	0.3954	1.4053	1.2555	22.667
1711	1	7	1	1	0.5010	0.8820	0	22
1800	1	8	0	0	0.3305	0.8560	0.4780	18
1801	1	8	0	1	0.4815	1.3836	1.0732	21.455
1811	1	8	1	1	0.4987	1.1968	1.0744	20.667
3100	3	1	0	0			1.9770	31.667
3200	3	2	0	0	0.6070	0.9390	0	26.333
3300	3	3	0	0	0.5686	0.6677	0.5469	28.067
3301	3	3	0	1	0	0.9327	0.3715	24
3400	3	4	0	0	0.4428	0.7651	0.7231	26.304
3401	3	4	0	1	0.4727	0.7358	0.8614	27.625
3410	3	4	1	0	0.4743	0.8886	0.7475	27.429
3500	3	5	0	0	0.6420	1.1024	0.7899	28.167
3501	3	5	0	1	0.6105	1.0396	0.7943	25
3510	3	5	1	0	0.4891	1.5857	0.6269	28.5
3600	3	6	0	0	0.5720	1.3072	0.7199	26.20
3601	3	6	0	1	0.4841	1.0410	0.8113	24.667
3610	3	6	1	0	0.6511	0.9907	0.8667	27.25
3700	3	7	0	0	0.2224	0.9864	0.9895	28.600
3701	3	7	0	1	0.5370	1.6019	1.2026	24
3800	3	8	0	0	0.4789	1.0784	0.8578	24.75
3801	3	8	0	1	0.5268	1.2491	0.9120	25.667
3811	3	8	1	1	0.6849	1.6152	1.0232	27
4100	4	1	0	0			0.3125	29.571

Hospital Type	Region	BSC	Gov	Teaching Status	CLASBI	CAUTI	SSI	HRO Score
4200	4	2	0	0	0.8070	0.3157	2.0750	28
4201	4	2	0	1	0	0	1.9930	30
4300	4	3	0	0	0.2805	0.4834	0.6795	26.739
4301	4	3	0	1	1.1085	0.7128	0.7279	28.5
4310	4	3	1	0	0	0.5670	1.4118	30.333
4311	4	3	1	1		0		30
4400	4	4	0	0	0.5261	0.8677	1.0246	25.074
4401	4	4	0	1	0.4477	0.8101	0.8127	25
4410	4	4	1	0	0.3482	0.9258	0.9938	27
4411	4	4	1	1	1.0765	0.6585	0.1893	27
4500	4	5	0	0	0.3772	0.5919	0.5287	24.053
4501	4	5	0	1	0.4373	1.1646	0.7961	24.714
4600	4	6	0	0	0.6485	0.8442	0.8397	25.667
4601	4	6	0	1	0.4432	1.0079	0.9930	24.60
4700	4	7	0	0	0.5220	1.0320	1.5710	23.333
4701	4	7	0	1	0.4363	1.0395	0.9019	22
4801	4	8	0	1	0.3968	1.2405	0.9246	24.417
5100	5	1	0	0		3.6760		32
5200	5	2	0	0		0	0	26.5
5300	5	3	0	0	0.4740	0.6758	0.4500	29.333
5310	5	3	1	0		0	0.3895	23
5400	5	4	0	0	0.6644	0.8441	0.7739	29.25
5401	5	4	0	1	0.2377	0.5010	0.1800	21.5
5410	5	4	1	0	0.3627	0.7996	0.7130	30.5
5500	5	5	0	0	0.6120	1.4472	0.5598	27.167
5501	5	5	0	1	0.3944	0.8228	0.7325	26
5510	5	5	1	0	0.8271	1.0844	0.3353	30
5601	5	6	0	1	0.5325	1.2565	0.8024	24
5610	5	6	1	0	0.6030	0.7032	0.7103	28
5801	5	8	0	1	0.6124	1.4671	0.8357	24
5811	5	8	1	1	0.5773	1.4571	0.9527	27
6200	6	2	0	0	2.7400	1.0910		27.286
6300	6	3	0	0	0.2240	0.5733	0.6696	24.333
6301	6	3	0	1	0.7303	0.7232	1.3167	32
6310	6	3	1	0		0	0.7635	27.667
6400	6	4	0	0	0.5437	0.9716	1.1101	27.667
6401	6	4	0	1	0.4094	1.2819	1.2099	30
6500	6	5	0	0	0.8673	1.7498	0.7320	28
6501	6	5	0	1	0.4238	1.0961	0.8996	27

Hospital Type	Region	BSC	Gov	Teaching Status	CLASBI	CAUTI	SSI	HRO Score
6600	6	6	0	0	0.2460	0.6490	0.1770	26
6601	6	6	0	1	0.3233	1.2406	1.0476	28
6700	6	7	0	0	0.7470	1.3120	1.6580	24
6701	6	7	0	1	0.3808	1.2704	0.8918	30
6801	6	8	0	1	0.4106	1.2810	0.9456	18
6811	6	8	1	1	0.4620	1.3110	1.7970	19
7200	7	2	0	0	0.4164	0.5761	0.7891	28.800
7300	7	3	0	0	0.5358	0.6139	0.7649	24.875
7310	7	3	1	0		0.6820	0	30
7400	7	4	0	0	0.5280	0.8298	0.8633	27.400
7401	7	4	0	1	0.6568	0.9447	0.7921	26.667
7410	7	4	1	0	0.1197	0.1772	0.6992	23
7411	7	4	1	1	0.8080	0.8640	0.3912	28
7500	7	5	0	0	0.6568	1.0734	0.7790	26.5
7501	7	5	0	1	0.4618	0.8143	0.5556	26
7510	7	5	1	0	0.2510	0.8027	0.7780	24
7600	7	6	0	0	0.6132	1.2090	0.7430	24
7601	7	6	0	1	0.6005	1.0221	0.8633	26
7610	7	6	1	0	0.2318	1.3885	0.7483	24
7700	7	7	0	0	0.8770	1.2875	1.4390	29
7701	7	7	0	1	0.5183	1.0519	0.6234	27
7711	7	7	1	1	0.6337	1.0330	0.9097	23
7801	7	8	0	1	0.5402	1.1332	0.9858	25
7811	7	8	1	1	0.5354	1.3604	1.4986	25
9200	9	2	0	0		0.4248	1.0412	27.42
9201	9	2	0	1			0	31
9210	9	2	1	0	0	1.6270	0.2910	26
9300	9	3	0	0	0.4542	0.4378	1.2452	26.83
9301	9	3	0	1	0.6290	0.3480	1.0471	29.5
9400	9	4	0	0	0.6414	0.9288	0.8714	25.143
9401	9	4	0	1	0.4322	0.8471	1.0445	25.167
9410	9	4	1	0	0.3438	0.4541	0.5136	24.5
9500	9	5	0	0	0.6010	1.0332	0.6292	29
9501	9	5	0	1	0.5010	1.1078	0.9261	25
9510	9	5	1	0	0.3405	1.4420	0.4063	23
9511	9	5	1	1	0.4546	0.9617	0.8856	24
9600	9	6	0	0	0.5655	1.0486	0.8450	25.33
9601	9	6	0	1	0.3895	1.2449	0.8209	25.71
9610	9	6	1	0	0.7930	1.0050	1.2760	21

Hospital Type	Region	BSC	Gov	Teaching Status	CLASBI	CAUTI	SSI	HRO Score
9611	9	6	1	1	0.4565	1.0255	1.1050	20
9700	9	7	0	0	0.5083	1.9233	1.0457	24.33
9701	9	7	0	1	0.3698	1.0859	0.8876	27.5
9711	9	7	1	1	0.5460	1.7310	1.5844	18
9800	9	8	0	0	0.5242	0.7594	1.1063	29
9801	9	8	0	1	0.3837	1.3850	1.0993	22
9811	9	8	1	1	0.3625	1.1387	0.8828	20.33

Appendix 5: Independent Analysis Results

Table A.3: Frequencies for the HAI Data Set by Region

	Region	Frequency	Percent	Valid Percent	Cumulative Percent
1	New England/Mid-Atlantic	418	17.3%	17.3%	17.3
3	South Atlantic	469	19.5%	19.5%	36.8
4	E. North Central	419	17.4%	17.4%	54.2
5	E. South Central	181	7.5%	7.5%	61.7
6	W. North Central	132	5.5%	5.5%	67.2
7	W. South Central	297	12.3%	12.3%	79.5
9	Mountain/Pacific	495	20.5%	20.5%	100.0
	Total	2411	100.0%	100.0%	

Table A.4: Frequencies for the HAI Data Set by Control Type

	Frequency	Percent	Valid Percent	Cumulative Percent
Non- Government	2084	86.4%	87.1%	87.1
Government	309	12.8%	12.9%	100.0
Total	2393	99.3%	100.0	
Missing	18	.7%		
Total	2411	100.0%		

Table A.5: Frequencies for the HAI Data Set by Hospital Size

BSC	Number of Staff Beds	Frequency	Percent	Valid Percent	Cumulative Percent
1	6-24 beds	4	.2%	.2%	.2
2	25-49 beds	45	1.9%	1.9%	2.0
3	50-99 beds	270	11.2%	11.3%	13.3
4	100-199 beds	769	31.9%	32.1%	45.4
5	200-299 beds	535	22.2%	22.3%	67.7
6	300-399 beds	316	13.1%	13.2%	80.9
7	400-499 beds	171	7.1%	7.1%	88.1
8	500+ beds	286	11.9%	11.9%	100.0
	Total	2369	99.4%	100.0%	
	Missing	15	0.6		
	Total	2411	100.0%		

Table A.6: Frequencies for the HAI Data Set by Teaching Status

	Frequency	Percent	Valid Percent	Cumulative Percent
Non-Teaching	1064	44.1%	44.4%	44.4
Teaching	1330	55.2%	55.6%	100.0
Total	2394	99.3%	100.0	
Missing	17	.7%		
Total	2411	100.0%		

Table A.7: Frequencies for the HRO Data Set by Region

	Region	Frequency	Percent	Valid Percent	Cumulative Percent
1	New England/Mid-Atlantic	93	15.2%	15.2%	15.2
3	South Atlantic	121	19.8%	19.8%	35.0
4	E. North Central	161	26.3%	26.3%	61.3
5	E. South Central	52	8.5%	8.5%	69.8
6	W. North Central	46	7.5%	7.5%	77.3
7	W. South Central	65	10.6%	10.6%	87.9
9	Mountain/Pacific	74	12.1%	12.1%	100.0
	Total	612	100.0%	100.0%	

Table A.8: Frequencies for the HRO Data Set by Hospital Size

BSC	Number of Staff Beds	Frequency	Percent	Valid Percent	Cumulative Percent
1	6-24 beds	33	5.4%	5.4%	5.4
2	25-49 beds	88	14.4%	14.4%	19.8
3	50-99 beds	96	15.7%	15.7%	35.5
4	100-199 beds	140	22.9%	22.9%	58.3
5	200-299 beds	93	15.2%	15.2%	73.5
6	300-399 beds	63	10.3%	10.3%	83.8
7	400-499 beds	35	5.7%	5.7%	89.5
8	500+ beds	64	10.5%	10.5%	100.0
	Total	612	100.0%	100.0%	

Table A.9: Frequencies for the HRO Data Set by Control Type

	Frequency	Percent	Valid Percent	Cumulative Percent
Non- Government	513	83.8%	83.8%	83.8
Government	99	16.2%	16.2%	100.0
Total	612	100.0%	100.0%	

Table A.10: Frequencies for the HRO Data Set by Teaching Status

	Frequency	Percent	Valid Percent	Cumulative Percent
Non-Teaching	397	64.9%	64.9%	64.9
Teaching	215	35.1%	35.1%	100.0
Total	612	100.0%	100.0%	

Table A.11: HAI Descriptive Output for Hospitals by Region

						95% Confidence Interval for Mean			
	Region	N	Mean	Standard Deviation	Standard Error	Lower Bound	Upper Bound	Min	Max
CLABSI	1	352	.5380	.52160	.02780	.4833	.5927	.00	3.40
	3	390	.5337	.46856	.02373	.4870	.5803	.00	2.72
	4	334	.4711	.45856	.02509	.4217	.5204	.00	2.86
	5	131	.5980	.51875	.04532	.5084	.6877	.00	2.34
	6	101	.4720	.49089	.04884	.3751	.5690	.00	2.74
	7	243	.5474	.50861	.03263	.4832	.6117	.00	3.29
	9	430	.4979	.55236	.02664	.4456	.5503	.00	4.77
	Total	1981	.5189	.50547	.01136	.4967	.5412	.00	4.77
CAUTI	1	399	1.1911	.94288	.04720	1.0983	1.2839	.00	6.01
	3	448	1.0256	.91021	.04300	.9411	1.1101	.00	4.98
	4	373	.9379	.84208	.04360	.8521	1.0236	.00	5.50
	5	174	1.0221	1.11138	.08425	.8558	1.1884	.00	8.77
	6	117	1.1467	.85069	.07865	.9910	1.3025	.00	3.18
	7	282	.9189	.86217	.05134	.8178	1.0199	.00	5.62
	9	464	1.0343	.92511	.04295	.9499	1.1186	.00	5.16
	Total	2257	1.0348	.91995	.01936	.9968	1.0728	.00	8.77
SSI	1	374	1.0672	.91086	.04710	.9746	1.1598	.00	5.83
	3	375	.8227	.74685	.03857	.7469	.8985	.00	5.14
	4	375	.9025	.80987	.04182	.8202	.9847	.00	5.32
	5	138	.6765	.67107	.05713	.5635	.7895	.00	3.41
	6	118	1.0408	.99205	.09133	.8599	1.2217	.00	5.64
	7	238	.8135	.68126	.04416	.7265	.9005	.00	3.56
	9	417	.9232	.74273	.03637	.8517	.9947	.00	3.58
	Total	2035	.9046	.80056	.01775	.8698	.9394	.00	5.83

Table A.12: HAI Descriptive Output for Hospitals by Bed Size

						95% Confidence Interval for Mean			
	BSC	N	Mean	Standard Deviation	Std. Error	Lower Bound	Upper Bound	Min	Max
CLABSI	2	10	.6436	.91545	.28949	-.0113	1.2985	.00	2.74
	3	93	.4609	.64610	.06700	.3278	.5939	.00	2.86
	4	582	.5354	.64046	.02655	.4833	.5875	.00	4.77
	5	494	.5464	.48900	.02200	.5032	.5896	.00	2.88
	6	312	.5174	.40884	.02315	.4719	.5629	.00	1.90
	7	168	.4798	.33642	.02596	.4286	.5310	.00	1.63
	8	284	.4936	.29453	.01748	.4592	.5280	.00	1.71
	Total	1943	.5214	.50691	.01150	.4988	.5439	.00	4.77
CAUTI	2	24	.5225	.82879	.16918	.1725	.8724	.00	3.25
	3	215	.6537	.92098	.06281	.5298	.7775	.00	5.22
	4	717	.8695	.97258	.03632	.7982	.9408	.00	6.01
	5	516	1.1281	.96330	.04241	1.0448	1.2114	.00	8.77
	6	315	1.1689	.85485	.04817	1.0742	1.2637	.00	4.45
	7	169	1.2927	.75107	.05777	1.1786	1.4068	.00	4.57
	8	286	1.2975	.65477	.03872	1.2213	1.3737	.00	3.52
	Total	2242	1.0332	.92009	.01943	.9951	1.0713	.00	8.77
SSI	2	6	1.1152	1.03205	.42133	.0321	2.1982	.00	2.74
	3	110	.7631	.85585	.08160	.6013	.9248	.00	5.08
	4	536	.8772	.86342	.03729	.8039	.9505	.00	5.83
	5	476	.8183	.77463	.03551	.7486	.8881	.00	5.47
	6	305	.8916	.71921	.04118	.8106	.9727	.00	4.80
	7	166	1.0434	.70988	.05510	.9346	1.1522	.00	3.77
	8	283	1.0059	.61574	.03660	.9339	1.0779	.00	3.84
	Total	1882	.8927	.77461	.01786	.8577	.9278	.00	5.83

Table A.13: Student T-Test Result by Control Type

		Levene's Test for Equality of Variances		T-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
CLABSI	Equal variances assumed	.301	.583	-1.086	1964	.278	-.03814	.03513	-.10705	.03076
	Equal variances not assumed			-1.157	315.83	.248	-.03814	.03296	-.10300	.02671
CAUTI	Equal variances assumed	.661	.416	-1.541	2240	.123	-.08912	.05782	-.20252	.02427
	Equal variances not assumed			-1.525	380.69	.128	-.08912	.05843	-.20401	.02576
SSI	Equal variances assumed	9.958	.002	-1.713	2016	.087	-.09207	.05375	-.19748	.01334
	Equal variances not assumed			-1.531	309.25	.127	-.09207	.06015	-.21043	.02629

Table A.14: Student T-Test Result by Teaching Status

		Levene's Test for Equality of Variances		T-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
CLABSI	Equal variances assumed	51.896	.000	1.686	1964	.092	.03973	.02356	-.00648	.08593
	Equal variances not assumed			1.583	1265.05	.114	.03973	.02510	-.00951	.08897
CAUTI	Equal variances assumed	3.982	.046	-5.972	2240	.000	-.23318	.03905	-.30975	-.15661
	Equal variances not assumed			-5.882	1938.22	.000	-.23318	.03964	-.31093	-.15543
SSI	Equal variances assumed	1.817	.178	-3.415	2017	.001	-.12396	.03630	-.19515	-.05277
	Equal variances not assumed			-3.398	1697.51	.001	-.12396	.03648	-.19551	-.05241

VITA

Sandra Catrice (Bell) Affare was born in Memphis, Tennessee to the late Marvin Earl Bell and Mary Louise Echols. She is the second child of their parentage. Sandra has two older siblings; Keddren L. Payne and Cynthia L. Bell, and seven younger siblings; Anthony D. Bell, Sr., Timothy L. Echols, Michael A. Bell, Rickey Echols, Rhonda Echols, Gregory L. Bell, and Kimberly D. Bell. Sandra attended James Madison High School in Milwaukee, Wisconsin and continued to East High School (pre-engineering program) in Memphis, Tennessee where she graduated in May 1992. Sandra obtained both, a Bachelor of Science in Engineering in December 1998 and a Master's in Business Administration in December 2001 from the University of Tennessee at Chattanooga. Sandra entered the Student Training Employment Project in May 1993 and began her professional career in May 2000, both at Tennessee Valley Authority (TVA) in Chattanooga, Tennessee. Sandra received her Project Management Professional designation in June 2005. After twenty-one years of government service, with the first seven being in non-retirement positions, Sandra retired from TVA as a result of their reduction in force. Early retirement provided the much needed time to continue her education with a doctorate in Industrial Engineering concentrating in Engineering Management at the University of Tennessee at Knoxville. Gabriel and Sandra C. Affare married in Cape Coast, Ghana in December 2005. They have one child, Elisabeth Esi Affare.