An Examination of Hospital Safety Climate

by

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DEDICATION

To

My parents,

John and Mary Jane Streeter

And

My family,

Brian Paul, Noah Colin, Sarah Megan, and Hannah Grace

ACKNOWLEDGMENTS

I would like to express my deep appreciation for the time, commitment and dedication demonstrated by the members of my dissertation committee. In addition, I would like to thank the following individuals for sharing their expertise, enabling me to conduct this research study: Dr. Colwick Wilson, Barry DeCicco, Carole Sanderson Streeter, Lynn Norman, Meredith Hartshorn, and Dr. Kevin Spratt.

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GLOSSARY

Climate - The aspect of culture that can be measured

Culture - The attitudes, values, beliefs, and behaviors shared by a group of people

Safety climate - One domain of the broader safety culture that provides a single-point-in-time assessment of an organization's safety norms and behaviors

Safety Culture (Culture of Safety) - The safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviors that determine the commitment to, and the style and proficiency of, an organization's health and safety management. The goal of a culture of safety is to lessen harm to patients and care providers through both effective systems and individual performance.

Organizational Culture - The attitudes, values, beliefs, and behaviors shared by the group within an organization

ABSTRACT

Safety Climate (SC) is a point in time measurement of an organization's culture relative to safety. Safety, both for patients and caregivers, is an important goal for healthcare organizations. SC is a complex phenomenon that is poorly understood. Few empirical studies have examined the factors that affect the registered nurse's perceptions of SC. The purpose of this study was to deepen the understanding of SC, identify elements of SC commonly measured by hospitals, and then test relationships between those elements and registered nurses' perceptions of SC.

This was a study conducted in two phases. A modified Delphi method was used in the first phase of the study to gain the insights of 38 healthcare safety experts' into 1) the key elements of SC as identified by Sammer et al. (2010), and 2) identify data sets commonly collected by acute care hospitals that operationalize these elements. A retrospective, cross-sectional design using hierarchical multivariable linear modeling was used in Phase II of the study to examine the relationships between the SC elements and SC. Institutional Review Board approvals were obtained prior to data extraction from 105 patient care units in 24 acute care hospitals. SC data were derived from the AHRQ's Hospital Survey of Patient Safety Culture (2012), with other data derived from institutional administrative warehouses. The findings of Phase I resulted in the modification of the Phase II study model, which included the independent variables of Leadership, Communication, Justice, Patient-Centeredness, RN staffing, Falls with Injury, and Serious Reportable Events (SRE). The

dependent variable was SC as operationalized by Overall Patient Safety. Hierarchical multivariable linear modelling supported the inclusion of Leadership, Communication, and Justice in the Safety Climate model. These three variables, with the addition of the type of unit, were statistically significant in independently predicting SC.

This study is an important addition to the Safety Climate body of knowledge. As the first known testing of Sammer's (2010) SC model, safety experts affirmed four of the seven elements of the model (Leadership, Communication, Justice, and Patient-Centeredness) and added three new elements (RN staffing, Falls with Injury, and SRE). The Phase II preliminary validations study supported the inclusion of Leadership, Communication and Justice in the SC model. Future studies should test both Sammer's original model and the modified SC model, using larger sample sizes and additional methods for measuring RN staffing and patient harm.

CHAPTER I

Introduction

More than a decade ago, the challenge to improve the quality of healthcare was issued by the Institute of Medicine (IOM) (1999). Some have referred to medical adverse events rates as a crisis, "epidemic" in proportion (Vogus, Sutcliffe, & Weick, 2002). Since 1999 regulatory agencies, such as The Joint Commission, the Centers for Medicare and Medicaid Services (CMS), the Agency for Healthcare Research and Quality (AHRQ), and award programs like the Magnet Recognition Program, have all taken steps to require or facilitate transformation of healthcare systems in order to achieve higher levels of patient care quality and safety. These organizations have approached motivating the development of quality and safety in a variety of ways; some address the improvement of systems and processes, some address the production of improved outcomes, and others address the cultural aspects of organizations that regularly produce high levels of quality and safety. Yet, with all the improvement efforts over the past decade, healthcare systems and processes continue to produce unacceptable and negative patient outcomes (Shekelle et al., 2011; Wachter, 2010). The public's view of this situation is articulated by the title of a recent *Wall Street Journal* article, "How to Stop Hospitals from Killing Us" (Makary, 2012). Clearly, more work is needed to achieve the quality and safety outcomes required.

The Joint Commission holds hospital leaders responsible and accountable for regularly assessing and working to improve a cultural aspect of safety – specifically, the

hospital's Culture of Safety. They recognize that leaders significantly influence the culture of an organization by determining what work receives the attention and allocating resources needed to achieve desired outcomes. The CMS transformed payment structures in 2008 to reduce and eliminate reimbursement for the costs of care resulting from selected hospital-acquired negative patient outcomes or defects in care (CMS, 2012). This was an effort to motivate healthcare providers to make improvements in patient safety and quality by addressing defects that had been previously rewarded through financial payments. AHRQ recognizing that culture is critical to healthcare quality and safety sponsored the development of an assessment tool to assess for a culture of safety and offered it free of charge to all hospitals in the United States. This tool, the Hospital Survey on Patient Safety Culture (HSOPSC), measures staff perceptions of the values, beliefs, and norms regarding patient safety, as well as which patient safety attitudes and behaviors are expected (AHRQ, 2011). Last, the Magnet Recognition Program®, which recognizes hospitals across the world for excellence in nursing care and patient outcomes, requires hospitals to demonstrate exceptional evidence of nurses working to improve patient safety, including transforming structures, processes and ultimately, patient outcomes. Nursing leaders are specifically expected by organizations that measure and recognize nursing quality to utilize their position and authority to create a safety culture (ANCC, 2014; Drenkard, 2011).

In order to create healthcare organizations that are safe for patients and that reliably produce few defects in patient care, structures, processes, and systems must be transformed. Changing organizational structures, systems. and even reimbursement payments are not adequate to create this new safe organization; the culture of healthcare organizations and the behaviors regularly demonstrated by its members must be transformed as well. But

healthcare systems are complex and models of safety culture are insufficient to guide rectification of the situation. In order to transform the culture of safety, the factors that influence the culture must be understood in greater depth.

It is important to define organizational culture, of which a culture of safety is one element, and to identify how this culture develops and is influenced. Social scientists have generally operationalized a definition of culture as the attitudes, values, beliefs, and behaviors shared by a group of people (Adler, 1986; Rousseau, 1990; Taormina, 2008). Organizational culture encompasses those characteristics shared by the group within that organization. An organization's leaders are thought to play a large role in shaping the organizational culture (Schein, 2004; Patterson et al., 2005). Leader behaviors determine how resources will be distributed, which policies are adopted by the organization, and which employee behaviors will be rewarded.

In healthcare, safety is one important element of the overall organizational culture. The goal of a culture of safety is to lessen harm to patients and care providers through both effective systems and individual performance (Cronenwett et al., 2007). While much has been written about a culture of safety in the past two decades, it is a complex phenomenon that is still poorly understood. Researchers have sought to understand and measure the phenomenon, while leaders in healthcare organizations have sought to change and improve this culture.

Nurses constitute a major portion of the workforce of an acute care hospital. Nurses' attitudes and behaviors are consistently cited as essential to keeping patients safe in hospital environments. Bedside nurses and nurse leaders are noted to be influential in creating safe environments and preventing adverse patient outcomes (IOM, 2010; Kurtzman & Buerhaus,

2008; Pronovost, Rosenstein, & Paine, 2008, Vogus & Sutcliffe, 2007a; Wong & Cummings, 2007). For the culture of a hospital organization to be measurably transformed, the nursing staff must be engaged in this change and perceive tangible transformation. Nurses are charged with professional responsibility to not only act as caregiver and healer, but also to be prepared to improve systems of care rather than become victims of faulty and defect-prone systems (Morath, 2011). But little is understood about how the daily experiences of nurses influence their perceptions of the organization's culture and, specifically, the safety aspects of culture. Daily nurse staffing levels may influence those perceptions, particularly if those planned staffing levels are significantly different than benchmarked norms. Additionally, if the staffing experienced on a given day is significantly less than planned, resulting in hurried and missed care, does that influence perceptions of safety if they occurred with frequency? Does the incidence of a significant negative event on the unit or within the hospital in a recent time period influence the perceptions of safety? Do high incidences of falls or pressure ulcers influence the nurses' perceptions of safety? Understanding the impact of these nursing related factors on the perceptions of nurses, relative to the culture of safety, would help organizations understand how to better plan for and guide organizational transformation.

The literature is sometimes confusing in its use of the terms safety culture and safety climate, at times using the names interchangeably. However, a number of authors are convincing in arguing that culture and climate are different. Climate is described as a feeling conveyed in a group (Ashkanasy, Wilderom, & Peterson, 2000), the artifact of the deeper culture (Schein, 2004), perceptions of culture (Vogus, Sutcliffe, & Weick, 2002), and an intervening variable between the broader context of an organization and the behavior of its

members (Patterson et al., 2005). Schein (2004) cautions against inferring deeper assumptions from cultural artifacts alone. Schein (2004) and Flin (2007) identify the aspect of culture that can be most readily measured as climate. Safety climate is one domain of the broader safety culture that provides a single-point-in-time assessment of an organization's safety norms and behaviors (Hudson, Sexton, Thomas, & Berenholtz, 2009). The dimensions of safety culture in organizations (Table 1.1), upon which the AHRQ Hospital Survey of Patient Safety Culture is based, actually measure the safety climate. For the purposes of clarity, this proposal will use the term safety climate (SC) as the component of culture that can be measured, with the exception of the Chapter 2 discussion of Culture of Safety and formal conceptual models and tools that use the term "culture" in their title.

Table 1.1 AHRQ's Dimensions of safety culture in an organization

1. Hospital management support for safety
2. Organizational learning
3. Teamwork within units
4. Supervisor/manager expectations and actions promoting safety
5. Compliance with procedures
6. Staffing
7. Error feedback and communication
8. Overall perceptions of safety
9. Openness of communication
10. Non-punitive response to error
11. Positive-reporting norms
12. Frequency of event reporting
13. Teamwork across units
14. Hospital handoffs and transitions

Agency for Healthcare Research and Quality (2012)

Climate research is attitude and perception research (Guldenmund, 2007). Attitude is a memory structure (Fazio, 1995) that affects information processing and perceptions, and motivates behavior (Eagly & Chaiken, 1993). Attitudes can be conceptualized as a type of schema or a part of a larger schema (Markus & Zajonc, 1985a), a cognitive structure that organizes prior knowledge and experiences. Attitudes involve evaluation of an object and

the encoding of memories (Eagly & Chaiken, 1993b), resulting in collective memories of evaluations and any associated emotions and behaviors populating the schema.

Safety climate attitudes and perceptions should minimally be influenced by 1) perceptions of management prioritization of safety (Feng, Acord, Cheng, Zeng, & Song, 2011; Flin, 2007), and 2) observation of adverse safety events (Flin, 2007). One way nurses can form attitudes and perceptions of management prioritization of safety is by observing how labor and equipment resources are allocated to their departments. In the context of their work environment, nurses can observe how resource allocation impacts safety processes and events. Perceptions of staffing have been shown to be a predictor of safety climate (El-Jardali, Dimassi, Jarnal, Jaafar, & Hemadeh, 2011). Adverse safety events can be observed by learning of individual patient harm that results in injury or death or learning about a co-worker who suffered harm while providing patient care. Additionally, the cumulative rates of adverse events, such as patient falls, are often published on patient care units, staff websites or other communication mechanisms, providing an additional information input to nurses about safety. It follows that staffing variables, adverse patient event variables, and adverse caregiver event variables could have relationships with the safety climate perceived by registered nurses.

Statement of the Problem

A gap in the literature exists regarding which factors predict and influence registered nurses' perception of their climate relative to safety. With nurses constituting the bulk of the healthcare workforce, these factors must be elucidated and addressed in order to create environments that promote safety behaviors. Safety climate itself is a complex phenomenon that is not clearly understood. This study attempted to move toward greater clarity in

understanding SC by exploring experts' agreement on the major conceptual components of a SC model, and how those concepts might be operationalized. Operationalized components were then examined relative to nurses' perceptions of SC.

Research Questions

This research addressed three questions:

1. Do patient safety experts agree on the conceptual definitions and variables that represent those definitions as presented in Sammer's Culture of Safety framework (leadership, teamwork, evidence-based practices, communication, learning, just, and patient-centered)?
2. For those variables where there is expert consensus, what types of data commonly available at the hospital unit level can be used to operationalize those variables?
3. What relationships, if any, exist at the individual, unit, or organizational levels between Registered Nurses' rating of safety climate and identified elements of a safety climate (leadership, teamwork, evidence-based practices, communication, learning, just, and patient-centeredness)?

Significance for Nursing and Healthcare

Gaining expert insight into the concepts within safety culture, as well as operationalizing these concepts by using measures commonly available in hospitals throughout the United States, has potential to take the science of SC one step closer to understanding of this phenomenon. Understanding the contributors to the formation of a SC could inform the potential interventions to improve that safety climate, and therefore the broader culture of safety. Nursing is at the heart of the inpatient healthcare enterprise.

Understanding what signifies signs of a safe climate for registered nurses is poorly understood. This study also had the potential to clarify important relationships between the safety climate for registered nurses and key elements of the nurse's environment and experience. Understanding these relationships can lead to effective interventions that will strengthen the safety climate for patients, registered nurses and for healthcare more broadly.

Organization of the Study

Chapter Two, Review of Literature, consists of four major sections: 1) organizational culture, 2) culture of safety, 3) variables that may impact safety climate, and 4) attitudes of the agent within context and shared perceptions. Review of the organizational culture literature includes the influence of leadership on organizational culture and a discussion of the differences between culture and climate. Review of the culture of safety literature includes the safety movement within healthcare, the measurement of culture of safety, and just culture as a required element of safety culture. Review of variables that may impact the safety climate will include 1) leadership, 2) teamwork, 3) evidence-based practices, 4) communication, 5) learning, 6) justice, and 7) patient-centeredness. Review of attitudes and perceptions literature focuses on what is known of how attitudes and perceptions are formed and accessed by the individual. Additionally, shared perceptions of agents within a social context will be explored in a review of pertinent social cognitive literature. The theoretical framework and model for the study will be presented.

Chapter three, Research Design and Methods, presents both phases of the study design, rationale for the choice of variables and tools, and methods for testing the relationships proposed in the model.

Chapter four, Results of the Modified Delphi Study, presents the sample, instruments, methods and results of the first phase of the research study. The results are then incorporated into a modified SC Model, which was used in the second phase of the study.

Chapter five, Results of the Preliminary Validation Study, presents the sample, methods and results of the second phase of the study.

Last, chapter six, Discussion, Conclusions and Recommendations, presents a discussion of the conclusions that can be drawn from the results of the research study, including additional limitations observed and recommendations for future research.

CHAPTER II

Review of Literature

Chapter Overview

The aim of this dissertation was to examine the relationships between the safety climate and a number of variables that were predicted to influence the formation of perceptions of safety. This review of literature will focus on four major areas: 1) organizational culture, 2) culture of safety, and 3) factors that may influence the safety climate, and 4) attitudes of the agent within context and shared perceptions. This review examines the perspectives of organizational science, nursing science, and health services research literature to inform the choice of factors to be included in the inpatient registered nurse safety climate model.

Review of Organizational Culture

The operational definition of culture, as conceptualized by social scientists, is the set of shared attitudes, values, beliefs, and behaviors of a particular group of people (Schein, 2004). Culture in many ways includes the accumulated shared learnings of a group, including the workable assumptions learned by a group as it dealt with the tasks of external adaptation and internal integration, as well as the behaviors consistently demonstrated by the group. In the case of organizations, these people are the employees and leaders. A number of different schemas for organizational culture can be found in the literature.

One broader view of culture (Hudson, Sexton, Thomas, & Berenholtz, 2009) includes the components of shared mental content (attitudes, values, beliefs, and priorities), norms (behavior patterns, language, traditions, or practices), institutions (roles, committees, and programs), and artifacts (physical structures and processes). This view holds that the group's context is critical to defining and describing the organizational culture.

Another model addresses the scope of culture. Schein (2004) describes four characteristics of culture. First, organizational culture is structurally stable; it survives even when members of the group leave. Second, culture resides in the deepest cognitive parts of the group. Culture is deeply embedded and any visible parts are not the essence of what is meant by culture. Third, organizational culture is pervasive, covering all the functioning of the group. Lastly, culture is an integrated whole; culture implies that behaviors, values, rituals and visible artifacts are tied together, serving to provide further stability to the functioning of the organizational group.

Large organizations have subgroups that vary from one another in key elements of culture (Schein, 2004). Culture is a context-specific, local phenomenon (Pronovost & Sexton, 2005; Weick & Sutcliffe, 2001). Different groups within a larger organization are found within differing contexts and therefore develop their own individual cultural elements. Some elements of culture may be common to multiple groups, depending on the size and complexity of the organization.

Social scientists argue that culture and leadership are intimately entwined (Schein, 2004; Taormina, 2008). Cultural norms define how an organization will define leadership (e.g., who gets promoted, who gets attention within the organization). But leaders also create, work within, and manage culture, playing a significant role in shaping the

organizational culture (Schein, 2004; Patterson et al., 2005; Kane-Urrabazo, 2006). Leaders have the power and authority to determine how resources will be distributed, which policies are adopted and which employee behaviors will be rewarded. By setting or changing the rules of an organization, leaders alter the culture of the organization. Behaviors of organizational leaders impact the culture of an organization.

Culture vs. climate. The term climate is sometimes used to describe culture, and is even used interchangeably with culture. Arguably, the literature is convincing in its view that culture and climate are different. Climate is described as a feeling conveyed in a group (Ashkanasy, Wilderom, and Peterson, 2000), the artifact of the deeper culture (Schein, 2004), perceptions of culture (Vogus, Sutcliffe, & Weick, 2002), and an intervening variable between the broader context of an organization and the behavior of its members (Patterson et al., 2005). Schein (2004) cautions against inferring deeper assumptions from cultural artifacts alone. It should be noted that safety culture surveys, as will be discussed later, typically measure safety climate (SC), and yet are often interpreted as accurate representations of the deeper culture. Climate research is attitude research (Guldenmund, 2007). Attitudes will be discussed at length later in this paper. Halligan & Zecevic (2011) note that while surveys are a pragmatic method of collecting data, these tools only provide a superficial picture of the climate and should not be inferred to represent the culture as a whole.

Healthcare Organizational Culture and Patient Outcomes. The literature is quite persuasive in arguing that organizational culture does affect organizational performance, and in the case of healthcare, affects patient outcomes. Organizational culture influences the attitudes of its members toward change (Rashid, Sambasivan, and Rahman, 2003). Attitudes,

once learned and strengthened through experiences and rehearsal, can be difficult to change. In addition to attitudes, culture as measured through climate also is associated with a number of important outcomes on the individual, group, and organizational levels (Patterson et al., 2005). Outcomes include turnover intentions, job satisfaction, individual job performance, organizational performance, customer perceptions of service quality, productivity, and leader behavior.

Recent studies in healthcare have shown that organizational culture, particularly the cultural element related to safety attitudes and behaviors, affects patient readmission rates (Hansen, Williams, & Singer, 2011), medication errors and patient falls (Vogus & Sutcliffe, 2007a, 2007b). However, not all studies have shown organizational safety climate to be associated with or predictive of patient outcomes (Ausserhofer et al., 2012).

Culture of Safety

Safety is one element or facet of an organization's culture. The Joint Commission defines a safety culture as "expressed in the beliefs, attitudes and values of an organization's employee regarding the pursuit of safety" (Blouin & McDonagh, 2011). The Agency for Healthcare Research & Quality's (AHRQ) definition, which comes from the Health and Safety Commission of Great Britain (1993) states, "The safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviors that determine the commitment to, and the style and proficiency of, an organization's health and safety management (p. 1)."

The goal of a culture of safety in healthcare is to lessen harm to patients and providers through a combination of systems effectiveness and individual performances. It is characterized by a continual striving to attain optimum attainable safety and can be seen in

the organization's safety structure, practices, controls, and policies. Safety culture is vulnerable to competing priorities (Vogus, Sutcliffe, & Weick, 2002). Some argue that programs and tools can help improve safety, but it is the organization's human principles that play the dominant role in creating a culture of safety – leadership, communication, teamwork and staff empowerment (Domrose, 2010).

Essential elements of a culture of safety in healthcare, as identified in one national survey, include the establishment of safety as an organizational priority, teamwork, patient involvement, openness/transparency, and accountability (Lamb, Studdert, Bohmer, Berwick, & Brennan, 2003). The study revealed that shared core values and goals, non-punitive responses to adverse events, the promotion of safety through education and training, strong committed leadership, and the engagement and empowerment of all employees characterize a safety culture.

Leaders determine and enable the safety culture in a number of ways. They can promote open communication and the reporting of unsafe conditions through relationship building and consistent behavior. They also determine when and how employees will be empowered to make decisions, utilize resources, etc. Leaders also create the psychological safety necessary to transform culture – through the endorsement of new behaviors, the use of new language and redefining the meaning of previously common, but now undesirable behaviors (Edmondson, 2004). Psychological safety then produces higher levels of engagement of employees in quality and patient safety improvement work (Nembhard & Edmondson, 2006; Tucker, 2007).

Sammer and her colleagues (2010) performed an analysis and synthesis of all the patient safety literature from 1999 through 2007. Their analysis resulted in the generation of

a framework for hospital culture of patient safety intended to be a tool to assist hospital leaders in operationalization of the complex concept of safety climate. Safety culture properties were identified and organized into seven subcultures: 1) leadership, 2) teamwork, 3) evidence-based practices, 4) communication, 5) learning, 6) justice, and 7) patient-centeredness. It was identified that senior leadership was one of the most significant facilitators for establishing a culture of safety, a finding consistent with the more mature organizational culture literature. The leadership subculture included perceptions that leaders recognize the high-risk nature of the healthcare environment and align vision/mission, staff competency and resources throughout the organization to reduce risk. Teamwork includes such elements as mutual respect, psychological safety, collaboration and "watching each other's backs." Evidence-based subculture refers to care practices based on evidence, standardization to reduce variation and striving for high-reliability and zero defects. Communication includes the behaviors of staff perceiving they hold a responsibility to speak openly about concerns and processes needing improvement. Hospitals with a strong Learning subculture learn from mistakes and continually improve. A Just Culture is one where individuals hold themselves accountable for their actions and investigations of care failures include examination of systems as well as the choices of individuals. Last, a Patient-centered culture is focused on the patient and family actively participating in care decisions and plans. Table 2.1 illustrates the seven subcultures of Safety Culture. Sammer's framework is conceptual, and has yet to be operationalized through empiric research.

Table 2.1 Sammer's Subcultures of Safety Culture

1. Leadership
2. Teamwork
3. Evidence-based
4. Communication
5. Learning
6. Just
7. Patient-centered

Sammer, et al. (2010)

Theoretical Framework

This study utilized a modification of Sammer's (2010) model of the seven subcultures of safety culture as the study theoretical framework. Sammer and colleagues identified safety culture as a complex phenomenon. Through analysis and synthesis of 38 healthcare safety culture studies from the years 1999 through 2007, the authors identified properties which were organized into seven subcultures: 1) leadership, 2) teamwork, 3) evidence-based practices, 4) communication, 5) learning, 6) justice, and 7) patient-centeredness. Sammer's study was a needed addition as the healthcare safety climate field has emerged without a strong theoretical framework. Sammer and colleagues presented their analysis as a conceptual model.

Prior to this study, Sammer's model had not been operationalized through empiric research. While other safety culture models are found in the literature, such as the AHRQ model discussed in Chapter 1, Sammer's model of safety subcultures is appealing in its

simplicity and was created based on the elements that researchers thought important and studied over a number of years. The beginning model used in this study is depicted in Figure 2.1. It was expected that the study would likely bring refinement and modification of this model.

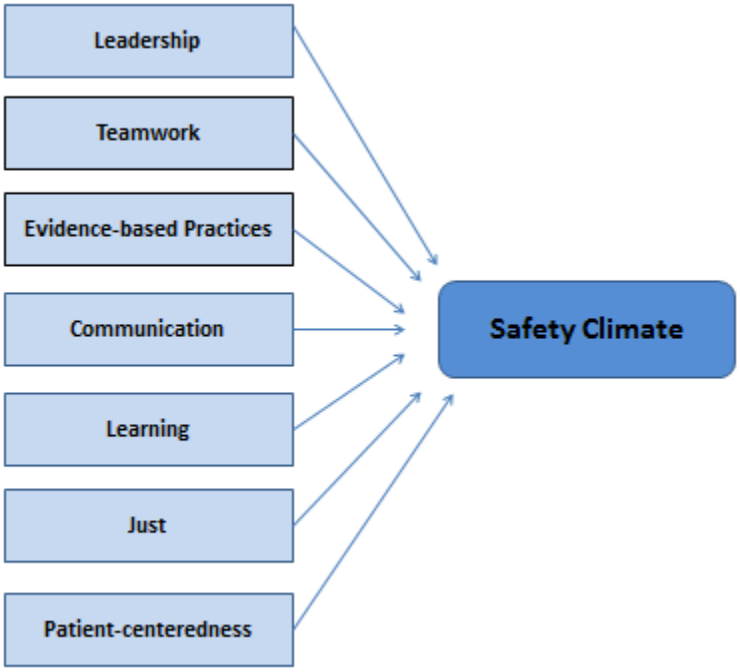


Figure 2.1 Initial Safety Climate Model
(Adapted from Sammer's Subcultures of Safety Culture)

Perceptions of the Safety Climate

A number of tools have been developed in an attempt to measure the culture of safety. Each of these tools measures what is more accurately referred to as the safety climate (SC), defined as the 'surface features of the safety culture from attitudes and perceptions of the individuals at a given point in time, or the measurable components of safety culture (Colla, Bracken, & Kinney, 2005; Halligan & Zecevic, 2011). Validated tools include the AHRQ's Hospital Survey on Patient Safety Culture (Blegen, Gearhart, O'Brien, Sehgal, & Alldredge,

2009), the Safety Attitudes Questionnaire (Sorra et al., 2008), the Patient Safety Culture in Healthcare Organizations Survey (Singer, Meterko, & Baker, 2007), and the Modified Stanford Patient Safety Culture Survey Instrument (Ginsburg, Gilin, & Tregunno, 2009).

Safety Climate and Outcomes. Recent studies show increasingly that a safety climate is associated with a number of desirable outcomes. Studies have found that hospitals that develop a safety climate have fewer adverse events such as medication errors (Katz-Navon, Naveh, and Stern, 2005; Squires, Tourangeau, Laschinger, & Doran, 2010; Vogus and Sutcliffe, 2007a). A climate of safety in healthcare has also been associated with decreased occupational injuries (Gershon, Karkashian, & Grosch, 2000; Hofmann & Mark, 2006). AbuAlRub and colleagues (2012) found that safety climate was associated with teamwork and intent to stay at work. Brown & Wolosin (2013) found that strong SC scores were positively correlated with fewer hospital-acquired pressure ulcers, greater use of fall protocols, high ratings of teamwork within units, hospital management support, and the reporting of fall occurrences. Skill mix, staff turnover, and number of patients per RN (a measure of workload intensity) were also found to have robust correlations with SC in this study.

Safety climate (SC) has been observed to vary in some consistent ways. Being a registered nurse or working in hospital units such as the OR, PACU, ICU. or Emergency Department is associated with lower safety climate scores (Singer et al., 2009). Nurses on smaller, less complex units are more likely to have higher SC scores, reporting greater compliance with reporting concerns and participation in error reduction (Hughes, Chang, & Mark, 2009). Older nurses with greater seniority tend to have high scores of SC (Feng, Bobay, Krejci, & McCormick, 2012; Singer et al., 2009). Trusted leaders (Feng et al., 2012;

Thomas, Sexton, & Neilands, 2005) and use of clinical pathways or protocols (Vogus & Sutcliffe, 2007a) are correlated with higher SC scores.

Just Culture, Patient Safety, and Safety Climate

Much of the work within patient safety over the past two decades has focused on processes and how they impact patient safety. At the same time, there has been a simultaneous reaction to errors in patient care that seeks out an individual to punish for making a patient care mistake (Griffith, 2010). Additionally, when errors are discovered severity bias influences the degree of punishment that observers think is an appropriate response. If the harm that results is minimal, little punishment is required, but if significant harm results, then severe punishment is called for. Counter to this response to errors, the concept of Just Culture, sometimes referred to as interactional justice (Squires et al., 2010), is increasingly being applied to situations where patient safety risk exists and errors have occurred in order to balance both the process and human side of patient safety events.

In an organizational environment where errors are individually punished and severity bias exists, employees are hesitant to identify safety concerns or report errors. Learning and improvement is impeded by this culture of silence, resulting in barriers to safety-promoting decisions and behaviors. Employees may recognize unsafe systems or environmental factors, and may be well aware of the likelihood of simple human error occurring, but because of a fear of punishment, will not voice that knowledge to leaders. The resulting culture is one of silence, with safety issues continuing unchecked.

An organization with a Just Culture promotes a recognition that humans can engage in three types of behavior that can lead to safety mishaps:

1) Human error (an inadvertent action, a lapse or a simple mistake)

2) At-risk behavior (an individual decision that increases a risk to safety), and

3) Reckless behavior (an individual decision to consciously disregard a substantial and unjustifiable risk) (Marx, 2001; Marx, 2007; Pepe & Cataldo, 2011).

In a Just Culture, severity bias is consciously excluded from the decisions made by leaders about consequences to behavioral choices. Human error is acknowledged as an organizational dynamic. Each safety event is evaluated for all the contributing components, including systems, processes and human elements. The culture created by consistent application of this leadership approach results in open communication between employees and leaders and little fear of retribution about reporting existing risks in the organizational environment and processes. For this reason, a just culture was identified by Reason (1997) as one of four essential components of creating a SC. What employees see in their organizational environment, including processes, human impact, and leadership behavior, affects their perceptions of the overall SC.

Variables that may Influence the Safety Climate

Many factors have the potential to influence the formation of SC attitudes in registered nurses. Several will be examined here including: staffing and serious patient adverse events.

Staffing. An increasing number of studies have demonstrated the significant relationship between nurse staffing and patient care outcomes (Aiken, Clarke, & Cheung, 2003; Aiken, Clarke, & Sloane, 2002; Cimiotti, Aiken, Sloane, & Wu, 2012; Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2002). By 2007, the evidence had already mounted to such a degree that AHRQ chose to publish a summary of all the studies

demonstrating the association between nurse education, amount of nursing care, nursing staff mix, fatigue and other factors to various patient care outcomes. Nurses consistently report that staffing affects their perceptions of such factors as overall quality of care they are able to provide, their confidence in patients' self-care ability following discharge from the hospital, patient adverse events and patients' reports of satisfaction (Zhu et al., 2012). ElJardali and colleagues (2011) found that nursing staff perceptions of staffing was a predictor of SC.

Staffing, as measured through direct care nursing hours per patient care day (RNHPPD), have been correlated with the safety behavior of reporting errors. Lower unit RNHPPD were found to correlate with higher numbers of nurses' reported medication errors in one study (Moody, Pesut, & Harrington, 2006). While a culture of safety includes elements of both communication openness and support of error-reporting (AHRQ, 2011), it is unclear from this study if the lower staffing levels drove an increased number of errors and the resulting number of reports, or whether the staffing levels had an impact on the nurses' perceptions of the SC, which in turn impacted the reporting behavior.

Staffing and length of shift, combined with the individual nurse's sleep hygiene behaviors, can also result in fatigue, which has been linked to patient safety. The Joint Commission (2011) recommended that fatigue be examined as a potential factor in all adverse patient events.

One study of the impact of the California Nurse Staffing legislation found that lower patient ratios were associated with lower mortality rates (Aiken et al., 2010). When the workload of the Registered Nurse was in line with the mandated ratios, nurse burnout and job dissatisfaction was lower, and nurses reported perceptions of higher quality of care. Needleman and his colleagues (2002) found that higher RNHPPD were associated with lower

length of stay, lower urinary tract infection rates, lower upper gastrointestinal bleeding, lower pneumonia rates, lower incidences of shock and cardiac arrest, and lower failure to rescue rates. Needleman and colleagues (2011) later found that when actual staffing was within 8 hours of target and patient turnover was not excessive, mortality was reduced.

Staffing may be one way that nurses determine the safety priorities of the leaders of an organization. Zohar (2003) observed that when workers perceived that safety issues were ignored or when getting more work done took precedence over safety issues, they concluded that safety was a low priority to the leaders and the organization. If nurses believe that their staffing plans are inadequate or that the staffing plans are not followed in order to boost productivity, they may conclude that the organization and its leaders do not value safety.

One recent study examined the correlation between SC and various structures related to staffing (Brown & Wolosin, 2013). A number of significant correlations were found between specific questions on the HSOPSC and variables such as RN turnover and workload intensity. Significant regressions across all HSOPSC domains were identified with % RN skill mix (.268), Non-RN skill mix (.225), % Contracted hours (.407), # Patients/RN (.447), # Patients/licensed staff (.356), RN turnover (.326), and % Sitter hours (.256).

Serious adverse patient events. Registered nurses have all seen adverse patient care events and have heard of many others. While adverse patient events may be common in healthcare, they have been shown to leave nurses with feelings of insecurity (DeFreitas et al., 2011). Serious reportable events, defined by the National Quality Forum (2011) as preventable, serious, and unambiguous adverse events that should not occur, include such conditions as Stage 3 and 4 hospital acquired pressure ulcers, falls that result in serious injury or death, wrong site surgeries or objects being left behind following surgery. Each of these

individual events has lasting effects on patients and is witnessed by registered nurses. Repeated witnessing or participation in, adverse patient events could result in a cumulative encoding of these memories and the feelings of insecurity they elicit, impacting the registered nurse's perceptions of safety.

Falls. Falls are a relatively frequent adverse patient care event, that can result in no injury to the patient or devastating injuries that result in death. The frequency of this kind of adverse event could have the potential to desensitize the registered nurse to the risk of a fall, but they could also, like serious reportable events, result in mounting insecurity and lowered perceptions of safety climate. Brown and Wolosin (2013) found significant correlations between specific questions on the HSOPSC with reported fall, and hospital acquired pressure ulcers Stage 2+. Significant regressions across all HSOPSC domains were identified with reported falls (.199).

Formation of attitudes

With SC serving as a measurement of the perceptions and attitudes about the safety in the individual's environment, it is helpful to examine how attitudes are formed and influence behavior. Ultimately, all the work to develop SC is done in service of promoting individual behaviors that protect from harm and create an environment of consistent safety. This section will examine the individual formation of attitudes, and the following section will extend into the effect of social influences on the formation of attitudes and perceptions.

Attitudes, as well as knowledge and skills, promote utilization of safety science (Barnsteiner, 2001). Indeed, the Quality and Safety Education for Nurses (QSEN), developed by experts through funding by the Robert Wood Johnson Foundation, identified

each of the attitudes that nurses would need to adopt in order to be deemed competent for safe practice (Cronenwett et al., 2007).

Attitudes are psychological tendencies, encoded within the brain's memory structure, that are expressed by evaluating a particular entity with some degree of favor or disfavor (Eagly & Chaiken, 1993). The entity that is the focus of the evaluation is referred to as the object of the attitude. Virtually anything can be the attitude object: people, concrete objects, behaviors, and abstract concepts (e.g., safety climate).

Social psychologists have attempted to explain attitudes from a number of different constructs: relationship with measurable behaviors, various models, consciousness vs. unconsciousness, relationship with other psychological constructs and cognitive memory. A brief overview will be presented, followed by a more in-depth discussion of attitude as schema and attitude as evaluation.

Attitudes are relevant to safety climate research because safety-related attitudes influence safety behaviors. Studies of the relationship between attitudes and behavior have accumulated since the 1930s (Eagly & Chaiken, 1993). Early studies indicated a weak relationship between attitudes and seemingly relevant behaviors. Critics of these studies went on to understand the influence of social norms and situational constraints, as well as habits, on the measurement of the attitude-behavior relationship. An individual might hold a strongly negative attitude about an object, but due to social constraints or long-standing habits, might modify the expression of that attitude. Fishbein and Ajzen (1975) developed the *theory of reasoned action*, which held that attitudes actually influence intentions, which in turn is the proximal cause of behavior (Fishbein & Ajzen, 1975). Attitudes are thought to have at least three separate structural elements: the cognitive (beliefs), the affective

(emotions), and behavioral (intentional prior actions) (Fazio, 1995). Much research has been done by trying to operationalize observable responses in these three domains. The recent studies of attitude recognize the complex nature of attitudes, including what aspects of attitude structures are accessed and what aspects might be activated when a person decides how they will behave in a given context and situation.

Another view of attitude is from the perspective of conscious (explicit) vs. unconscious (implicit) processes (Greenward & Banaji, 1995; Nisbett & Wilson, 1977). Survey tools request the subject to access their attitude toward an object. But research over the last two decades has established that attitudes are activated largely outside of conscious attention, and that attitude activation is much more rapid than what can be accomplished on a conscious basis (Bargh, Chaiken, Govender, & Pratto; 1992; Greenwald & Banaji, 1995). Implicit activation of attitude in the memory is unlikely to involve retrieval of large amount of past knowledge, beliefs, emotions and behaviors about an object. Rather, closely related representations are retrieved. If there still isn't enough information on past formed attitudes, direct or related, the subject might form a judgment on the spot (Schwarz, Groves, & Schuman, 1998). It is unlikely that thoughts about safety climate are given much conscious attention outside of safety climate surveys. There also continues to be debate about how much of attitude is retrieved from memory of previous evaluation and how much is based on evaluation of an object on the spot in context, whether conscious or unconscious (Schwartz, 2003; Schwartz, Groves, & Schuman, 1998).

With attitudes encoded in the memory structures, a useful perspective has been to regard attitudes as one type of schema or one element of a complex schema (Eagly & Chaiken, 1993; Markus & Nurius, 1986; Markus & Zajonc, 1985). Over the past several

decades, the schema model has become a prevailing paradigm in social and cognitive psychology (Stein, 1995). Schemas are content-specific organizations of knowledge stored in the long-term memory (Cantor, 1990). These knowledge structures organize and process all the experiences, beliefs, attitudes, knowledge, dreams about the future, and past behaviors about an object. The greater the number of experiences about an object, the more information stored in memory, and the greater the elaboration and density of the schema. When cognitive, affective or behavioral aspects of an attitude are accessed in the memory structure, they will be retrieved from that object's schema or a related schema. The schema model is important to the study of attitudes and has implications for how an individual processes information and how they choose to take action in the face of a given task or challenge. Schemas have been purported to influence all aspects of information processing (Markus & Zajonc, 1985). Some schemas, such as the self-schema, serve as strong internal regulators of behavior (Estabrooks & Courneya, 1997).

Several factors have been associated with strengthening attitudes and their accessibility, and increasing attitudes' effect on behavior. First, the amount of direct experience with an object affects the strength of the attitude. Attitudes that are formed based on first-hand experience are stronger than those based on indirect experience (Fazio, 1995). For example, personal experience with seeing patients harmed are likely to have greater influence on attitude formation than hearing about patient harmed elsewhere in the organization. Second, there is some evidence that when an individual is tasked to rehearse the attitude and verbally express the main points of the attitude with examples (improvisational role playing), the stronger the attitude formed (Hovland, 1953/1966). Lastly, some evaluative structures are likely to be infused with emotional elements. The

stronger these affective nuances of the attitude, the more likely they are to energize and direct behavior (Eagly & Chaiken, 1993). Attitudes without good vs. bad meaning are less likely to elicit an affective response and energize behavior.

Social Cognitive Theory

Perceptions involve not only the individual but the collective perceptions of whatever group the individual holds membership. Within healthcare, individuals are members of one or more teams. Nurses are typically members of units or departments. Physicians are members of practices or teams (e.g., employed hospitalists). When organizations implement changes to improve patient care or protect the safety of patients, they must address both the thinking of the individual but also the thinking of the collective group within the context of the group.

Implementation science has increasingly been addressing this influence of the collective and the context on the individual. Safety culture efforts are ultimately about influencing the actions of the individual. Bandura (2001) addressed the role of the individual agent. The agent engages in actions that are consistent with their intentions and potential. The agent has individual properties that can be considered somewhat independent of the context – knowledge, attitudes and belief systems, self-regulation and the ability to adapt to change, and self-renewal. Weiner (2009) also point out that the individual functions within a collective social construct. Actions can be taken by more than one agent who shares a common goal. Perceptions can be shared and reinforced, with actions coordinated in a cooperative environment. Weiner and colleagues (2011) described the importance of shared summary perceptions to successful implementation. A strong implementation climate

depends on the extent to which individuals share perceptions that their innovative actions are rewarded, supported and expected in the organization.

May and Finch (2009) describe in Normalization Process Theory a notion of both individual and group agency in the mobilization of resources and social mechanisms to enact the work of implementation, all occurring within an environmental and social context. Agents have to have the intentions and commitments to implement the change, referred to by the authors as potential, and the capacity to engage in cooperative and coordinated joint agency. This capacity issue likely correlates with the concept of adequate staffing level, discussed earlier.

Summary

In summary, safety culture is a complex phenomenon that is still poorly understood. Safety climate (SC) is the aspect of safety culture that can be measured. There are few empirical studies that examine the factors that affect the registered nurse's perceptions of SC. Prior to this study, no studies had attempted to operationalize and test Sammer's (2010) conceptual model of seven safety subcultures. SC measures attitudes and perceptions. Perceptions are formed through experience, knowledge and evaluative judgments accumulating within the individual's memory. Factors exist in the environment of the nurse that stimulates conscious or unconscious evaluation of the safety of that environment. Those factors may include any of the subcultures identified in Sammer's conceptual model, along with other factors such as observing the human resources allocated by the organization to ensure safety or seeing patients experience harm.

CHAPTER III

Research Design and Methods

Chapter Overview

This chapter presents the research design and methods that were used to examine the conceptual components of Safety Climate (SC), operationalize those components, and examine relationships between inpatient registered nurses' perceptions of the SC and seven elements of the study's SC Model, a modification of Sammer's Safety Subcultures Model (2010). Specifically, it will provide information about the sample and data collection procedures, the psychometric properties of the variables, and the analytic strategies that were be used in this study.

Design

The study was conducted in two stages. The first stage used a modified Delphi technique to affirm and operationalize the study's model. Using data commonly collected by acute care hospitals in the United States, each of the model's elements were operationalized. The second stage of the study involved a retrospective, descriptive, cross-sectional, correlational design (Brink & Wood, 1998) to examine the variables identified in the first stage of this study and their relationship with the dependent variable, nurses' perceptions of safety climate.

Stage One – modified Delphi study

Sample and Setting

A modified Delphi design was selected because it maintains subject anonymity and also minimizes bias or coercion that can be experienced through the dominance of individual members or group dynamics (Linstone & Turoff, 2002: Lee, Johnson, Newhouse, & Warren, 2013). The Delphi method was first used in the early 1950's in the defense industry to gain consensus of opinion by a group of experts (Linstone & Turoff, 2002). Following these earlier examples of modified Delphi studies, eighty SC experts were invited to participate in the modified Delphi study to identify which data collected by acute care hospitals in the United States best represents the seven subcultures of the SC model, based on Sammer's analysis (2010). Experts were selected from one or more of the following groups: 1) published first authors (years 2004–2013), and speakers (years 2009–2013) on the topic of healthcare SC, 2) members of teams, including AHRQ and the Institute of Medicine, involved in the patient safety movement and identified from each organization's website, and 3) nursing leaders from the American Organization of Nurse Executives roster, as these leaders have competency in both SC and data available within acute care hospitals. Exclusions included any individuals with a former or current dependent or reporting relationship with the researcher, and those individuals where contact information cannot be obtained. To reduce the risk of bias, participants were drawn from multiple disciplines, including nursing, medicine, and pharmacy, and reside in multiple countries. During each of the two rounds, participants completed an electronic tool, logging their opinions of the fit of various common hospital-collected measures to the seven SC subcultures. Additionally, they were asked to indicate the importance of each of the seven concepts, and identify if any

additional measures should be included as a measure of SC, but not a fit with and of the seven SC subcultures of Sammer's model.

Methods/Procedures for Data Collection

The experts were sent an electronic invitation with a hyper-link to a website hosting the first round of the Delphi study. First round: participants were presented with the study model description, objectives of the study, how much input would be expected of them, and how their contributions would be used. Voluntary participation implied consent.

Section One: Participants were asked to consider each of the seven subcultures or concepts along with Sammer's (2010) definition, and indicate on a scale of 1 = not important to 5 = very important (Linstone & Turoff, 2002), their importance for inclusion as a concept within safety climate (Appendix C). Section Two: For each of the subcultures or concepts, including Sammer's definition of the concept, the participants were offered a choice of two data elements commonly collected within acute care hospitals in the US. Participants were asked which of the data elements best operationalizes the SC concept, or whether neither option operationalizes the concept (Appendix D). Section Three: The experts were asked if there was any data element that should be included as a potential factor affecting or representative of SC, even if it did not fit well with any of the seven subcultural concepts.

Section One: Concepts rated as important (4) or very important (5) (a mean of greater than 3.5 to capture the affirmative responses of important or very important) were included in Stage 2 of the study. Section Two: The highest percent response for each concept, in terms of the best data element (option 1, option 2, or neither) was included in Stage 2 of the study. Several of the data elements (for leadership, communication, justice, teamwork, teamwork) were selected as individual questions from the AHRQ HSOPSC. HSOPSC uses several

individual questions, structured within domains. Domains were not selected as options because no other alternative data element could be identified in order to provide a second option to the participants.

In order to be selected, the data element had to receive at least 50% positive responses. If neither data element was selected by receiving the highest percent response for the item, the concept was not included in Stage 2. If the data elements were selected equally by respondents, both data elements were explored in the second round of the Delphi study. Any additional measures noted by the participants were included in the second round. Second round: Participants were informed of the results of the first round survey. Participants were then asked to rate the importance of the data elements added in the first round with the same scale used in Round One, with 1 = not important and 5 = very important. Most commonly, three rounds are sufficient to achieve stability in the responses (Linstone & Turoff, 2002). In this study, two rounds were sufficient to answer research questions 1 and 2.

The tool could not be divided, as is sometime done in the modified Delphi technique (Custer, Scarcella, & Steward, 1999), because of the need for the participants to indicate any missing measures. It was hoped that at least one data element would be identified as reasonably representing each of the seven SC subcultural elements. That was not the case, as will be explained in Chapter Four. Additional data elements were identified by the experts as representing SC and rated as being important, but not a fit with any of the seven subcultural elements. These data sets were included in the second stage of this study.

Stage Two – Preliminary Validation Study

Sample and Setting

Based on the results of the modified Delphi study, a secondary analysis was performed using available data from a convenience sample of 24 community hospitals and 105 step-down, telemetry and medical/surgical patient care units from 9 states (Michigan, Ohio, Indiana, Iowa, Idaho, California, Maryland, Oregon, and Illinois). Each of these hospitals was affiliated with a single hospital system and worked with NDNQI, reporting data on a quarterly basis for most inpatient units. Additionally, these units conducted AHRQ's Hospital Survey on Patient Safety Culture on an annual basis.

Data on serious reportable events were reported within several days of each event and collected by the individual hospital at the organizational level. Nurse staffing data were collected monthly and reported on a quarterly basis. HCAHPS survey data were collected continually from patients who have received care on an inpatient basis, and were available from the organization's vendor, Press-Ganey. Data on falls with injury were collected monthly and reported quarterly. While four quarters of falls with injury data were available, only the most recent single quarter was used for the study. For the majority of the units, the first quarter of 2012 data were available. For units with missing data for the first quarter 2012, the fourth quarter of 2011 was used.

For purposes of this study, data from pediatric and obstetrical units were excluded due to the infrequency of patient falls and pressure ulcers. Data from intensive care units were excluded due to the lack of variation in staffing, the infrequency of falls and the lack of HCAHPS data for ICU patients. HCAHPS data were collected based on the unit from which the patient was discharged, which is rarely the ICU. Data on all variables were measured at

the unit and hospital levels, or unit level alone and corresponded with the closest data available to May 2012, the time period of the safety climate data. For the variable of serious reportable patient injury or death, hospital level data from the 12 months of 2011 were used. Each analysis was conducted using the largest data set available.

Measures

Dependent Variable

There was one dependent variable in the study, the overall perception of SC as reported by registered nurses from inpatient units and measured as Overall Perceptions of Safety (OPS). Attitudes involve judgment, are not directly observable, and must be inferred from overt responses, often in the form of a survey (Himmelfarb, 1993). These self-reports are highly context specific (Schwarz, 2003) requiring that nurses' perception of SC be measured at the unit or sub-culture level. Subjective data about the registered nurses' perceptions of their unit's SC were obtained using the AHRQ scale: Hospital Survey on Patient Safety Culture (available in Appendix A). This scale has 12 sub-dimensions of safety culture and two single-item measure of outcomes. The measure for analysis was the Overall Perception of Safety. This item is comprised of the results of four questions in the survey: 1) It is just by chance that more serious mistakes don't happen around here (reverse coded), 2) Patient safety is never sacrificed to get more work done, 3) We have patient safety problems in this unit (reverse coded), and 4) Our procedures and systems are good at preventing errors from happening. Measurement were at the unit level. Thus after back scoring the negative statements, the dependent variable was measured on a scale from 4 (least favorable) to 20 (most favorable) by adding the scores from the 4 responses.

AHRQ's HSOPSC was selected because it is so widely used by acute care hospitals in the United States. The 2012 AHRQ database contains data from 1,128 hospitals (AHRQ). The survey contains questions and domains that measure overall perceptions of safety as well as 4 of the 7 subcultures in Sammer's model (leadership, teamwork, communication, and justice.

Instrument

Hospital Survey on Patient Safety Culture

The dependent variable, perception of the patient safety climate, was measured using the Hospital Survey on Patient Safety Culture (HSOPSC), developed by AHRQ and made available to hospitals in the United Stated in 2008. This tool has been used repeatedly and psychometric analyses have been reported (Blegen, Gearhart, O'Brien, Sehgal, & Alldredge, 2009). This self-report tool is well suited for direct clinical care providers such as nurses, nursing assistants and physicians, as well as non-direct care providers and support personnel, including managers and administrators. This tool was developed for public use and is available free of charge to any hospital interested in evaluating its safety culture. The current database is very large, with the 2011 report consisting of data from 472,397 hospital staff in 1,032 hospitals; 512 of the participating hospitals have submitted data more than once (AHRQ, 2011). The tool is composed of 42 items, with subscales to measure 12 dimensions of safety culture, and an additional two single-item measures of outcomes.

Psychometrics. The survey was tested with 802 hospital caregivers in three hospitals (Blegen et al., 2009). These caregivers included (in order of group size) registered nurses, residents, pharmacists, and attending physicians. Other respondents included other nursing care providers, therapists, administrators and managers. The hospitals included an academic

teaching hospital, a managed care organization hospital and a private community hospital. The surveys were gathered both before and after an educational and patient engagement intervention. Response rate for the pre-intervention survey was 96 percent and the post-intervention, 81 percent.

Responses from all responses prior to the intervention were used in an exploratory factor analysis. Principal components extraction with Equamax rotation produced results close to the dimensions identified by the developers. In a factor analysis including all 42 items, five of the 12 dimensions were reproduced – teamwork within units, hospital management support for safety, frequency of error reporting, handoffs and transitions, and non-punitive response to error. Items from the other seven dimensions were intermingled with numerous double loadings. The staffing subscale was removed and factor analysis repeated to find 11 dimensions. Eight of the 11 dimensions were reproduced, with the remaining three linked to their dimensions, but demonstrating secondary loadings. In general, the factors identified through factor analysis reflect the dimensions proposed in the HSOPSC when the staffing items were removed and the number of dimensions was reduced to 11. The authors identify that the discrepancies may reflect either the uniqueness of their sample (multiple disciplines represented) or some instability in the factor structure. Overall, they identified that the underlying factor structure is moderately stable.

Blegen and her team calculated the inter-item consistency (Cronbach α) coefficient for each dimension in order to determine the reliability of the tool. Calculations were done including all 802 responses, and were repeated for the sample of nurses and the sample of physicians to compare the reliability across the two disciplines. All of the coefficients were lower than those reported by AHRQ (ranging between 0.40 and 0.83), with only half

reaching the minimum recommended Cronbach α of 0.7. The dimension with the lowest reliability coefficients was staffing (0.4 to 0.6). Two other dimensions had relatively low reliability: communication openness (0.58 to 0.64) and overall perceptions of safety (0.53 to 0.61).

The purpose of measuring safety culture is to describe a group level phenomenon. The authors calculated ICCs to determine whether the scores on the tool reflected a unit level pattern. The ICC1, the group variability or reliability of individual ratings ranged between 0.00 and 0.07 (usual range is between 0.05 and 0.3) pre-intervention and between 0.01 and 0.15 post-intervention. The ICC2, the mean interrater reliability or similarity among respondents in each group ranged between -0.06 and 0.91 (values close to 1.0 are desirable) pre-intervention and between 0.69 and 0.96 post-intervention. The ICCs of -0.06 was associated with the dimension of organizational learning, indicating that respondents did not agree among themselves. However, post-intervention respondents were in strong agreement about organizational learning, demonstrating the ability of the tool to capture group level culture. The authors also surmise that the increase in agreement among group members across time indicates that group members may have learned from one another and increasingly shared a common perspective after participation in interdisciplinary interventions.

To examine the ability of the safety culture dimensions to predict outcomes, the authors analyzed bivariate correlations among the tool subscales and the outcomes. Outcomes included the frequency of event reporting, overall perceptions of safety, and a single item that asks the respondents to give the organization a safety grade between an A (excellent safety) and E (failure). The grades were given numerical values and analyzed as

interval data. All correlations were positive and statistically significant at $p<0.01$, and for both time periods. Error feedback and communication was most highly correlated with frequency of event reporting (0.562 and 0.536). Supervisor/manager expectations and actions promoting patient safety were most highly correlated with overall perceptions of safety (0.475 and 0.427) and safety grade (0.458 and 0.491). Hospital handoffs and transitions were highly correlated only post-intervention with overall perceptions of safety (0.416) and safety grade (0.436). Other subscales highly correlated with safety grade only after intervention included teamwork within units (0.456), organizational learning (0.418), hospital management support for safety (0.523), communication openness (0.503), and teamwork across units (0.531). Staffing highly correlated with overall perceptions of safety only after the intervention (0.408).

Lastly, the authors examined the sensitivity of the HSOPSC tool. Caregivers in the study rated the safety culture dimensions higher after the study interventions. The scores varied by site and were significantly different between the disciplines. Registered nurses perceived a stronger safety culture than physicians or pharmacists. The authors concluded that the tool is adequately sensitive and able to detect change over time, between disciplines and between different organizational sites.

Tool Administration. The HSOPSC tool includes 42 items with 12 dimensions and two outcome measures. The entire tool can be found in Appendix A. The survey takes 10-15 minutes to complete, is completed in its entirety and is administered in a web based format.

Scoring. The instrument is scored on a 5-point Likert scale with scores ranging from 1.0 to 5.0 (1 = strongly disagree and 5 = strongly agree, with 3 = neutral). The items of the survey are positively and negatively scored. The seventeen negatively scored items are

reverse coded so across all of the items a higher score means a more positive response concerning patient safety. It is common to examine the percentage of positive scores (score of 4 and 5).

Independent Variables

The independent variables were selected as potential measures representative of Sammer's (2010) seven subcultures of the broader safety climate, as well as selected demographic measures (Table 3.1) at the hospital, unit and individual levels. The actual independent variables that were used in the second stage of the study were selected based on the results of the first stage of the study. It was hoped that at least one independent variable would be identified for each of the seven subcultures in the model. Any additional variables identified by the experts as measures of SC, but not measures of any of the seven subcultures, were included in the second stage of the study.

Table 3.1 Study Demographic Covariates

Variable	Variable Type
1. Hospital – total licensed beds	Continuous
2. Hospital – All payor Case Mix Index	Continuous
3. Hospital – Magnet, Magnet-like, or non-Magnet	Categorical
4. Hospital – rural, urban, or suburban	Categorical
5. Unit – medical, surgical, medical/surgical, or step-down	Categorical
6. Unit – number of licensed beds	Continuous

Leadership Support of Safety. Organizational culture identifies what is valued, what are enduring beliefs and assumptions, and how work gets done within an organization. Leaders and leadership behavior play a significant role in the shaping of organizational culture. Leaders also control the allocation of resources within the organization. Measures of organizational culture and perception of resource allocation can be representative of perception of leadership.

Teamwork. Acute care hospitals are treating patients with increasingly complex disease processes. Treatment modalities and complex technologies require increasing levels of teamwork and collaboration among members of a diverse healthcare team (NQF, 2006).

Evidence-based. Defects in care include many conditions that develop in the acute care setting, such as falls, pressure ulcers and infections. Some of the most significant defects in care are Serious Reportable events, all of which result in patient harm or death. Staff throughout acute care hospitals are aware of serious incidences of patients being harmed. In many hospitals in the sample formal communications are circulated among the

hospital staff to share learnings from analysis of adverse patient care events. Adverse events are discussed in improvement forums, such as hospitals safety huddles, making these events common knowledge within the staff throughout the hospital.

Communication. Communication is a critical part of a SC. Clarity in structured communications includes "read backs", "shift hand-offs", "time-outs" and communication between clinical staff and formal leadership about potential safety issues.

Learning. A climate of learning is evident in a hospital that openly examines defects in care and other safety issues and seeks to learn and continually improve processes of care. Healthcare organizations that are learning and continually improving should produce improving outcomes of patient care.

Justice. A just climate is one that examines errors for both the individual accountability and the system failure. It is a non-punitive climate and includes an open, blame-free atmosphere for reporting errors and open communication about safety risks.

Patient-centered. A patient-centered climate is one that recognizes that the healthcare organization exists only to serve and meet the needs of patients and families. The patient experience is designed to promote healing. Patient input into the planning of care and decision-making is valued and sought.

Hospital demographics. Six additional variables were captured at the hospital and unit levels, and included in the models to control for potential confounding (see Table 3.1). These included the Hospital – total licensed beds, Hospital – all payor Case Mix Index, Hospital – Magnet, Magnet-like, or non-Magnet, Hospital – rural, urban, or suburban, Unit – medical, surgical, medical/surgical, or step-down, and Unit – number of licensed beds. These served as measures of the complexity of the context within which the nurses work and

make their judgments about SC. Independent variables and covariates were analyzed for the 12 months prior to May 2012, the timeframe of the HSOPSC survey, at the unit level.

The acute care hospital environment contains great complexity. A number of variables could confound the relationship between the independent variables and the dependent variable, RN perceptions of SC. It was important to control for confounding as much as possible. For instance, higher staffing could be associated with the intensity of care required by the patients, which could be a causal factor for the RN perception of SC. So the intensity of care required (i.e., acuity) could confound the association between staffing and RN perception of SC. Case Mix Index, while differing to some degree from intensity of care and acuity, could act as a reasonable substitute control measure. Likewise, working in a Magnet hospital could be associated with individual tenure, which could be a causal factor for the RN perception of SC. Therefore, individual tenure could confound the association between Magnet status and RN perceptions of SC.

Methods/Procedures for Data Collection

A secondary analysis of existing data was conducted to examine the relationships between nurses' perceptions of safety climate and selected organizational culture, work environment, and patient outcome data. A data warehouse was maintained at the system level of a large multi-hospital healthcare system, and data on selected components in this warehouse were extracted for analyses. For the SC dependent variable, inclusion criteria included units with a minimum of 15 RN responses and 50% return rate. It is anticipated that this would yield an adequate number of units for meaningful data analysis. Additional data were obtained from Press-Ganey for the patient-centeredness variable that was selected through the modified Delphi study. All data were maintained with the organization's secured

data system. IRB approval was obtained from both the University of Michigan and the hospital system.

The dependent variable varied on a scale from 4 to 20. The distribution of this variable could have been quite skewed. The fit of the model was tested by examining the residuals to see whether they were approximately normally distributed and exhibited approximately constant variance.

Data Analysis

SAS® 9.4 (SAS Institute Inc., Cary, NC, USA) was used for all analyses. Multivariable analysis was conducted at the unit level with methods to account for the correlation of nurse evaluation within unit and of unit within hospital.

Research Questions 1 and 2. "Do patient safety experts agree on the conceptual definitions and variables that represent those definitions as presented in Sammer's Culture of Safety framework (leadership, teamwork, evidence-based practices, communication, learning, just, and patient-centered)?" and "For those variable where there is expert consensus, what types of data commonly available at the hospital unit level can be used to operationalize those variables?"

After the first round of the Delphi was concluded, analysis began and informed the second round content. Section One: Medians were computed for each concept. Concepts rated as important (4) or very important (5), with a mean greater than 3.5, were included in Stage 2 of the study. Section Two: The highest percent response for each concept, in terms of the best data set (set 1, set 2, or neither) was included in Stage 2 of the study. If neither data set was selected, the concept was not be included in Stage 2. If the data sets were selected equally by respondents, both data sets were explored in the second round of the

Delphi study. Section Three: Any additional measures noted by the participants to be an important fit to SC, but not to any of the 7 subculture concepts, were included in the second round. Following the second round (and potentially third round, if needed) the experts' responses were analyzed for convergence, computing medians and percent agreement as well as interquartile ranges calculated as measures of dispersion (Linstone & Turoff, 2002).

Research Question 3. "What relationships, if any, exist at the individual, unit, or organizational levels between Registered Nurses' rating of safety climate and identified elements of a safety climate (leadership, teamwork, evidence-based practices, communication, learning, just, and patient-centeredness)?"

Univariate, descriptive statistics (means and standard deviations, medians and interquartile ranges, or percentages) were used to describe and summarize all study variables. The mean (average), where numerator X represents each value in the data set, and denominator N represents the total number, provides an informative measure of the central tendency of the variables (Hinton, 2014; Munro, 2005).

The standard deviation (*s*), a measure of variability, describes how values vary from the mean. Based on the theory of the normal curve the *s* assumes there is 95% probability that a given measured value in the data set would fall within 2 standard deviations of the mean of the population (Hinton, 2014, Munro, 2005). A percentage distribution of each variable (safety climate and any of the variables selected by the Delphi study) were prepared, allowing for comparison among the study units.

The median is the value of the variable at the 50th percentile of the distribution, with equal number of higher and lower values. The interquartile range is the range of values

between the 25th and 75th percentile. This is a more appropriate measure of central tendency when the variable is not approximately normally distributed.

Significance testing relies on sufficient sample size and significance level determination. In the proposed study the level of probability was set at 0.05 ($p \leq 0.05$) to minimize the risk of committing a Type I error, a claim to have found a significant difference when there is not one (Hinton, 2014). From this, testing for directionality or non-directionality significance and *t* value calculation was performed.

Bivariate preliminary analysis was used to test the relationship between each of the independent variables and the dependent variable, SC. Quantifying relationships between the variables could have been done in several ways. A Pearson correlation coefficient (*r* statistic), a measure of the how one variable changes in relationship to a second variable (Hinton, 2014), was performed to measure how the dependent variable changes in relationship to each of the independent variables. It can be calculated as either a parametric or non-parametric statistic, with ranges between -1 and +1, and the strength of the relationship indicated by the size of the correlation. A simple correlation coefficient however, does not take into account the effect of other variables on the relationship between the two variables of interest. It also may not express the relationship in a way that is meaningful for making decisions. For those actions a more complex statistical model, allowing for random and fixed effects testing, was required.

Multiple regression modeling assumes the responses obtained from testing are independent of one another (Munro, 2005). In the proposed study this assumption was not valid; there was a potential for correlation between responses, for example, when the unit of measurement was made repeatedly with subjects with something in common, such as

registered nurses completing multiple sections on one survey, or working within the same unit work environment with homogenous patient population. Additionally, a preliminary viewing of the dependent variable data indicated that there was significant variation in SC across the care units, eliminating ordinary regression model from consideration in analysis. Possible correlations between independent variables and variation across units with the dependent variable indicated the appropriateness of using a hierarchical structure.

Nested data structures are common in healthcare and the social sciences (Beretvas, 2009). Multilevel modeling allows for the estimation of fixed and random effects where ordinary regression includes only fixed effects. In this study, there was a desire to understand the relationship between the independent variables and RN's perceptions of SC. These relationships might have varied from one unit to another or one hospital to another in the data set. It was important to understand if some characteristics of the unit, such as measures of workload intensity, lessened or overcame the relationship between the independent variables and the dependent variable. In order to be able to understand the best place to intervene and improve perceptions of SC, we wanted to understand not only which variable were most predictive of the outcomes, but also at which level we could gain the most potent understanding of the outcomes. In other words, would intervention at the hospital level or unit level have the greatest impact on RN's perceptions of SC?

Hierarchical Linear Modeling (HLM) is the method that was used to determine whether any of the variables representing Sammer's domains was an independent predictor of RN level perception of safety culture. HLM goes by a number of other names, depending on the discipline using this model. In sociological research, it is referred to as a multilevel linear model (Goldstein, 1995; Bryk & Raudenbush, 1992). In biometric research, the terms

mixed-effects models and random-effects models are common (Laird & Ware, 1982). Covariance components model is used in statistical literature (Dempster, Rubin, & Tsutakawa, 1981), while random-coefficient regression model is the term used in econometrics literature (Bryk & Raudenbush, 1992; Longford, 1993). Nurses commonly work within multilevel organizational structures, necessitating the need to understand the impact of factors at the individual, unit, and even organizational levels. HLM is a complex form of ordinary least squares (OLS) regression that is often used to analyze variance in the dependent variable when the predictor variables are at different hierarchical levels (Woltman, Feldstain, MacKay, & Rocchi, 2012). This match between the model's characteristics and the natural structuring of data related to nurses has led to increased use of the hierarchical linear models in nursing research (Adewale, Hayduk, Estabrooks, Cummings, Midodzi, & Derksen, 2007).

A two-level HLM was used in this study. Individual nurses' responses were clustered within care units, and the care units were clustered with the different hospitals in which they work. Inclusion of variables in the model was based on what is known from the literature about their possible influences on perception of SC as discussed in the previous sections; and from the results of expert opinion derived during the first phase of this study. All continuous variables were centered at their means to improve the convergence of the model to a solution.

All independent variables were summarized with descriptive statistics as described above. These descriptive statistics were used to examine the data set for outliers. The data were assessed for any unusual variables to determine whether they are within the realm of expected values or could represent a coding error. If a coding error was suspected, the cell was deleted and considered missing.

Bivariate associations were tested using Pearson Correlation Coefficient for age and Spearman Rank Correlation (Munro, 2005) for other continuous variables. The Kruskal Wallace test (Munro, 2005) was used for other categorical variables to assess their association with the outcome.

The researcher tested whether any of the independent variables were associated with the RN perception of SC using a multivariable linear mixed model (SAS PROC MIXED) as justified earlier. Along with the 6 potential confounding variables, seven other independent variables representing the 7 domains of study model were included.

Experts are divided about whether to remove insignificant variables from a model or to interpret the effect of the variables from the full model, taking all other variables into account regardless of their statistical significance (Bryk & Raudenbush, 1992). The main reason to remove variables from the model is the need for parsimony, especially if the model is going to be used for prediction of the outcome in future subjects. In a prediction model, it is often an advantage to collect as few variables as possible, if the predictions are not too different from those obtained from the full model using a lot of variables. In this study, however, the model was being used strictly for estimation so limiting the number of variables in the model was not a concern. There are good clinical reasons to include each of the variables chosen because they may be important causally and may confound the association of the other variables with the outcome. Even if a variable does not show statistical significance at the 0.05 level, it may still be important in modifying the relationships between the other variables and the outcome. There is no downside to keeping all the variables in the model except for overfitting. Removing variables in a stepwise fashion as is often done, may contribute to false positive and false negative associations that have been shown to plague

multivariable models (Wiegland, 2010). Overfitting occurs when there are too many variables being tested for the amount of information available in the data (Harrell, 2010). Overfitting was unlikely in this analysis because the study used at least 1575 data points (105 units x 15nurses/unit).

The model was tested for adherence to the assumptions of linear modeling by inspecting the standardized residuals from the model to look for variation from a normal distribution, using a QQ plot and by plotting the standardized residuals against the fitted values. If the diagnostic plots had shown lack of conformity to the linear assumptions, a transformation of the dependent variable or one or more of the independent variables might have been necessary (Faraway, 2006).

The researcher determined whether the random effect terms, hospital and unit, are significant using the –REML log likelihood test (West, Welch, & Galecki, 2007).

The estimated coefficient for each variable in the model can be interpreted as the amount of change expected in the outcome (RN perception of SC) for every unit change in the independent variable. To understand the relative effect of each independent variable, the researcher looked at the change in model R2 when one variable at a time is removed from the model. This was an indication of the proportion of variability in the outcome explained by that independent variable.

Preliminary Limitations

The use of a convenience sample of secondary data is not random and might not have been representative of the population of registered nurses and units. This may have resulted in selection bias and limit the generalizability of the results of the study. Additionally, this

study limited data analysis to medical, surgical, medical/surgical and step-down units. Results are not be generalizable to other types of units.

This was a cross-sectional study. Data that most closely aligns with the SC survey time frame were analyzed. However, this data may not be representative of the work environment and contextual factors at work in the minds of the registered nurses who provided data on their perceptions of the SC May 2012. Further examination of the model's relationships would be needed to increase confidence in the study's results.

A finite number of data were available for analysis from 2012. However, it was anticipated that the available sample size would be adequate for meaningful analysis

A significant limitation of the study was the likelihood that all confounders were not included. Turnover of senior leaders in the organization or financial downturns with staff reductions are examples that could have profound confounding effects on the RN perceptions of SC. Additionally, the demographic variables selected might not have adequately measured the confounders. An example of this would be measurement of hospital CMI and unit bed size, measures that were intended to measure the intensity of work related to patient care, but might have been inadequate to measure the concept.

This study only tested the Sammer (2010) subcultures that were able to be operationalized through the Delphi procedure in the first stage of the study. This was likely to yield only partial testing of the model, yet provide valuable insights for future expansion and testing of the entire model.

Summary

Safety climate is a complex phenomenon that is poorly understood. This study used experts in SC to explore their agreement on the major conceptual components of SC and to

identify how those components could be operationally defined and measured. The study went on to examine the relationship of the identified measures on registered nurses' perceptions of the organization's safety climate.

This is the first study to examine the relationship between Sammer's (2010) seven subcultures on nurses' perceptions of safety climate. A two-phased study is used to first affirm the elements of SC and operationalize each elements, and second, to examine the relationship between RN perceptions of SC and the operationalized elements of SC. The national emphasis on patient safety and the need for healthcare organizations to create a culture of safety made this study relevant, with the potential to add to the existing body of knowledge for nursing, safety climate and healthcare in general.

CHAPTER IV

Delphi Study Results

Chapter Overview

This chapter presents the results of the first stage of this research study. In this stage a modified Delphi technique was used to gain the input of Safety Climate (SC) experts in identifying the conceptual components of SC and data sets to measure those components. The resulting data sets were used in the second stage of this research study.

The first stage of the study was designed to answer two research questions:

1. Do patient safety experts agree on the conceptual definitions and variables that represent those definitions as presented in Sammer's Culture of Safety framework (2010) (leadership, teamwork, evidence-based practices, communication, learning, just, and patient-centered)?
2. For those variables where there is expert consensus, what types of data commonly available at the hospital unit level can be used to operationalize those variables?

Sample

A modified Delphi method was used to gain the expertise and opinions of Safety Climate (SC) experts. Participants were drawn from multiple disciplines, including nursing, medicine, and pharmacy, and lived in multiple countries, to reduce the risk of bias. Experts were selected from one or more of the following groups: (1) published first authors (years

2004–2013), and speakers (years 2009–2013) on the topic of healthcare SC, (2) members of teams, including AHRQ and the Institute of Medicine, involved in the patient safety movement and identified from each organization's website, and (3) nursing leaders form the American Organization of Nurse Executives roster, as these leaders have competency in both SC and data available within acute care hospitals. Exclusions included any individuals with a former or current dependent or reporting relationship with the researcher, and those individuals where contact information could not be obtained. Eighty eligible experts were identified (Table 4.1) with 9 (11.3%) from countries outside of the United States.

Table 4.1 Study invitees

Study Participants	Expert Invited	Valid Emails	Distribution Valid Invites	Responses Participants Round 1/2	% Response Round 1/2
Nurses	50	48	72.7	28/22	58.3/45.8
Physicians	6	4	6.1	2/2	50.0/50.0
Pharmacists	3	3	4.5	3/3	100.0/100.0
Other	21	11	16.7	5/4	45.5/36.3
Total	80	66		38/31	57.6/47.0

Note: $n = 80$

Survey requests were emailed to the 80 identified experts. Fourteen (14) email addresses were found to be inaccurate or no longer active, resulting in 66 experts actually receiving the request to participate in the study.

Instrument

The instrument was developed by the researcher and designed to gain the input of the expert participants in answering the two research questions. In the first section of the first round survey, participants were asked to consider each of the seven subcultures or concepts in the initial study model, which was derived from Sammer's (2010) metanalysis of recent safety culture literature. Participants rates each concept on a 5 point Likert scale with 1 = not important to 5 = very important based on their perceptions of the importance for inclusion as a concept within SC (Appendix C). In the second section of the first round survey, the participants were offered a choice of two data elements commonly collected within acute care hospitals in the US for each of the seven concepts (Appendix D). Participants were asked which of the data elements best operationalized each of the seven concepts. A third option was offered if the participant did not think either of the data elements operationalized the SC concept. Concepts receiving a mean score of 3.5 or greater on the 5-point scale, and having a hospital data element selected by the majority of the participants were retained for the second round survey. Last, the participants in the First Round Survey were asked if any of the 14 data element options should be included as a factor representative of SC, even if it does not fit well with any of the seven subcultural concepts.

A paper version of the instrument was tested by two SC experts known to the researcher, both of whom are registered nurses. Slight modifications of the early version of the instrument were incorporated into the final tool used in the online survey, based on the feedback of these two safety experts.

Methods

During the first round, participants received an email with a hyper-link to a website hosting the Delphi study instrument. On the website, participants were presented with the study description and objectives, a description of the SC model, information regarding how much would be expected of them, and how their contributions would be used. A reminder email was sent one week after the initial request. The first round survey was available for 2 weeks. Participants completed the electronic tool indicating the importance of each of the seven concepts on a 5-point Likert scale, with 5 indicating the highest level of importance. Additionally, participants logged their opinions of the fit of various common hospital-collected measures to the seven SC concepts (Appendix C). Last, they were asked to identify if any additional measures should be include as measures of SC that didn't fit with the seven SC subcultures model.

During the second round, participants again received a repeat of the background explanation of the study as well as the results of the first round. A reminder email was sent one week after the initial second round request, with the survey open for 2 weeks in total. Participants were then asked to rate on a 5-point Likert scale the importance of each of the three data elements that were rated in the first round as good measures of SC, but not a good fit to any of the seven SC concepts. Only concepts receiving a mean score of 3.5 or greater would be retained for the second phase of the study.

Results

In the first round, 80 survey requests were emailed to the identified experts. Fourteen (14) email addresses were inaccurate or no longer active. Thirty-eight (38) surveys were completed for a 57.6% return rate. No information is available on the group that responded

and the group that did not respond to determine differences. Six respondents also sent an email to the investigator offering comments and encouragement. These emails affirmed that study participants were international.

The experts first rated the importance of each of the seven concepts in the SC model. Only concepts receiving a mean score of greater than 3.5 ("4-important" or "5-very important") would be retained in the model. Each concept was rated by the experts as important to SC, with mean scores of 4.5 or greater (Table 4.2). Evidence based practice (EBP) and Patient Centered had the lowest mean scores and the greatest variation in responses based on standard deviations of 0.669 and 0.726, respectively.

Table 4.2 Round One Importance of Safety Climate Concepts

Concept	N	Min	Max	Mean	SD
Leadership	38	3	5	4.89	0.388
Teamwork	38	3	5	4.89	0.388
EBP	38	3	5	4.66	0.669
Communication	38	4	5	4.95	0.226
Learning	38	4	5	4.82	0.393
Just	38	4	5	4.89	0.311
Patient Centered	38	3	5	4.50	0.726

The experts were then asked to consider each of the seven concepts in the SC model and select one of two data sets commonly collected by acute care hospitals in the United

States as a best fit for measuring that concept. If neither data element was a good fit in the opinion of the expert, the participant could select "Neither." For a data element to be considered a fit for the concept a majority, the data element needed to receive at least a 50% positive response. Four of the concepts were rated with one of the data element selections receiving at least 50% positive responses. Three of the concepts were eliminated because neither data element option received 50% or more positive responses (Table 4.3).

Table 4.3 Round One Selection of Common Acute Care Hospital Data Sets for Each Safety Climate Concept

Concept	% Selecting Data Set 1	% Selecting Data Set 2	% Selecting Neither Data Set
Leadership	67.6	5.4	27.0
Teamwork	29.7	29.7	40.5
EBP	8.1	18.9	73.0
Communication	86.5	2.7	10.8
Learning	21.6	8.1	70.3
Just	51.4	8.1	40.5
Patient Centered	54.1	16.2	29.7

Note: *n* =38

The experts were then asked to review all 14 data element options and indicate if any of the data elements were important to SC, but not a best fit to one of the 7 concepts. 84.4% of the participants responded "yes." Participants were next asked to select the data sets important to SC, with three data elements receiving a positive response of greater than 50% (Table 4.4).

Table 4.4 Round One Data Sets Important to Safety Climate but not Individual Concepts

Data Set	Response %	Response Ct.
AHRQ F8: The actions of hospital management show that patient safety is a top priority	17.2	5
RN Staffing: Total productive RN Hours/patient days	58.6	17
AHRQ A1: People support one another in this unit	24.1	7
AHRQ A3: When a lot of work needs to be done quickly, we work together as a team to get the work done	24.1	7
Falls with injury: # of patient falls with injury in a given time period/1000 patient days	51.7	15
SRe resulting in permanent injury or death over one year's time	55.2	16
AHRQ C2: Staff will freely speak up is they see something that may negatively affect patient care	13.8	4
AHRQ C5: In this unit, we discuss ways to prevent errors from happening again	34.5	10
Falls with injury improvement: Difference in fall rate between 2 adjacent years	38.3	14
Pressure Ulcer rate improvement: difference in pressure ulcer rate per 1000 patient days between 2 adjacent years	38.3	14
AHRQ A12: When an event is reported, it feels like the person is being written up, not the problem	24.1	7
AHRQ A16: Staff worry that mistakes they make are kept in their personnel file	31.0	9
HCAHPS: During this hospital stay, staff took my preferences and those of my family or caregiver into account in deciding what my healthcare needs would be when I left	13.8	4
HCAHPS: During this hospital stay, did doctors, nurses, or other hospital staff talk with you about whether you would have the help you needed when you left the hospital?	31.0	9
No response	31.0	9

Note: $n = 34$

The result of the first round yielded the selection of four of the seven concepts rated as both important to SC and having a data set that was a good fit to measure that individual concept. Additionally, three data elements were selected as important to measuring SC, but not a fit to any of the seven SC concepts.

In the second round, participants were emailed a second survey request. Of the 66 participants with good email addresses, 31 responded for a 47.0% response rate.

Each of the three data elements received a mean score of greater than 3.5 ("4-important" or "5-very important"), indicating their importance in measuring SC (Table 4.5). Each of the three data elements was retained in the final model used in Stage 2 of the study (Table 4.6).

Table 4.5 Round Two Importance of the Data Sets Not Matching Safety Climate Concepts

Statistic	RNHPPD	Falls with Injury	SRE
N	31	31	31
Mean	4.42	3.97	4.29
Median	5.00	4.00	5.00
Mode	5	5	5
Min	1	2	1
Max	5	5	5
Percentile 25th	4.00	3.00	4.00
Percentile 50th	5.00	4.00	5.00
Percentile 75th	5.00	5.00	5.00

Note: n=31

Discussion

The modified Delphi method was effective in obtaining the opinions of SC experts from diverse professional disciplines and geographic locations. Through the online process, experts retained four of the seven concepts in the initial model, eliminated three concepts (teamwork, evidence-based practices, and learning), and added three data elements commonly collected by acute care hospitals in the United States (Registered Nurse staffing, falls with injury, and serious reportable events) to the final model.

The unsolicited emails from six of the participants provided some insight into the thinking of the participants as they responded to the questions in the instrument. Two of the participants commented that the three concepts included the initial model but eliminated through the Delphi study (teamwork, evidence-based practices, and learning) had some relationship to SC, but were distinct concepts that are not wholly contained within SC. Additionally, it is possible that the selection of different hospital data sets would have provided a better match to these concepts, allowing them to be retained in the model.

In each of the two rounds of the modified Delphi study, the participants were only given 2 weeks to complete the instrument and received only one reminder one week after the initial mailing. It is possible that a longer response period and additional reminders might have increased the response rate for each of the two rounds of the survey.

Implications

The resulting seven variables (Table 4.6) were used in the second stage of the study to determine the relationship between these independent variables and Registered Nurses' ratings of their perceptions of the overall Safety Climate. The final model for use in the second stage of the study was comprised of four of Sammer's concepts (Leadership, Communication, Justice, and Patient-Centeredness), as well as three additional variables (RN staffing, falls and serious reportable events).

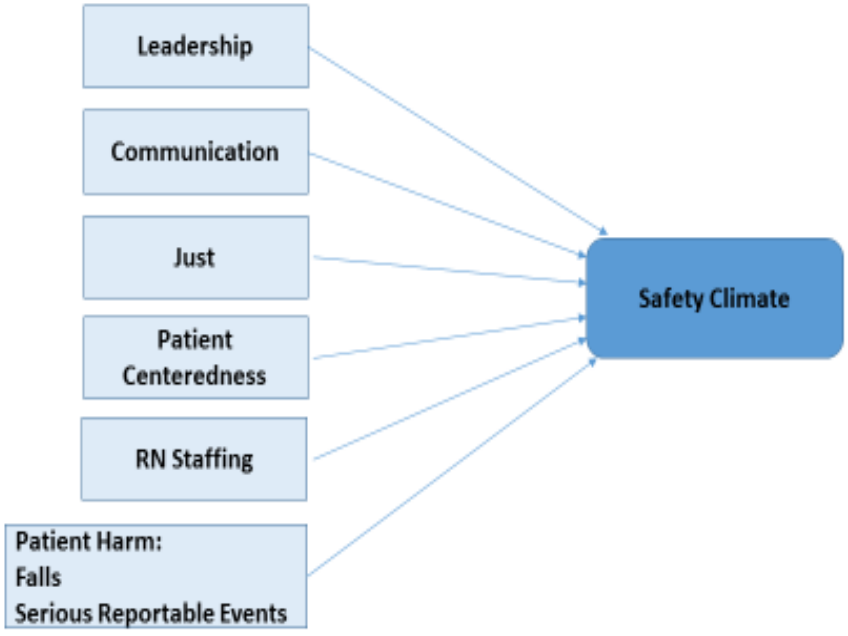
Table 4.6 Modified Delphi study - Final Independent Variables for Stage 2 Study

Fit to Sammer SC Concepts	Variable	Source of Data Set	Timeframe
Leadership	The actions of hospital management show that patient safety is a top priority	AHRQ Hospital Survey on Patient Safety Culture	April 2012
Communication	Staff will freely speak up if they see something that may negatively affect patient care	AHRQ Hospital Survey on Patient Safety Culture	April 2012
Justice	When an event is reported, it feels like the person is being written up, not the problem	AHRQ Hospital Survey on Patient Safety Culture	April 2012
Patient-Centered	During this hospital stay, staff took my preferences and those of my family or caregiver into account in deciding what my healthcare needs would be when I left	HCAHPS	Q1 2012
No	Registered Nurse Hours per Patient Day	NDNQI	Q1 2012
No	Patient Harm: Falls with Injury	NDNQI	Q4 2011/Q1 2012 (most recent)
No	Patient Harm: Serious Reportable Events	Organizational Database	12 months 2011

It is interesting to note that two of the variables added by the experts are two measures of a common concept; falls with injury and serious reportable events are both measures of harm to patients within the healthcare setting. Falls with injury is a unit level

measure, and includes all kind of injuries, mild, moderate, severe and death. Serious reportable events is a hospital level measure, and includes serious injury to patients and death. Serious reportable events include the most severe injuries to patients from falls. There is some overlap in the two variable's datasets (i.e. some unit falls with injury are also serious enough to be included in the hospital SRE data), however the data available does not allow for the identification of how large an overlap in data exists. Pearson Correlation was performed to understand the correlation between these two datasets. The correlation between falls with injury and SREs was r=-0.1351, with no statistical significance found (p=0.1575). Figure 4.1 represents the modified SC Model that will be used for the Preliminary Validation Study.

Figure 4.1 RN Safety Climate Model for Preliminary Validation Study



CHAPTER V

Preliminary Validation Study Results

Chapter Overview

This chapter will present the results of the preliminary validation study, an analysis of the study data that was collected to determine if there is a predictive relationship between the independent variables (leadership, communication, justice, patient-centeredness, Registered Nurse (RN) staffing, falls with injury and serious reportable events) and the dependent variable safety climate (SC). The analysis will include univariate descriptive statistics to summarize all study variables, bivariate analysis to test the relationship between each of the independent variables and the dependent variable, and hierarchical multivariable linear modeling (HLM) to test the predictive relationship between the independent variables and the dependent variable, while accounting for the effect of other variables on the relationship between each of the two variables of interest.

Research Question

Chapter 4 described the results of the modified Delphi study where patient safety experts participated in selection of key elements of Safety Climate (SC) and operationalized each element by selecting a data set commonly collected within acute care hospitals in the United States. The modified Delphi study answered the first two study questions, the results of which, in turn, modified the third study question. This chapter will address the third and last study question: What relationships, if any, exist at the unit or organizational levels

between Registered Nurses' rating of safety climate and identified elements of a safety climate (leadership, communication, justice, and patient-centeredness, RN staffing, falls with injury and serious reportable events)?

Sample and Data Collection

Data Collection Procedure. Data for the preliminary validation study were collected following approval for the research study by the hospital system, approval by the hospital system IRB and approval by the University of Michigan IRB. Data were collected at the hospital and unit levels, and deidentified by coding for each hospital and each unit within each hospital. Retrospective data was collected from five sources within the hospital system's data repository: (1) AHRQ's Hospital Survey on Patient Safety Culture (leadership, communication, justice, overall patient safety), (2) Press-Ganey patient satisfaction (patient-centeredness), (3) National Database on Nursing Quality Indicators (NDNQI) (falls with injury, RN staffing, hospital id, unit id, unit type), (4) risk/quality database (serious reportable events), and (5) revenue statistics warehouse and administrative database (hospital bed count, unit bed count, unit case mix index, Magnet status, hospital location).

Sample. Data were initially collected for 34 hospitals and 1526 units within the hospital system. All units and departments other than medical, surgical, medical/surgical, and step-down nursing units were removed. Any units that did not have Hospital Survey on Patient Safety Culture data for 2012 or had responses from fewer than 50% of the unit's staff were removed. This process yielded 113 units within 24 hospitals for analysis.

Any units that did not have falls with injury data for either 4th quarter 2011 or 1st quarter 2012 were removed. The data for falls with injury was found to have many quarters of missing data. The original plan was to include the four quarters prior to April 2012. However, with many quarters of falls with injury data missing, there was no quarter that included data from all units. It was decided to use one of two quarters, either 4th quarter 2011 or 1st quarter 2012. If both quarters were present in the data set, the most recent 1st quarter 2012 was used in the analysis. This process yielded 94 quarters of data for analysis.

It was discovered that at least 11 units had undergone renovation during the data period. As a result, the units moved to other locations or the units' patients were dispersed to various units. Four of these units' data was able to be matched and were included in the analysis. The other 7 units' data could not be reliably matched and these units were removed from the analysis.

Five units had collected data for the Hospital Survey on Patient Safety Culture (HSOPSC) by splitting the individual unit into two separate data sets, the day shift and the night shift. Both of these data sets were included, adopting the assumption held by the unit leadership that these two shifts were different enough to be considered different units. Data for the other variables was collected for the entire unit, resulting in duplicate matching of unit-wide RN staffing, Patient Centeredness, Falls with Injury, SRE, and the covariates to the shift measures of leadership, communication, justice, and OPS.

As a result of the above procedures to address incomplete data elements, the final merged data set included complete data from 24 hospitals and 105 units.

Methods

All data sets were merged and sorted by hospital identifier and unit identifier. A data dictionary was developed. SAS® 9.4 (SAS Institute Inc., Cary, NC, USA) was used for all analyses.

All data were imported into SAS. The SAS program completed the sort to include only one quarter of falls data, either the 4th quarter 2011 or 1st quarter 2012. Additional unit identifiers were created to retain the five units that had split data collection between their day and night shifts. Descriptive statistics for the variables of interest were performed using SAS PROC MEANS for numerical variables and PROC FREQ for categorical variables. SAS PROC CORR was used to analyze bivariate correlations between variables. Last, SAS PROC MIXED was used to fit hierarchical multivariable linear models to evaluate the independent association of hypothesized predictors and SC.

Results

Univariate Analysis. Hospitals included in the study were situated in urban, suburban and rural locations, with the largest percent (66.7%) from suburban communities (see Table 5.1). The hospitals ranged from 42 beds to 570 beds, with a median of 250.50 beds. Case mix for the hospitals ranged from a low of 1.16 to a high of 2.43, with a median of 1.53.

Of the 24 hospitals, 20.8% were either Magnet (8.3%) or had worked on meeting Magnet standards for a number of years and were within one year of formal application for Magnet designation (12.5%). The remainder of the hospitals (79.2%), were not Magnet or near-Magnet.

One year's count of serious reportable events across each of the hospitals ranged from a low of a single event in one study hospital to 47 in another study hospital. Fifteen SREs was the median for the study hospitals.

One hundred five units were included in the study, ranging from 1 unit to 9 units per participating hospital. The median number of units per hospital was 4.

Table 5.1 Hospital Characteristics

Hospital Characteristic	*N*	Frequency (percent)
Location		
Urban	24	4 (16.67)
Suburban	24	16 (66.67)
Rural	24	4 (16.67)
Magnet		
Yes	24	2 (8.33)
No	24	19 (79.17)
Applying in less than 1 year	24	3 (12.50)
		Median (Min., Max.)
Number of Units	24	4.00 (1–9)
Bed Count	24	250.50 (42–570)
Case Mix	24	1.53 (1.16–2.43)
Serious Reportable Events	24	15.00 (1–47)

Note: n = 24 hospitals

The 105 participating units included nearly an even spread of medical (24.8%), surgical (24.8%), medical/surgical (26.7%), and step-down (23.8%). The units varied in size from 12 to 63 beds, with 30 beds as the median.

The investment of nursing resources to care for patients was measures as Registered Nurse hours per patient day, and ranged from 4.45 to 11.18, with a median of 6.24 RNHPPD. See Table 5.2 for additional detail.

Safety Climate was measured as Overall Perception of Safety (OPS), a measure contained in the Hospital Survey on Patient Safety Culture (HSPSC). Registered Nurses' scores for this measure ranged from 25.0% 4's and 5's (on a scale of 1 to 5) to 84.2% 4's and 5's, with a median of 55.2% 4's and 5's. Leadership, also captured through the HSPSC, ranged from 6.7% to 95.7%, with a median of 65.5%. Communication, also captured through the HSOPSC, ranged from 41.9% to 100.0%, with a median of 70.6%. Justice, also captured through the HSOPSC, ranged from 13.0% to 79.6%, with a median of 45.0%. It is interesting to note that Leadership had the widest range of these four measures.

Patient Centeredness was measured through one of the questions on the HCHAPS survey. Patient scores of this measure ranged from 71.6% to 87.9%, with a median of 78.1%.

Table 5.2 Unit Characteristics

Unit Characteristic	*N*	Frequency (percent)
Type		
Medical	105	26 (24.8)
Surgical	105	26 (24.8)
Medical/Surgical	105	28 (26.7)
Step-down	105	25 (23.8)
		Median (Min., Max.)
Beds	105	30.00 (12.00-63.00)
RN Hours per Patient Day	105	6.24 (4.45-11.18)
Falls/1000 patient days	94	0.69 (0-3.19)
Overall Perception of Safety	105	55.21 (25.00-84.15)
Leadership	105	65.51 (6.67-95.65)
Communication	105	70.58 (41.94-100.00)
Just	105	45.00 (13.04-79.55)
Patient Centered	105	78.10 (71.60-87.90)

Note: $n = 105$

Bivariate Analysis. Unit level data for Leadership ($r = 0.7464$, $p < 0.0001$), Justice ($r = 0.5608$, $p < 0.0001$), and Communication ($r = 0.6179$, $p < 0.0001$) were found to be all highly correlated with the Overall Patient Safety (OPS) dependent variable. Unit level actual

RN staffing showed no statistically significant correlation with the nurses' ratings of OPS (r = -0.0391, p = 0.6932). Unit level patient satisfaction with being involved in the planning of care (HCAHPS) (r = 0.2863, p = .0031) showed a weak but statistically significant correlation with OPS (Table 5.3).

Table 5.3 Phase II Study Correlations

	OPS	Leadership	Communication	Just	Patient-Centered	Staffing	Falls	SRE
OPS	1.000	0.7464 <0.0001***	0.6179 <0.00001***	0.5608 <0.0001***	0.2863 0.0031**	0.0391 0.6932	-0.0251 0.0141*	0.1074 0.2756
Leadership	0.7464 <0.0001***	1.0000	0.4499 <0.00001***	0.3424 0.0002***	0.1444 0.1416	0.0313 0.7525	-0.0946 0.3620	0.1616 0.0995
Comm.	0.6179 <0.0001***	0.4499 <0.0001***	1.0000	0.5669 <0.0001***	0.2757 0.0044**	-0.0018 0.9859	-0.1889 0.0668	0.0292 0.7672
Just	0.5608 <0.0001***	0.3424 0.0002***	0.5669 <0.0001***	1.0000	0.2581 0.0079**	0.0223 0.8221	0.0455 0.6615	0.1089 0.2688
Patient-Centered	0.2863 0.0031**	0.1444 0.1416	0.2757 0.0044**	0.2581 0.0079**	1.0000	0.1672 0.0680	-0.2403 0.0127*	-0.1029 0.2610
Staffing	0.0391 0.6932	0.0313 0.7525	-0.0018 0.9859	0.0223 0.8221	0.1672 0.0680	1.0000	-0.0668 0.4966	-0.2493 0.0060**
Falls	-0.2512 0.0141*	-0.0946 0.3620	-0.1889 0.0668	0.0455 0.6615	-0.2403 0.0127*	-0.0668 0.4966	1.0000	0.2008 0.0381*
SRE	0.1074 0.2756	0.1616 0.0955	0.0293 0.7672	0.1089 0.2688	-0.1029 0.2610	-0.2493 0.0060**	0.2008 0.0381*	1.0000

Level of significance: *0.05, **0.01, ***0.001

Unit level falls with injuries (the second measure of patient harm) showed a negative correlation with OPS (r = -0.2512, p =.0141). This fits with the study model and is to be expected with a higher rate of patient falls with injuries corresponding with a lowered OPS. Conversely, hospital level Serious Reportable Events (the first measure of patient harm) are the worst of patient harm events and showed no statistically significant correlation with the nurses' ratings of OPS (r = 0.1074, p = 0.2756).

The effect of Hospital level CMI (r = -0.0914, p = 0.2636) and hospital beds (r = 0.0168, p = 0.8598), both variables intended to control for complexity of care across the broader organization, were not statistically significant. While the effect of hospital beds was not even near statistical significance, the effect of unit beds (r = -0.177, p =.0715) approached significance.

Hospital level Magnet designation was a variable intended to serve as a surrogate for a strong work environment and high quality patient outcomes. The effect of Magnet designation was not statistically significant (r = -0.0560, p = 0.5702).

Mixed Effects Modeling – Model Combining all predictors, with the exclusion of Falls with Injury and SRE. Although the safety experts identified seven elements of SC, two of the variables are typically viewed as the outcome of SC rather than potential influences on SC. For this reason, models were run by first excluding falls with injury and SRE, and later adding in all the variables.

The PROC MIXED model was run using five of the seven individual predictors (leadership, communication, justice, patient-centered, and RN staffing) and along with all of the covariates. The model was used to explain the association of variation of units within hospitals for OPS with the variation of units within hospitals for the factor(s) used in the models. Residuals for all variables were approximately normally distributed.

Table 5.3 shows that the associations between nurse ratings for Leadership (coefficient value = 0.3886, $p<0.0001$), Communication (coefficient value = 0.2290, p =0.0027), Justice (coefficient value = 0.2145, p = 0.0010), and Overall Perceptions of Safety (the measure for RN perceptions of safety) were all positive and significant. As each of these variables increase by a unit of one, the OPS score will increase by a unit corresponding to the coefficient value. The effect of the HCAHPS patient rating for patient centered care was not statistically significantly associated with OPS (coefficient value = 0.2030, p = 0.4018). There was no association demonstrated between Nurse staffing and OPS (coefficient value = 0.8683, p = 0.2746). The association of unit type, hospital location, Magnet status, hospital bed count and unit bed count were not statistically significant (Table 5.3). Without the effect of falls with injury and SREs, hospital case mix index demonstrated statistical significance (coefficient value = -15.5370, p = 0.0083). F values are shown in Table 5.4.

The Intraclass Correlation Coefficient (ICC) was 0.2508 (p-value = 0.0524) and approaching statistical significance. The ICC examines how well the units correlate within hospitals once you remove the association that is related to the seven predictor variables. Only Sammer's variables of Justice, Communication, and Leadership, as well as the hospital case mix index type were significant in predicting OPS.

Table 5.4 Solution for Mixed Effects with all Variables except Falls with Injury and SRE

Effect	Estimate	SE	df	t-value	Pr>[t]
Intercept	5.8887	22.0356	17	0.27	0.7925
RN Staffing	0.8683	0.7887	71	1.10	0.2746
Patient Centeredness	0.2030	0.2406	71	0.84	0.4018
Justice	0.2145	0.06223	71	3.45	
0.0010***					
Communication	0.2290	0.07375	71	3.11	0.0027**
Leadership	0.3886	0.06136	71	6.33	<.0001***
Hospital Case Mix Index	-15.5370	5.7213	71	-2.72	0.0083**
Unit type – Medical	0.9381	2.0655	71	0.45	0.6511
Unit type – Surgical	7.3558	2.1804	71	3.37	0.0012**
Unit type – Step-down	1.5510	2.2764	71	0.68	0.4979
Unit type – Medical/Surgical (baseline)	0	-	-	-	-
Hospital location – rural	-7.4323	5.0263	71	-1.48	0.1437
Hospital location – suburban	0.3675	3.1011	71	0.12	0.9060
Hospital location – urban (baseline)	0	-	-	-	-
Magnet	0.4159	4.1387	71	0.10	0.9202
Magnet-like	-0.5047	4.5902	71	-0.11	0.9128
Non-Magnet (baseline)	0	-	-	-	-
Hospital bed count	-0.0011	0.0097	71	-0.12	0.9083
Unit bed count	-0.0630	0.0951	71	-0.66	0.5099

Level of significance: *0.05, **0.01, ***0.001

Table 5.5 Mixed Effects Model with all Variables except Falls with Injury and SRE

Effect	Numerator df	Denominator df	F Value	Pr > F
RN staffing	1	72	1.65	0.2035
Patient-centered	1	72	0.83	0.3643
Justice	1	72	12.25	0.0008***
Communication	1	72	10.30	0.0020**
Leadership	1	72	43.67	<0.0001***
Hospital CMI	1	72	7.59	0.0074**
Unit Type	3	72	4.60	0.0053**
Hospital Location	2	72	1.31	0.2753
Magnet Status	2	72	0.03	0.9732

Level of significance: *0.05, **0.01, ***0.001

Mixed Effects Modeling - Model Combining all Predictors and Covariates. The PROC MIXED model was run using all seven individual predictors included in the SC model modified through the Stage I Delphi study along with all six covariates. The model was used to explain the association of variation of units within hospitals for OPS with the variation of units within hospitals for the factor(s) used in the models. Residuals for all variables were approximately normally distributed.

Table 5.5 shows that the associations between nurse ratings for Justice (coefficient value = 0.2128, $p = 0.0015$), Communication (coefficient value = 0.2217, $p = 0.0039$), Leadership (coefficient value = 0.3816, $p < 0.0001$), and OPS were all positive and significant. The association of Falls with Injury rates and OPS (coefficient value = -1.4649, $p = 0.1156$), as well as SREs and OPS (coefficient value = 0.0291, $p = 0.7251$), were not statistically significant. The effect of the HCAHPS patient rating for patient centered care was not statistically significantly associated with OPS (coefficient value = 0.3385, $p =$

0.1659). There was no association demonstrated between Nurse staffing and OPS (coefficient value = 0.4743, p = 0.5601). The association of unit type was statistically significant, with statistically significant differences between the OPS means on the various unit types (See Table 5.5). This indicates that there was significant difference in the OPS scores between the different types of units, even within the same hospital. Surgical units had the highest values of OPS as a group, and were the reference group (i.e., other units types are compared to them). Medical units had a reduction from that reference of 4.5439 (p = .0361), medical/surgical units a reduction from the reference of 5.3393 (p = .0221), and step-down units a reduction from the reference of 5.5220 (p = .0140) (this is for the mean OPS, which was measured on a 0 to100 scale with a mean of X and a SD of Y).

There was no statistically significant association of hospital case mix index (coefficient value = -5.8956, p = 0.3955) or Magnet designation (coefficient value = -1.7520, p = 6408) and OPS. The effect of hospital location on OPS was not statistically significant (see Tables 5.5 and 5.6). Last, neither hospital bed count nor unit bed count were significant associated with OPS (coefficient value = -0.0187, p = 0.2346; coefficient value=-0.0250, p = 0.7941, respectively).

The Intraclass Correlation Coefficient (ICC) was 0.2244 (p-value = .1199) and not statistically significant. The ICC examines how well the units correlate within hospitals once you remove the association that is related to the seven predictor variables. Only Sammer's variables of Justice, Communication, and Leadership, as well as the unit type were significant in predicting OPS.

The partial mixed effects model containing all variables with the exception of Falls with Injury and SREs demonstrated an r^2 for hospital level variance of 63.97%, with the

model explaining a majority of the hospital level variance. The r^2 for unit level variance was 70.87%, with the model explaining almost ¾ of the patient care unit level variance.

The full mixed effects model containing all variables demonstrated an r^2 for hospital level variance of 69.68% and an r^2 for unit level variance of 74.12%. The full mixed effects model was able to explain a larger percentage of the variance at both the hospital and patient care unit level than the partial mixed effects model (Table 5.8).

Table 5.6 Solution for Mixed Effects with all Variables

Effect	Estimate	SE	df	t-value	Pr>[t]
Intercept	-10.5289	23.0408	16	-0.45	0.6588
Falls with injury	-1.4649	0.9180	62	-1.60	0.1156
Hospital SRE	0.0291	0.08249	62	0.35	0.7251
RN Staffing	0.4743	0.8096	62	0.59	0.5601
Patient Centeredness	0.3385	0.2415	62	1.40	0.1659
Justice	0.2128	0.06421	62	3.31	0.0015**
Communication	0.2217	0.07392	62	3.00	0.0039**
Leadership	0.3816	0.06152	62	6.20	<.0001***
Hospital Case Mix Index	-5.8956	6.8898	62	-0.86	0.3955
Unit type – Medical	-4.5439	2.1215	62	-2.14	0.0361*
Unit type – Medical/Surgical	-5.3393	2.2751	62	-2.35	0.0221*
Unit type – Step-down	-5.5220	2.1828	62	-2.53	0.0140*
Unit type – Surgical (baseline)	0	-	-	-	-
Hospital location – rural	-4.9517	4.5686	62	-1.08	0.2826
Hospital location – suburban	-0.1724	3.0916	62	-0.06	0.9557
Hospital location – urban (baseline)	0	-	-	-	-
Magnet	-1.7520	3.7367	62	-0.47	0.6408
Magnet-like	3.7748	5.1048	62	0.74	0.4624
Non-Magnet (baseline)	0	-	-	-	-
Hospital bed count	-0.0187	0.01560	62	-1.20	0.2346
Unit bed count	-0.0250	0.09541	62	-0.26	0.7941

Level of significance: *0.05, **0.01, ***0.001

Table 5.7 Mixed Effects Model with all Variables

Effect	Numerator df	Denominator df	F Value	Pr>F
RN staffing	1	71	1.21	0.2746
Patient-centered	1	71	0.71	0.4018
Justice	1	71	11.88	0.0010***
Communication	1	71	9.64	0.0027**
Leadership	1	71	40.09	<0.0001***
Hospital CMI	1	71	7.37	0.0083**
Unit Type	3	71	4.67	0.0049**
Hospital Location	2	71	1.24	0.2963
Magnet Status	2	71	0.01	0.9880

Level of significance: *0.05, **0.01, ***0.001

Table 5.8 Variance Explained by the Mixed Effects Models

Models	Hospital level variance	Unit level variance	r^2 (hospital level)	r^2 (patient care unit level)
Random effect only (baseline)	35.72	131.97	na	na
Partial model	12.87	38.44	63.97%	70.87%
Full model	10.83	35.48	69.68%	73.12%

CHAPTER VI

Discussion, Conclusions and Recommendations

Chapter Overview

This chapter presents interpretation of the study results as well as insights into recommendations for further studies. The chapter is divided into three sections. The first section is a discussion of the results presented in Chapter 5. The second section is a discussion of the broader considerations of the study's findings as well as limitations identified through the data analysis. The third section offers recommendations for application of the knowledge gained through this study, as well as future study opportunities.

Discussion of Results

Leadership, Communication and Justice. These three variables were found to be statistically significant in both simple correlations and hierarchical multivariable linear modelling (HLM). These three variables and the dependent variable of Overall Patient Safety (OPS) come from the same survey tool and are collected at the same time. Not only are leadership, communication and justice associated with OPS, they also demonstrate statistically significant intercorrelation. There is a significant correlation between leadership and communication ($r = 0.4555$, $p < 0.0001$), leadership and justice ($r = 0.3420$, $p = 0.0004$), and between communication and justice ($r = 0.5624$, $p < 0.0001$). The high degree of correlation between the four variables could be interpreted in a number of ways.

The research question for the preliminary validation study asked, "What relationships, if any, exist at the individual, unit, or organizational levels between Registered Nurses' rating

of safety climate and identified elements of a safety climate (leadership, teamwork, evidence-based practices, communication, learning, just, and patient-centeredness)?" The modification of this question derived from the modified Delphi study, asked, "What relationships, if any, exist at the unit or organizational levels between Registered Nurses' rating of safety climate and identified elements of a safety climate (leadership, communication, justice, patient-centeredness, nurse staffing, falls, and serious reportable events)?" Nurses form their attitudes about OPS through a complex mechanism of taking in information from their environment, comparing that with retrieved memory of other events and information, and forming an attitude at a point in time. This attitude formation could happen quickly in the moment or through a process that involves more retrieval of previous attitudes than formation in the present. This study sought to explore what might contribute to the formation of a nurse's attitude or perception of safety at a point in time. Could the nurse's evaluation of the Leadership they observe contribute to the OPS? Could their evaluation of Communication contribute to the OPS?

One interpretation of the high correlation between Leadership, Communication, Justice and OPS is that Leadership, Communication and Justice precede the formation of perceptions of OPS and there is a causal relationship between the nurses' perception of these unit qualities and their perception of OPS. Since this is a cross-sectional study, with all measures collected at the same time, the reverse could also be possible, with OPS perceptions preceding and influencing the ratings of Leadership, Communication, and Justice.

Another interpretation is that the high correlation between Leadership, Communication, Justice and OPS could be due to the "halo effect." In other words, if a nurse views their unit climate highly, he or she would tend to give high ratings to every question, without making the needed distinction between the domains of interest. This would yield

high correlation between these four variables, but make it harder to interpret the association of individual domains with OPS. Presumably, the previous extensive validation of HSOPSC would have minimized the halo effect.

The study demonstrated significant association between the nurses' perception of Justice, Communication, and Leadership and their perception of OPS and although there may be several interpretations for these associations and all of the above interpretations may have played some role, this study provides support for Sammer's model of 7 SC subcultures as well as the SC model modified by the Stage I modified Delphi study. However, a different study design where the measurement of Justice, Communication and Leadership precedes the measurement of OPS would be necessary to provide additional evidence for causality.

Sammer's description of hospital leadership describes leaders of the organization, as well as specifically referring to examples of senior leadership action in some of the studies included in the literature analysis. AHRQ uses the language of managers, referring to lower-level supervisors of staff. The literature is replete with descriptions of the differences between leaders and managers (Gilley, 2005; Hickman, 1992; Williams & Deal, 2003). The differences between leaders (inspirational, transformational) and managers (supervising activities and processes), as well as the hierarchical difference in organizational level between senior leaders and front-line managers can indicate a mismatch between Sammer's concept and the variable used to measure this concept.

RN Staffing. RN Staffing demonstrated no significant correlations in either simple correlations or HLM. This was initially surprising to the researcher because it was thought that inappropriate staffing could contribute to nurses feeling they cannot safely care for patients. This premise has good support, as noted earlier in various studies, and demonstrated in the ongoing efforts to enact legislation to enhance nurse staffing. The RN

staffing variable measured hours of Registered Nurse care per patient day (RNHPPD). This "dose" of nursing care is intended to flex the number of nurses caring for patients up and down based on the total number of patients requiring care on the unit. It is also a mean number because daily staffing will vary in at least two additional ways. First, individual patients can require more care than the "normal" patient for that unit and staffing is typically enhanced yielding a higher HPPD for that day. Second, staffing is not adjusted with the addition or deletion of a single patient. Several patients may be added to the unit census before an additional RN is added to the staffing. This makes the actual HPPD variable by patient census; four RNs caring for 20 patients represents 4.8 RNHPPD while five RNs caring for 21 patients represents 5.7 RNHPPD. RNs in this situation could feel stressed and less safe caring for 20 patients and not stressed with the altered staffing for 21 patients. Alternatively, that additional patient could be very complex and the five RNs could feel less safe in the 21 patient situation, even with an additional RN added to the staffing.

This preliminary analysis is not supportive of the Stage I Delphi Study participants' inclusion of RNHPPD as a measure of SC. RNHPPD may be too rough of a measure to adequately measure RN staffing relative to how RNs think about their environment. Nurses, like any other human can become acclimated to their environment. RNs caring for a similar patient population could feel "safe" with 6.0 RNHPPD or "safe" with 8.0 RNHPPD. A particular staffing level for a patient population type does not mean that it is adequate. The staffing level relative to the patient care demand is a complex issue. This study groups all medical units together, as defined by NDNQI. Those units likely vary in the complexity of patient care required from hospital to hospital or even within hospitals. 8.0 RHHPPD on one medical unit could be adequate staffing, while on another medical unit it would be considered inadequate relative to the patient care demand.

RNs could also view their staffing from the perspective of whether actual staffing is in line with planned staffing or is regularly short of the plan. Varying staffing from what is planned could yield more feelings of an unsafe environment, even if that altered and lowered staffing is the same as another unit that feels their environment relative to staffing is a safe one. For example, unit #1 plans to staff 8.0 RNHPPD, but staffs at 7.0 RNHPPD on a daily basis. Unit #2 plans to staff at 6.8 RNHPPD and due to patient care needs, staffs at 7.0 RNHPPD. Assuming that the patient populations on the two units are the same, RN on unit #2 could feel much safer than unit #1. This result could be based more on unmet expectations than on the actual safety of the situation. This study did not include any measurement of the planned staffing or variation from planned staffing. The addition of other staffing variables to compliment RNHPPD might yield a different result relative to correlation with OPS. A variable that measures variation from planned staffing could add sensitivity to the staffing analysis and identify an association with OPS. Additionally, when RNHPPD is measured as a mean over the day, week, or month, some specificity can be lost. The analysis could potentially be strengthen by RNHPPD being measured for the shift over a shorter period of time than the quarterly basis used in this study.

Additionally, hospital CMI was intended to help control for variation in the patient severity of illness, which gives some indication of the level of care demanded. Adding a variable that measures patient care demand more precisely on the unit level would be helpful in better understanding the adequacy of RN staffing. This data was not available for the hospitals and units involved in this study. However, many hospitals do possess a patient classification or acuity system. This type of system gathers data on the amount of nursing care that is required by the patients actually on the unit at a given point in time. It would be

an interesting additional piece of data to add to the analysis of RN staffing and its association with RN perceptions of SC.

Last, the RN staffing data were actual staffing measurements, while the dependent variable of SC as measured by OPS was a measurement of RN perception. This study did not evaluate the RN's perceptions of staffing, instead analyzing actually staffing. A measure of staff perceptions of staffing could yield different correlations with OPS.

Patient Centeredness. Patient satisfaction with being involved in the planning of care (HCAHPS) was intended to be a measure of Sammer's subculture of Patient Centeredness. The analysis showed a weak but statistically significant simple correlation with OPS, but Patient Centeredness lost statistical significance in the hierarchical multivariable linear modelling. The experts participating in the modified Delphi study selected this variable as a way to operationalize Patient Centeredness using data typically available to acute care hospitals in the United States. It is possible that this concept is indeed important to SC, but the measure taken from HCHAPS is imperfect in measuring the concepts. HLM looks for the independent contribution of a variable, once the impact of the other variables is accounted for. It is possible that an independent contribution to SC exists, but this study was unable to find it due to inadequate sample size, an inadequately sensitive instrument, or other factors.

A single question was used to measure patient-centeredness. Sammer's (2010) concept of patient-centeredness included not only involvement of the patient in their care (which the variable used measured), but also the patient acting as liaison between the hospital and the community. Patient-centeredness may have required multiple data elements to fully capture the full concept in the conceptual model.

There is some challenge in theoretically explaining how the nurse completing the OPS tool would fully appreciate the patient's perception of their involvement in care and how that would positively impact perceptions of the safety climate. Nurses in the study hospitals have received training on the importance of patients participating in their care, providing an additional layer of safety. Examples of patient's involvement in the safety climate would be the requests made of patients to identify to their caregivers when the caregiver does not wash hands, or when the medication they are being given does not look like the patient's regular medication. While the nurse might not make a complete connection between the involvement of the patient in their care and SC, it is possible that patient centeredness does contribute to perceptions of SC but this study was unable to find that relationship.

Falls. Falls, a measure of patient harm, demonstrates a statistically significant negative simple correlation with OPS, but is not substantiated as an independent predictor in the HLM. Correlations can be the result of spurious reasons and no causality can be inferred. The results seen may be because other independent variables are correlated with falls and also influence OPS. Unit type might be an example of such a confounder. If patients on medical units are sicker and more likely to fall and medical units have a lower OPS in general, it may appear on bivariate analysis that falls and OPS are correlated. It is difficult to identify this kind of relationship in this type of cross-sectional analysis. It is also possible that within each hospital, falls and OPS are not related at the unit level, but that hospitals that tend to have higher falls rates also tend to have lower OPS, so the simple analysis that does not take into account the correlation within a hospital, could find a significant bivariate association.

Another interpretation of an association between SC and falls is that SC is a predictor of falls and not the other way around. If the perception of SC is good, safety behaviors are plentiful and falls are prevented. This study tried to limit this problem in attributing causation by ensuring that the measure of falls preceded the measure of SC.

A negative simple correlation and HLM coefficient value were expected and seen in the analysis. It is interesting that the direction of the hierarchical multivariable linear modelling relationship is correct theoretically by not statistically significant. Theoretically, as the incidence of falls with injury increases on the unit, the perceptions of OPS would decline. Based on this analysis, for every increase in falls with injury/1000 patient days, the OPS would decrease by 1.4649. It could be that the direction of the relationship is correct, but the study underpowered. With a larger data set, the results could potentially be similar but statistically significant. Falls, as a measure of patient harm fits with the study model, as modified by the State I modified Delphi study. Further study would be needed to determine whether falls, perhaps under the domain name of patient harm incidents, should be included as a predictor of SC.

Falls with injury and SRE were not part of Sammer's conceptual model. These measures are typically viewed as outcomes of SC. Sammer's concepts were derived from themes found in studies of Safety Culture. The experts in the modified Delphi study viewed falls with injury and SRE as important to SC, and for that reason were included in the Phase II study. However, just because the experts saw these elements as important to SC does not mean they are equal in concept and framework to Sammer's subcultures. They may be important to SC, but not contribute to SC in the same manner.

Serious Reportable Events. SRE, the worst of patient harm events, showed no significant correlation with nurses' ratings of OPS in either simple correlations or HLM.

Theoretically, we might expect that with high numbers of patient harm events, the OPS would decline. An alternative theory is that a positive direction of the relationship (increased reporting of SRE corresponding with increased OPS) would be reflective of the higher OPS climate encouraging the reporting of all events. The literature (Flin, 2007) indicates that this increased reporting of harm events has been correlated with a higher OPS climate.

Perhaps a more significant factor is that SRE is a hospital level variable. It could be assumed that when a patient harm event occurs on one unit, the staff throughout the hospital learn of the event and their thinking is affected by the event. It is possible that OPS could be negatively affected by knowledge of patients experiencing harm within the organization. With the practice of hospital safety huddles and communication of harm events, we can have some assurance that knowledge of the events is spread throughout the organization. However, communication is a common issue in hospitals and flow of knowledge is often uneven, weakening the theoretical association between SRE and perceptions of SC. Variable spread of the knowledge of events could have affected correlations with OPS. No conclusions about the correlation of SRE and SC can be made as a result of this study.

Falls and SREs are both measures of patient harm. As indicated by the experts participating in the Phase I modified Delphi study, these variables could aid in the understanding of whether actual safety experience contributes to RN perceptions of SC. Falls with injury is a unit-level variable, which is likely to be more salient for the nurses working on that unit. SREs are measured at the hospital level, requiring that communication of these events reach the RN at the unit level. More study is needed to understand the relationship between falls, SREs, and SC.

Hospital CMI. Hospital level CMI, a variable intended to control for complexity of care, did not show statistical significance in either simple correlations or HLM. The

differences between hospitals' CMI are narrow (range in the sample 1.16–2.43) and may have affected the ability to achieve statistical significance.

Unit and Hospital Beds. The count of beds in each unit and the overall count of hospital beds showed no significant relationship in either simple correlations or HLM, although the count of unit beds approached significance. This negative association of unit beds with OPS is what was expected from the data; when unit complexity as measured by number of beds rises, perceptions of SC will decline. Staff may be astute in recognizing that with greater complexity, the challenge of practicing in a safe manner may also be greater and more difficult to achieve.

Magnet. Hospital level Magnet designation shows a negative association with OPS in both simple correlations and HLM that is not statistically significant, with OPS means higher in Magnet hospitals, lower in Magnet-like hospitals, and lowest in non-Magnet hospitals. Magnet was intended to serve as a surrogate for a strong work environment and high quality patient outcomes. Magnet designation was measured as Magnet designated, within one year of applying for Magnet designation or Magnet-like, and not Magnet. It was thought that a Magnet organization would have a higher OPS than a Magnet-like, and a Magnet-like organization have a higher OPS than a Non-Magnet organization. Organizations that are within one year of applying for Magnet have usually been working on their work environment and delivering high quality patient outcomes and patient satisfaction for a number of years. There may be little difference in the sample between Magnet and near-Magnet organizations. The organizations that are not Magnet could also have several of the good elements of a Magnet organization but not have committed to meeting all of the required standards. Correlations are usually not advised for categorical variables because the difference between Magnet and Magnet-like may not be equal to the distance between

Magnet-like and Non-Magnet. The variable may not have served to control for high vs. low quality work environment or patient outcomes. Alternatively, it is possible that a statistically significant association could be seen in a larger data set.

Unit type. Unit type is a categorical variable delineating four different types of hospital unit: step-down, medical, surgical, and medical/surgical combined. Unit type shows no statistical significant correlation, but does demonstrate the ability to independently predict OPS once the influence of other variables is removed through HLM. There is a significant difference in the OPS scores between the different types of units, even within the same hospital. Surgical units had the highest values of OPS as a group, followed by medical units, medical/surgical units and step-down units. This may be the result of other factors not measured through this study and therefore not accounted for in the HLM analysis. Unit type might also be a better measure of the complexity of care on an individual unit than hospital CMI, hospital bed count, or unit bed count.

In conclusion, the only statistically significant predictors of the dependent variable, SC as measured by OPS, were Leadership, Communication, Justice and unit type. It is interesting to note that all of these variables are measured at the unit level. No hospital level variables were found to be statistically significant in the hierarchical multivariable linear modelling. Leadership, Communication, and Justice were the only variables from the study model to demonstrate statistical significance in predicting the dependent variable, SC. It is possible that the other four concepts (Patient Centeredness, RN staffing, Falls with Injury, and Serious Reportable Events) are indeed important to SC, but that was not supported by the results of the preliminary validation study. This study provides support for the inclusion of Leadership, Communication, and Justice in the model of SC.

Conclusions

The Phase I modified Delphi Study added to our knowledge of Safety Climate. The input of the study's body of safety experts was significant in expanding an understanding of safety climate, and the refining of and extending of Sammer's original model, derived from a metanalysis. The modified Safety Climate model yielded by the modified Delphi study informed the preliminary validation study.

Phase II of the study tested the Sammer (2010) subcultures that were able to be operationalized through the Delphi procedure in the first stage of the study. The model yielded by the Phase I modified Delphi study removed three elements from Sammer's model and added three new elements. This resulted in Phase II testing of the modified SC model. Phase II provided a partial testing of Sammer's model, and only preliminary testing of the modified SC model, yet it provided valuable insights for future expansion and testing of the entire model. The results of Phase II supported the inclusion of Leadership, Communication and Justice in the model. Patient centeredness, RN staffing, Falls with Injury, and Serious Reportable Events were not supported by the results of the study. However, the preliminary validation was not definitive and may have been insufficiently powered, with only 94 units of data able to be matched and used in the analysis.

Additional testing of the modified RN Safety Climate Model will need to be done with a larger data set to better understand and validate the model.

Observed Limitations. A number of limitations emerge from this study. The selection of Sammer's framework for Safety Culture contains several large overlapping concepts. Emails from the modified Delphi study participants expressed concern that concepts such as teamwork, evidence-based practice and communication are complex, do have some overlaps and connections to Safety Climate (SC), but are not fully entailed within the SC framework.

This could have led to study participants being confused by the task, with some retaining the concept, noting a high score for the concepts relevance to SC, and selecting a representative hospital data set, and other participants giving that same concept a lower score, not selecting a representative hospital data set, resulting in the concept being eliminated from the model.

The selection of hospital data sets, although pre-tested with two test participants, could have been less than optimal choices. It is possible that selection and presentation of different hospital data sets to the modified Delphi participants could have resulted in one or more of the discarded concepts being retained in the model for the preliminary validation study.

The use of Serious Reportable Events (SREs) as a variable assumes that there is uniform reporting. SREs have national definitions that are communicated within the acute care hospitals. However, many factors, including a lack of SC, can hinder the open reporting by caregivers of these untoward patient events. If an event is not reported, other caregivers within the organization may not learn of the event and the harm experienced by a patient under the care of the organization. This lack of organizational knowledge could impact the overall perception of safety, rendering that perception less informed by the experience of the organization. The use of SREs as a variable also lacks any measurement of the severity of the injury to the patient. An SRE count includes a wide variation of untoward patient harm events, including everything from a broken arm requiring surgery as a result of a fall to death of a patient as a result of a medication error. Severity of the event is not measured in the SRE count, but the impact of varied patient harm could impact nurses' SC perceptions in widely varying ways. In other words, one hospitals 3 annual SREs that all involved patient deaths could have a much more significant impact on nurses' perceptions of SC than another hospital's 12 SREs that resulted in moderate but repairable patient harm.

The sample included 23 community hospitals from the same healthcare system. The hospitals varied in size from 25 to 570 beds. While a large percentage of acute care is provided in community hospitals, it would have been enriching to the study had it included an academic medical centers as well as larger community hospitals.

One of the covariate variables was unit type. The criteria for a medical, surgical, medical/surgical or step-down unit is defined by NDNQI. However, the definitions are broad and could have led to variation in the individual hospital interpretation of the unit type criteria. While the differences between medical, surgical and medical/surgical units, which tend to be staffed with a similar dose of nursing care, step-down units have wider interpretation from hospital to hospital. Operating criteria for step-down units are developed internal to the organization. Patients who would be cared for in a smaller organization on an Intensive Care Unit could be cared for on a step-down unit in another, larger organization. This may explain why the RN staffing data was skewed to the right, with one unit staffing at 15.76 hours per patient day, more than three times the dose of nursing care of the lowest staffing unit of 4.45 hours per patient day.

Within acute care hospitals, nursing units often undergo renovations or minor construction to add equipment. Examples could include renovations to add ceiling lifts to rooms, updating of the room environment to better satisfy family needs, or the installation of computers in each patient care room. Units and the patient populations cared for may temporarily move to another location during these renovations. Individual patients may be moved during these renovations, leading to confusion for the patients in completing the HCHAPS survey. There may be variation in how a hospital notes the unit on which a fall occurred. Is it the unit on which the patient was admitted and actually fell or is that fall

coded in the medical record to the final unit from which the patient was discharged? This inconsistency between hospitals could make any findings less relevant.

Hierarchical Linear Modeling (HLM) assumes that variables are independent. However, there is some overlap in untoward patient events that could confound results. All falls with injury on an individual unit includes a wide array of injuries from minor to major. There is a subset of the unit falls with injury, those with moderate harm, severe harm or resulting in death, which is also included in the hospital level variable of SREs. This overlap in the use of the same patient harm, may confound those variables. However, the measurement of these two overlapping variables at two different levels of the organization is informative and allowable in HLM.

The unit falls data included four quarters of falls data, from the second quarter of 2011 to the first quarter of 2012. However, due to variation in the hospitals' reporting of the data, a number of quarterly data elements were missing. In order to deal with this issue, only the most recent quarter of data for each unit was used. This most recent quarter was the best match to the timeframe of the independent variable, collected in spring 2012. While the vast majority of units had reported data for first quarter 2012, 5 units were missing this data. For these 5 units, the fourth quarter 2011 data was used. This results in an additional source of variation. The lack of recentcy of falls with injury on these 5 units could impact the relationship between falls with injury and the overall SC data.

The leaders of five units in the study decided that their day and night shift staff were different and collected data for HSPSC dividing the two shifts into two separate data sets. Three independent variables (Leadership, Communication, and Justice) as well as the dependent variable (SC as measured by OPS) were derived from this data set. For this study, both data sets were retained for analysis. However, the other variables included data from

the entire unit, resulting in duplication of data points to correspond with the divided units. This duplication added additional error to the analysis.

Implications for Practice

This study was originally intended to help identify potential influences on RN perceptions of SC. This understanding had the potential to provide focus and direction in planning interventions to positively influence RN perceptions of safety. The results of this study indicates that surgical units have higher mean RN perceptions of SC, which might indicate that healthcare leaders should focus greater efforts toward medical, medical/surgical and step-down units, where mean perceptions of SC are lower. Additionally, the study provides evidence that leadership, communication and justice are predictive of perceptions of SC in Registered Nurse populations. Efforts to focus on improving leadership, communications between staff and leadership as well as throughout the organization, and improving consistency in dealing justly when errors occur are likely to yield improvements in the overall perceptions of SC in the Nursing workforce.

Recommendations

Experts on certain topics are often used when exploring that topic. That was the choice made when developing this research study. However, in studying RN perceptions of SC, perhaps it is the staff RNs that should be considered the experts when it comes to defining the concepts important to their perceptions and how those concepts should be measured. An important future study would be to repeat the Phase I of this study using a larger set of experts, with staff nurses comprising that set of experts. Comparisons between the results of Phase I using the experts in this study and the staff nurse experts would provide important insights into SC at the bedside in hospitals.

It has been discussed that the data element options provided to the expert participants in Phase I were limited and did not include the broader domains measured by AHRQ's HSOPSC. It would be important that future studies to explore operationalizing SC use additional and richer data elements that would better measure the SC concepts.

In order to better measure and understand the RN Safety Climate Model derived from the results of Phase I of this study, it will be important to use larger data sets to determine the relationships between the independent variables and the dependent variable further validating the RN Safety Climate Model. We recommend testing all of Sammer's seven subcultures, with different measures to operationalize three of the variables eliminated in the first phase of this study (Teamwork, Evidence-Based Practice, and Learning), and the addition of the three variables added by the first phase of this study (RN staffing, Falls with Injury, and Serious Reportable Events (SRE)) and included in the modified RN Safety Climate Model. As discussed, the three eliminated variables could have been retained in the model had different data sets been offered as options for operationalizing the variables. The input of the safety experts in the first phase of the study was important in adding RN staffing, Falls with Injury and SRE to the model of SC and should be further tested.

Hospitals and healthcare organizations are replete with data. Much information could be gleaned from these data source. However, in order to perform meaningful analysis of data, it will be important for hospitals to establish consistent data collection and segmentation schemes. What will define a unit; does a unit include all activities for a given department or could that department be divided by varying time periods of work? With units frequently moving, splitting or changing in other ways, how will data be collected for patients usually receiving care on that unit? With staff floating to units other than their own, what constitutes the RN's home unit designation? How much presence on a unit is enough to make the RN

part of that unit subculture? And for hospitals that are coming together as systems, how will they prioritize the need to collect data in a consistent manner between hospitals? How can processes ensure consistent collection of data and elimination of missing data elements?

It will be important for hospitals and their leaders to prioritize collection of all data in a manner that will allow matching of various data sets for future analysis. While many organizations recognize the value of the data they collect, the fragmented manner in which it is collected, with variation potentially introduced with each change in unit or hospital leadership, limits the value and predictive potential of the data.

A deeper understanding of RNs, the largest group of caregivers in the US healthcare system, is essential to creation of safe environments for care. So much insight into the world of nurses and the environmental influences on nurses could be gleaned from data available within healthcare organizations. Use of the data to gain this needed insight will only be accomplished through continual improvement in the ways the data is collected, retrieved, and matched for analysis.

APPENDIX A

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.

- *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…	**Strongly Disagree**	**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

SECTION A: Your Work Area/Unit (continued)

Think about your hospital work area/unit…

Strongly Disagree Disagree Neither Agree Strongly Agree

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.

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…

Strongly Disagree Disagree Neither Agree Strongly Agree

1. We are given feedback about changes put into place based on event report

• 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?*

Strongly Disagree Disagree Neither Agree Strongly

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** Excellent • **B** Very Good • **C** Acceptable • **D** Poor • **E** Failing

SECTION F: Your Hospital

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

Think about your hospital…

Strongly Disagree 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…

Strongly Disagree 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

In the past 12 months, 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 hospital?

- 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

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

- 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 hours per week 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

SECTION H: Background Information (continued)

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

- a. Registered Nurse
- b. Physician Assistant/Nurse Practitioner
- 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.

APPENDIX B

Delphi Survey, Round One, Section One

Directions: How important is each of the concepts for inclusion in *Safety Climate*?

Concept	Definition based on Sammer et al., 2010	Scale 1 = Not Important 5 = Very Important
Leadership	Leaders acknowledge the healthcare environment is a high-risk environment and seek to align vision/mission, staff competency and fiscal and human resources from the board room to the front line.	1, 2, 3, 4, 5
Teamwork	A spirit of collegiality, collaboration and cooperation exists among executives, staff, and independent practitioners. Relationships are open, safe, respectful, and flexible.	1, 2, 3, 4, 5
Evidence-Based Practices	Patient care practices are based on evidence. Standardization to reduce variation occurs at every opportunity. Processes are designed to achieve high reliability.	1, 2, 3, 4, 5
Communication	An environment exists where an individual staff member, no matter what his or her job description, has the right and the responsibility to speak up on behalf of the patient.	1, 2, 3, 4, 5
Learning	The hospital learns from its mistakes and seeks new opportunities for performance improvement. Learning is valued among all staff, including the medical staff.	1, 2, 3, 4, 5
Just	A culture that recognizes errors as system failures rather than individual failures and, at the same time, does not shrink from holding individuals accountable for their actions.	1, 2, 3, 4, 5
Patient-Centeredness	Patient care is centered around the patient and family. The patient is not only an active participant in his own care, but also acts as a liaison between the hospital and the community.	1, 2, 3, 4, 5

APPENDIX C

Delphi Survey, Round One, Section Two

Directions: Select the data sets that best operationalizes each *Safety Climate* concept?

Concept	Definition of Concept	Data Set 1 & definition	Data Set 2 & definition	Neither are good options
Leadership	Leaders acknowledge the healthcare environment is a high-risk environment and seek to align vision/mission, staff competency and fiscal and human resources from the board room to the front line.	AHRQ HSOPSC Section F/Question 8: The actions of hospital management show that patient safety is a top priority (Unit and individual levels available)	Registered Nurse Staffing: Numerator: Total Productive RN Hours, Denominator: Patient Days (Unit level available)	Neither
Teamwork	A spirit of collegiality, collaboration and cooperation exists among executives, staff, and independent practitioners. Relationships are open, safe, respectful, and flexible	AHRQ HSOPSC Section A/Question 1: People support one another in this unit (Unit and individual levels available)	AHRQ HSOPSC Section A/Question 3: When a lot of work needs to be done quickly, we work together as a team to get the work done (Unit and individual levels available)	Neither
Evidence-Based Practices	Patient care practices are based on evidence.	Falls with injury: Numerator: Number of	Serious Reportable Events (NQF categories)	Neither

	Standardization to reduce variation occurs at every opportunity at every opportunity. Processes are designed to achieve high reliability.	patient falls with injury in a given time period Denominator: per 1000 patient days in that same time period (Unit level available)	resulting in permanent injury or death over one year's time (hospital level available)	
Communication	An environment exists where an individual staff member, no matter what his or her job description, has the right and the responsibility to speak up on behalf of the patient.	AHRQ HSOPSC Section C/Question 2: Staff will freely speak up if they see something that may negatively affect patient care (Unit and individual levels available)	AHRQ HSOPSC Section C/Question 5: In this unit, we discuss ways to prevent errors from happening again	Neither
Learning	The hospital learns from its mistakes and seeks new opportunities for performance improvement. Learning is valued among all staff, including the medical staff.	Falls with injury improvement: Difference in fall rate (fall with injury per 1000 patient days) between 2 adjacent years (Unit level available)	Pressure Ulcer rate improvement: Difference in pressure ulcer rate (Hospital acquired pressure ulcers) per 1000 patient days between 2 adjacent years (Unit level available)	Neither
Just	A culture that recognizes errors as system failures rather than individual failures and, at the same time, does not shrink from holding individuals	AHRQ HSOPSC Section A/Question 12: When an event is reported, it feels like the person is being written up, not the problem	AHRQ HSOPSC Section A/Question 16: Staff worry that mistakes they make are kept in their personnel file (Unit and	Neither

	accountable for their actions.	(Unit and individual levels available)	individual levels available	
Patient-centeredness	Patient care is centered around the patient and family. The patient is not only an active participant in his own care, but also acts as a liaison between the hospital and the community.	HCAHPs question: During this hospital stay, staff took my preferences and those of my family or caregiver into account in deciding what my healthcare needs would be when I left. (Unit level available)	HCAHPs question: During this hospital stay, did doctors, nurses, or other hospital staff talk with you about whether you would have the help you needed when you left the hospital? (Unit level available)	Neither

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