Effects of Individual Nurse and Hospital Characteristics on Patient Safety and Quality of Care

BY

SEUNG EUN LEE
B.S.N., Yonsei University, Seoul, South Korea, 2003
M.S.N., University of British Columbia, Vancouver, Canada, 2014

THESIS

Submitted as partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Nursing Sciences
in the Graduate College of the
University of Illinois at Chicago, 2017

Chicago, Illinois

Defense Committee:

Catherine Vincent, Chair and Advisor
Chang Gi Park
Karen Dunn Lopez
Linda D. Scott, University of Wisconsin-Madison
Susan Dahinten, University of British Columbia

This thesis is dedicated to my sons, my husband, my mother, and my brother, without whom it would never have been written. I also dedicate this thesis to my dear father, who will always watch over me and is happy to see this thesis completed.

ACKNOWLEDGEMENTS

I would like to thank my advisor and dissertation chair, Dr. Catherine Vincent, for her continuous encouragement, guidance, and support. Her endless guidance as an advisor and support as a mentor made my dissertation project possible. My sincere appreciation is also extended to Dr. Linda Scott for the unwavering support and guidance in all areas that helped me to accomplish my research goals. I would also like to express my sincere gratitude to Dr. Susan Dahinten, who provided me with strong support and guidance as well as constructive feedback throughout my PhD program. In addition, I sincerely thank Dr. Karen Dunn Lopez for her encouragement and valuable comments while I conducted this study. And I extend special appreciation to Dr. Chang Gi Park for his continuous support and sharing of his expertise during my PhD program.

I would also like to thank Dr. Mi Ja Kim for her support and valuable advice throughout the journey of my doctoral studies. I am also extremely thankful to Dr. Maura MacPhee for her cheerful encouragement and for allowing me to use her dataset for this study. Moreover, I would like to express my thanks to Dr. Farinaz Havaei for her support and encouragement throughout my doctoral studies.

I would like to acknowledge all the faculty, staff, and friends at the College of Nursing for their support throughout my doctoral studies. I am also extremely thankful to Mr. Jon Mann for not only his great support in editing all of my academic papers but also his valuable advice throughout my doctoral program.

Most importantly, I would like to thank my family for their support, endless love, and innumerable sacrifices throughout my education. I truly appreciate my beloved sons, Henry and Jason Kim; my best friend and husband, Won Jung Kim; my lovely mother,

Young Ja Kim; and my brother and supporter, Young Hwan Lee. Thank you very much for always being there for me. Finally, I send my special thanks to my father, In Gil Lee, who provided me with unconditional love and support throughout my life and helped me to accomplish all my educational goals. Dad, I miss you a lot, and I will love you forever.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

CHAPTER PAGE

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AHRQ	Agency for Healthcare Research and Quality
BC	British Columbia
BSN	Baccalaureate in Nursing Science
CFI	Comparative Fit Index
CIHI	Canadian Institute for Health Information
CI	Confidence Interval
HSOPSC	Hospital Survey on Patient Safety Culture Questionnaire
ICC	Intraclass Correlation
IOM	Institute of Medicine
OR	Odds Ratio
PES-NWI	Practice Environment Scale of the Nursing Work Index
PSI	Patient Safety Indicator
RMSEA	Root Mean Square Error of Approximation
RN	Registered Nurse
SAQ	Safety Attitudes Questionnaire
SOS	Safety Organizing Scale
SRMR	Standardized Root Mean Square Residual
U.S.	United States
SPO	Structure-Process-Outcome

SUMMARY

The twofold purposes of this study were to investigate the impacts of individual nurse and hospital characteristics and their interactions on patient safety and quality of care using a multilevel approach and to provide an integrative review of the literature on the relationship between safety culture and patient safety and care quality outcomes in hospital settings. The specific aims were to (a) examine the effects of individual nurse characteristics on patient adverse events and quality of care, (b) examine the effects of hospital characteristics on patient adverse events and quality of care, (c) examine the relationship between safety culture and outcomes for patient safety and care quality in hospital settings through a literature review, and (d) closely examine the existing literature to identify areas that warrant future study.

This dissertation includes the findings of this study presented in two manuscripts. The first manuscript includes findings from a data-driven research study that investigated the effects of individual nurse and hospital characteristics and their interactions on nurse-reported patient adverse events and quality of care. The second manuscript includes findings from an integrative review that examined the existing literature on organizational safety culture and patient safety and care quality outcomes in hospitals. The appendix includes the notice of determination of human subject research for the study issued by the Institutional Review Board of the University of Illinois at Chicago. The author's curriculum vitae concludes the dissertation.

I. EFFECTS OF INDIVIDUAL NURSE AND HOSPITAL CHARACTERISTICS ON PATIENT ADVERSE EVENTS AND QUALITY OF CARE: A MULTILEVEL ANALYSIS

Background

The Institute of Medicine (IOM) has challenged healthcare professionals to ensure safe, effective, patient-centered, timely, efficient, and equitable care (IOM, 2001). Patient safety is an important consideration of quality of care in healthcare (IOM, 2001), and thus it is often evaluated using patient outcomes such as patient adverse events (Cho, Chin, Kim, & Hong, 2016). Along with patient safety, broader aspects of quality of care must be evaluated to improve healthcare systems (IOM, 2001).

Because nurses constitute the major workforce in healthcare systems, they are key potential contributors to enhancement of patient safety and quality of care (IOM, 2003). Researchers have investigated factors affecting nursing care (Aiken, Clarke, Cheung, Sloane, & Silber, 2003; Aiken et al., 2014; Aiken, Clarke, Sloane, Lake, & Cheney, 2008; Aiken, Cimiotti et al., 2011; Aiken, Sloane et al., 2011; Aiken et al., 2012; Aiken et al., 2013; Cho et al., 2015; Lake et al., 2016) and suggested that both individual nurse and organizational characteristics can play a significant role in patient safety and quality of care (Karsh, Holden, Alper, & Or, 2006). However, the relative contribution of these characteristics remains unclear.

Multiple factors have been linked to patient safety, including nurse education. Despite increasing recognition of the significance of nurse education, little is known about how it contributes to patient safety (Ridley, 2008). Moreover, previous studies have produced inconsistent evidence for the relationships between nurse education and patient safety. For example, while some researchers found beneficial effects of higher levels of nurse education on

patient safety outcomes in hospitals (Aiken et al., 2003; Aiken et al., 2014; Aiken et al., 2011; Blegen, Goode, Park, Vaughn, & Spetz, 2013), others found no significant relationship between the two concepts (Lucero, Lake, & Aiken, 2010). Furthermore, with respect to nurse education, patient mortality has been the most commonly investigated patient outcome (Aiken et al., 2014; Aiken et al., 2011; Cho et al., 2015), and thus more research is required to explore the influences of nurse education on patient outcomes that are more sensitive to nursing as well as on quality of care. Additionally, previous investigators have focused on examining hospital-level nurse education (e.g., proportions of nurses with baccalaureate degrees in hospitals) in relation to patient safety and quality of care; that is, the effects of nurse education have been examined as a hospital characteristic rather than as individual nurse characteristic. However, in multilevel theory, organizations are multilevel systems with complex hierarchical structures. In such systems, individuals are parts of larger organizations and systems, and both individual characteristics and organizational factors have important effects on organizational outcomes (Karsh et al., 2006; Karsh & Brown, 2010). In the multilevel approach, nurse education is viewed as an important individual characteristic with respect to patient safety outcomes (Karsh et al., 2006), and thus it is worthwhile to examine its effects on patient adverse events and quality of care at the individual level in addition to the hospital level.

Nurses' years of experience has also been linked to patient safety. Researchers have examined nurses' years of experience at either the unit or hospital level and this variable's relationship to patient outcomes, but study findings were inconsistent. For instance, some investigators found that units with higher proportions of nurses with more nursing experience had fewer medication errors and lower patient fall rates (Blegen, Vaughn, & Goode, 2001), whereas others found that years of nursing experience was not associated with patient mortality

in hospitals (Aiken et al., 2003; Kutney-Lee, Sloane, & Aiken, 2013). To date, nurse experience has been primarily examined as an organizational rather than an individual characteristic. However, in the multilevel approach, nurse experience is viewed as an important individual characteristic that can impact patient safety (Karsh et al., 2006). Therefore, it is advantageous to examine its effects on patient adverse events and quality of care at both the individual and hospital levels.

With regard to organizational characteristics, nurse work environment has been identified as an important factor in patient safety and care quality (Institute of Medicine, 2003). This environment consists of "the organizational characteristics of a work setting that facilitate or constrain professional nursing practice" (Lake, 2002, p. 178). However, a recent review of studies of nurses' work environments and patient outcomes revealed that much of the research to date has been limited by a focus on the effects of staffing on patient outcomes (Stalpers, de Brouwer, Kaljouw, & Schuurmans, 2015). Staffing is only one of several important work environment characteristics, and other important characteristics related to patient adverse events and quality of care need to be examined. In addition, although research has shown that a favorable nurse work environment is linked with improved patient outcomes, mortality has been by far the most commonly investigated patient outcomes (Aiken et al., 2008; Aiken et al., 2011; Cho et al., 2015; Friese, Lake, Aiken, Silber, & Sochalski, 2008). For these reasons, additional research is needed to more comprehensively investigate the effects of nurse work environment on more nursing-sensitive patient adverse events as well as quality of care.

In addition to nurse work environment, organizational safety culture has been identified as an important factor for improving patient safety in healthcare organizations (Mardon, Khanna, Sorra, Dyer, & Famolaro, 2010). Organizational safety culture is the product of individual and

group values, attitudes, perceptions, competencies, and patterns of behavior that affect the dedication, approach, and effectiveness of an organization's management of health and safety (Agency for Healthcare Research and Quality [AHRQ], 2004). Because both nurse work environment and organizational safety culture impact patient safety outcomes, examining the effects of organizational safety culture on the outcomes necessitates that the effects of nurse work environment also be considered. That is, the two sets of characteristics need to be examined simultaneously because of their potential confounding effects on patient safety (Ausserhofer et al., 2013). However, few researchers have concurrently examined the influences of organizational safety culture and other nurse-related organizational factors on patient adverse events and quality of care (Ausserhofer et al., 2013).

Given these considerations, this study was performed to investigate the effects of individual nurse and hospital characteristics and their interactions on patient adverse events and quality of care using a multilevel approach.

Conceptual Model

This study was guided by a multilevel conceptual framework based on Donabedian's structure-process-outcome (SPO) model on quality of care (Donabedian, 1988; Kozlowski & Klein, 2000). Structure refers to the attributes of the settings in which care is delivered and includes material and human resources as well as organizational structure. Process refers to activities performed in providing and receiving care and includes applications of good care, proper practice, and interactions between healthcare providers and patients. Outcome refers to the effects of care and includes clinical outcomes as well as quality of care (Donabedian, 1988; Donabedian, 1966). Donabedian assumed that good care settings and supportive structures would increase the probability of good processes, and good processes would increase the likelihood of

good outcomes. Because outcome measures are of intrinsic interest and can reflect all aspects of care (Mant, 2001), the SPO model concepts of structure and outcome have been applied to examine relationships between organizational structure and outcomes in healthcare industries (Krapohl, Manojlovich, Redman, & Zhang, 2010; Park, Blegen, Spetz, Chapman, & De Groot, 2012). Based on Donabedian's model and previous research, the primary interest for this study was a relationship between structure and outcomes. Healthcare organizations are multilevel systems with complex hierarchical structures (Kozlowski & Klein, 2000). In such systems, individual characteristics (micro perspectives) and organizational characteristics (macro perspectives) have different but important effects on outcomes (Karsh & Brown, 2010; Kozlowski & Klein, 2000). Thus, the differing influences of levels on these outcomes need to be examined using a multilevel approach (Karsh & Brown, 2010). This approach is especially beneficial for understanding organizational phenomena where nurses are nested within hospitals (McHugh & Lake, 2010) because nurses' perceptions and performance can be impacted by both their own individual and hospital characteristics (Karsh & Brown, 2010). In this study, structure refers to human resources in terms of two individual characteristics—nurse education level and years of experience—and to organizational structure in terms of hospital characteristics—hospital-level nurse education and experience, work environment, and organizational safety culture. Outcomes refer to nurse-reported patient adverse events (administration of wrong medication, time, or dose; patient falls with injury; and urinary tract infections) and to quality of care.

Based on the conceptual framework shown in Figure 1, two research questions were developed to be addressed in this study: (a) What are the independent effects of individual nurse characteristics (individual-level nurse education and experience) on patient adverse events and

quality of care? and (b) What are the independent effects of hospital characteristics (hospital-level nurse education and experience, work environment, and organizational safety culture) on patient adverse events and quality of care?

Methods

Design and Sample

This study was a secondary analysis of data collected in 2014 as part of a larger study performed to evaluate nurse workload and work environment in British Columbia (BC), Canada. The nurse questionnaire used to obtain data was based on Aiken's RN4CAST survey, which has undergone rigorous reliability and validity testing (Sermeus et al., 2011). To conduct the BC nurse survey, a proportionate stratified random sample was selected from a database maintained by the BC nurse union; the selection of the sample was based on BC health authorities and nurse employment status. To ensure the confidentiality of respondents, the union rather than the research team mailed study invitation postcards (each containing a unique password) that invited nurses to complete the online survey using Fluidsurveys; thereafter, reminders were e-mailed to nurses at 2-week intervals over one month. A second invitation consisting of a hard-copy survey was mailed to increase the overall response rate. Survey participation was voluntary, and entry in a raffle for one mini-iPad was used as an incentive for nurses to complete the survey.

The structure of the dataset was hierarchical: RNs (Level-1) were nested within hospitals (Level-2). RNs working in the same hospital may tend to be more similar to each other than RNs working in different hospitals because similar work experiences can be shared within a hospital. Therefore, individuals working in a given hospital could show correlated errors during statistical analysis, and this situation violates one of the basic assumptions of conventional regression. This issue can be accounted for by employing multilevel analysis (Luke, 2004). Therefore, multilevel

modeling was conducted to achieve the study's purpose.

After institutional ethics approval was obtained, data for this study were extracted from a database containing the BC nurse survey data. Subsequently, data for 1,053 RNs in 63 hospitals were analyzed. Facility data were obtained from publicly available information for the 2010-2011 and 2012-2013 periods maintained by the Canadian Institute for Health Information (CIHI).

Measures

Nurse demographics. Nurses' demographic information, including age, gender, and work status, was examined.

Individual nurse characteristics. Nurses reported their highest nursing education degree as diploma, bachelor's, or master's degree. The categories were collapsed into a binary variable for analysis in this study; that is i*ndividual-level nurse education* was analyzed as diploma (equal to zero) or baccalaureate or master's degree (equal to one). *Individual-level nurse experience* data were drawn from nurses' responses to the question, "how many years have you worked as a nurse?" Then, a within-subjects centering technique, which involved subtracting each hospital's mean years of nurse experience from each nurse's years of experience was used to establish values for individual-level nurse experience. Use of this technique is essential because it allows separation of within-subject effects from between-subject effects in multilevel models, which in turn avoids the ecological fallacy (Van de Pol & Wright, 2009).

Hospital characteristics. Hospital characteristics were measured by aggregating nurse-specific reports. This method is known to be accurate for showing group characteristics (Aiken et al., 2011) and is frequently used in the literature in the U.S. and other countries (Aiken et al., 2014; Aiken et al., 2011; Blegen et al., 2013; Cho et al., 2015). *Hospital-level nurse education*

was measured as the proportion of nurses in each hospital with a bachelor of science in nursing (BSN) degree or higher, and *hospital-level nurse experience* was measured as the mean years of experience of the nurses in each hospital.

Hospital-level nurse work environment was measured using the 28-item Practice Environment Scale of the Nursing Work Index (PES-NWI) (Lake, 2002). This instrument addresses five dimensions, namely (a) nurse participation in hospital affairs (8 items); (b) nursing foundations (such as a preceptor program for newly hired nurses) for quality of care (9 items); (c) nurse manager ability, leadership, and support of nurses (4 items); (d) staffing and resource adequacy (4 items); and (e) collegial nurse-physician relations (3 items). Responses are measured on 4-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). For this study sample, Cronbach's alpha values for the five PES-NWI subscales were 0.82, 0.76, 0.78, 0.82, and 0.83 respectively, and the alpha value for the total score was 0.91. Confirmatory factor analysis of the 28-item measure confirmed the original five-factor model. Model fit was evaluated using the following goodness-of-fit indices: the root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), and comparative fit index (CFI). For this study data, the RMSEA was 0.07, the SRMR was 0.06, and the CFI was 0.82. An RMSEA value smaller than 0.08 (Hair, Anderson, Babin, & Black, 2010), an SRMR value less than 0.08 (Hu & Bentler, 1999), and a CFI value in the range between 0.80 and 0.89 (Doll, Xia, & Torkzadeh, 1994) indicate an acceptable model fit. In addition, the construct and convergent validity of the 28-item PES-NWI has been demonstrated in Canadian hospital settings (Laschinger & Leiter, 2006). To calculate hospital-level nurse work environment scores, individual RN responses to items on each subscale were averaged. Next, the subscale scores of the individual nurses were aggregated to the hospital-level mean for each hospital, and then the

scores were categorized as unfavorable (lowest quartile), mixed (interquartile range), and favorable (highest quartile). Use of this method has been documented and supported in studies conducted in the U.S. and other countries (Aiken et al., 2012; Coetzee, Klopper, Ellis, & Aiken, 2013).

Hospital-level organizational safety culture was measured using seven items drawn from the AHRQ's Hospital Survey on Patient Safety Culture Questionnaire (AHRQ, 2009). The items addressed the prevailing patient safety culture within RNs' healthcare organizations (Sermeus et al., 2011). The seven items were phrased as follows: (a) staff feel like their mistakes are held against them, (b) important patient care information is often lost during shift changes, (c) things fall between the cracks when transferring patients from my primary unit to another, (d) staff feel free to question the decisions or actions of those in authority, (e) we discuss ways to prevent errors from happening again, (f) we are given feedback about changes put into place on event reports, and (g) the actions of my hospital's management show that patient safety is a top priority. Responses were made on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). In this study, negatively worded items (a,b, and c) were reversed for scoring purposes prior to the analysis. For this study sample, the Cronbach's alpha for the scale was 0.76. Using a minimum Eigen value of 1.0, factor analysis of the measure confirmed the one-factor model. The overall value of the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.76 and Bartlett's Test of Sphericity was statistically significant ($\chi 2$ (21) = 1680.542, $p < 0.001$), which indicated moderately high factorability. Therefore, a single composite score for the seven items was calculated by averaging the RN scores for each hospital; higher scores indicated stronger organizational safety culture in hospitals.

Outcomes. Patient adverse events and quality of care were examined as outcome

variables. Three nurse-reported *patient adverse events* were measured. Nurses reported the frequency of (a) administration of wrong medication, time, or dose; (b) patient falls with injury; and (c) urinary tract infections over the last year on a 7-point Likert scale that ranged from "never" to "everyday." These variables were analyzed as ordinal variables in this study. Nurses' reports of patient adverse events have been used in multiple international studies and have been reported to be reliable and valid measures (Aiken et al., 2013; Cho et al., 2016; Van Bogaert et al., 2014).

Quality of care was measured using a composite score for two items addressing (a) nurse-reported overall quality of care on their last shift using a 4-point Likert scale ranging from 1 (poor) to 4 (excellent) and (b) their recommendation of their hospital to friends and family if they needed care using a 4-point Likert scale ranging from 1 (definitely no) to 4 (definitely yes). These two items have been found to provide a reliable indication of quality of care in hospitals (Aiken et al., 2008; Aiken et al., 2012; Poghosyan, Clarke, Finlayson, & Aiken, 2010; Sochalski, 2004) and have established predictive validity (Nantsupawat et al., 2011).

The CIHI performed standardized comparisons of BC hospitals based on three hospital characteristics: teaching status, patient volumes, and patient complexities. The hospitals were then categorized in one of the following groups: teaching, community-large, community-medium, or community-small (CIHI, 2016a). In this study, the differences across hospitals were taken into account by controlling for these hospital characteristics. Also controlled for were unit types (medical-surgical, intensive care, emergency, operating and recovery room, and other) and BC health authorities (Fraser Health, Interior Health, Island Health, Northern Health, Provincial Health Services Authority, Providence Health Care, and Vancouver Coastal Health).

Data Analysis

Prior to the analyses, data were screened to assess their appropriateness (e.g., normality and outliers) for the planned analytic procedures. Descriptive statistics were used to describe the demographic characteristics of the sample and key study variables. Pearson correlations were conducted to examine the strength and direction of the relationships between key study variables. Pearson correlations and variance inflation factors were applied to identify potential multicollinearity among the independent variables. Multilevel ordinal logistic regressions and multilevel linear regressions were employed based on levels of measurements of the outcome variables (three patient adverse events and quality of care) to accomplish the study's purpose. Statistical analysis was conducted with STATA version 13 (StataCorp, LP, College Station, TX, USA). In all analyses, the statistical significance level was set at $p < 0.05$.

Results

Descriptive Statistics

The number of RNs in the analytic sample was 1,053. The number of RNs per hospital averaged 16; the number of hospitals was 63. Characteristics of the sample are presented in Table I. Most of the respondents were female (98.10%), with a mean age of 41.94 years and a mean of 14.28 years of work experience as a nurse. Approximately half (55.61%) were working full-time, 26.43% worked part-time, and 17.97% worked on a casual basis. Most (65.72%) had a baccalaureate or higher degree in nursing. The respondents' primary work areas included medical, surgical, and medical-surgical (44.06%); intensive care (11.11%); emergency (12.45%); operating and recovery room (9.00%); and other (23.37%) units. With respect to age, work status, gender, and level of education, the study sample was similar to the BC nursing workforce as reported by the CIHI (CIHI, 2016b). Regarding the characteristics of the 63 hospitals, four

were teaching hospitals (6.35%), 16 were community-large hospitals (25.40%), 19 were community-medium hospitals (30.16%), and 24 were community-small hospitals (38.10%).

Descriptive statistics for selected variables along with relevant F-statistics and the intraclass correlation (ICC) (1) are presented in Table II. Significant F test results and the ICC (1) values indicated that the data aggregation of nurse work environment and organizational safety culture variables to the hospital level was justified (Kozlowski & Klein, 2000). At the hospital level, the mean work environment score on the 4-point scale was 2.49 (*SD* = 0.13), and the mean organizational safety culture score on the 5-point scale was 2.94 (*SD* = 0.24). With regard to patient adverse events, administration of wrong medication, time, or dose; patient falls with injuries; and urinary tract infections were reported to occur a few times a month or more by 19.14%, 14.55%, and 23.13%, respectively. The mean nurse-reported quality of care score on the 4-point scale was 2.99 (*SD* = 0.63).

Multilevel Models

Two-level models were estimated to examine the effects of individual nurse and hospital characteristics on (a) nurse-reported patient adverse events and (b) quality of care while controlling for teaching status, patient volumes, and patient complexities of hospitals, unit types, and BC health authorities. The effects of individual nurse and hospital characteristics on the outcomes were separately examined by each model. The results of the multilevel ordinal regressions for patient adverse events and the multilevel linear regressions for quality of care are shown in Table III. For all outcome variables, the log likelihood ratio test comparing the unconditional model with the single-level ordinal logistic regression and linear regression model suggested that the unconditional model that estimated the between-group variance was preferred ($\chi^2_{(1)} = 6.33$, $p < 0.01$; $\chi^2_{(1)} = 26.75$, $p < 0.001$; $\chi^2_{(1)} = 12.27$, $p < 0.01$; and $\chi^2_{(1)} = 70.58$, $p <$

0.001 for administration of wrong medication, time, or dose; patient falls with injuries; urinary tract infections; and quality of care, respectively). Consequently, multilevel ordinal logistic regressions and multilevel linear regressions were conducted.

For each outcome variable, testing was conducted for the null model (Model 1, model with no predictors), the random-intercept model with Level-1 predictors (Model 2), and the random-intercept model with Level-1 and Level-2 predictors (Model 3). In the fully adjusted models (Model 3), no individual nurse characteristics were statistically significant predictors for any of the outcome variables. Among hospital characteristics, only organizational safety culture was a statistically significant predictor for all outcome variables while controlling for individual nurse and other hospital characteristics. In hospitals with stronger organizational safety culture, RNs reported that occurrences of patient adverse events were 64% lower for administration of wrong medication, time, or dose (odds ratio [OR]= 0.36, 95% confidence interval [CI]=0.16 - 0.80); 58% lower for patient falls with injury (OR=0.40, CI= 0.18 - 0.96); and 60% lower for urinary tract infections (OR=0.40, CI= 0.18 - 0.86). In addition, the results showed that for each one-unit increase in the composite score for organizational safety culture, nurse-reported quality of care increased 0.36 point on average ($p < 0.05$). This finding indicated that RNs who worked in hospitals with stronger organizational safety culture tended to report higher levels of quality of care in their hospitals.

Additional analyses were conducted to examine whether the effects of individual-level BSN education and years of experience on nurse-reported quality of care would vary across hospitals. For these analyses, random-intercept and random-slope models (Models 4 and 5) were developed. In Model 4, the slope variance of BSN education at the individual nurse level was small (< 0.01) but significant ($p < 0.05$), which implied that the effect of BSN education on

nurse-reported quality of care differed across hospitals. To further explore whether this variance could be explained by a particular hospital-level predictor, cross-level interaction models were developed. Among hospital characteristics, only hospital-level nurse education interacted with individual-level BSN education, and the coefficient of the interaction term was 0.79 ($p < 0.05$). This result indicated that BSN education had a more positive effect on nurse-reported quality of care in hospitals with higher proportions of BSN nurses; in other words, a BSN nurse in a hospital with a relatively high proportion of BSN nurses was more likely to report higher quality of care. In Model 5, the slope variance of years of experience at the individual nurse level was very small (< 0.01) but significant ($p < 0.05$), implying that the relationship between individual-level experience and nurse-reported quality of care varied across hospitals. Further examination of this random effect with hospital-level variables revealed no significant interactions.

Discussion

The purpose of this study was to examine the effects of individual nurse and hospital characteristics at different levels and their interactions on patient adverse events and quality of care. The study revealed that organizational safety culture was significantly associated with all three types of patient adverse events as well as quality of care. When the effects of nurse and hospital characteristics were controlled for, RNs in hospitals with stronger safety culture were 64% less likely to report administration of wrong medication, time, or dose; 58% less likely to report patient falls with injury after admission; and 60% less likely to report urinary tract infections than RNs in weaker safety culture. In addition, RNs who worked in hospitals with a stronger safety culture were significantly more likely to report higher levels of quality of care in their hospitals. These findings were consistent with several previous studies reporting that positive safety culture was related to fewer adverse events such as medication errors and urinary

tract infections (Hofmann & Mark, 2006) and fewer AHRQ patient safety indicators in U.S. hospitals (Mardon et al., 2010; Singer, Lin, Falwell, Gaba, & Baker, 2009), fewer medication errors and patient falls in Korean hospitals (Hwang & Hwang, 2011), and better quality of care in Swiss nursing homes (Zuniga et al., 2015).

This study showed that from the RNs' perspectives, a strong organizational safety culture was related to fewer patient adverse events and higher levels of quality of care. However, the concept of safety culture is a complex phenomenon that includes many elements such as leadership, teamwork, evidence-based practice, communication, learning, and just culture (Sammer, Lykens, Singh, Mains, & Lackan, 2010). Therefore, to improve safety culture in healthcare organizations, hospital administrators and managers should strive to create a trusting and non-punitive environment for error reporting to allow personnel to learn from their mistakes (Sammer et al., 2010), and they should also encourage staff to share important safety-related information (Patankar, Brown, Sabin, & Bigda-Peyton, 2012). Furthermore, both managers and employees should be responsible for improving safety and thus create an environment that would increase staff-management trust (Patankar et al., 2012). Moreover, all caregivers should embrace teamwork and collaboration in establishing a system-wide safety culture (National Quality Forum, 2006). In addition, given this study's findings that hospital characteristics affected the outcomes, hospital administrators who are designing and implementing safety interventions should carefully consider their hospital-level effects on patient adverse events and quality of care. At the national level, financial incentives and rewards should be allocated to healthcare organizations attempting to implement care processes based on evidence-based practices in order to improve quality of care (Institute of Medicine, 2001). Such approaches could help to foster stronger safety culture in more healthcare organizations, which in turn could reduce patient

adverse events and improve quality of care.

In this study, nurse work environment was not a statistically significant predictor for nurse-reported patient adverse events or quality of care. This finding is consistent with previous research reporting that nurse work environment was not associated with nurse-reported patient adverse events (Ausserhofer et al., 2013; Lucero et al., 2010) or quality of care (McCusker, Dendukuri, Cardinal, Laplante, & Bambonye, 2004) in Swiss, U.S., and Canadian hospitals. Although some researchers found that favorable work environments were related to better patient outcomes (Coetzee et al., 2013; Kirwan, Matthews, & Scott, 2013; Lake et al., 2016), a recent review of the literature revealed inconsistent findings on effects of work environment on patient outcomes (Lee & Scott, 2016). In the current study, one possible reason for the non-significant effect of work environment could be related to the use of the PES-NWI to measure work environment at the hospital level. This approach does not account for the fact that each type of healthcare unit has its own unique characteristics and that nurses' perceptions of their work environment are influenced by the organizational characteristics of their unit (Adams & Bond, 1997). When researchers applied the PES-NWI at the unit level, they found that nurses' perceptions of their work environments varied according to their work units in U.S. hospitals (Choi & Boyle, 2014). Although the PES-NWI has been used in various international nursing studies to measure the concept of nurse work environment at the hospital level (Aiken et al., 2008; Aiken et al., 2011; Cho et al., 2016; Coetzee et al., 2013; Lucero et al., 2010), this scale may better reflect unit differences than hospital differences in work environments. Notably, Lake (2002) indicated that two PES-NWI subscales (nurse participation in hospital affairs and nursing foundations for quality of care) reflected hospital-wide environments whereas the other three subscales (nurse manager ability, leadership, and support; staffing and resource adequacy; and

collegial relationships) reflected unit environments. Therefore, further research is needed to examine effects of nurse work environment on patient adverse events and quality of care at the unit level.

Despite the assumption that the RNs' education levels would be an important predictor for nurse-reported patient adverse events and quality of care, in this study, both individual- and hospital-level nurse education were found to be non-significant predictors. Earlier studies on the effects of nurse education on patient outcomes have shown mixed results. For example, while some researchers found that a higher percentage of nurses with a baccalaureate or higher degree was associated with lower patient mortality rates in U.S. hospitals (Aiken et al., 2014; Aiken et al., 2011; Blegen et al., 2013), others found that nurses' education levels were not related to rates of medication error or patient falls in U.S. hospitals (Blegen et al., 2001). In addition, in a recent Iranian study, researchers found that individual nurses' education levels were not associated with their reports of patient adverse events such as medication errors, patient falls, and nosocomial infections (Abadi, Akbari, Akbari, Gholami-Fesharaki, & Ghasemi, 2016). However, a notable finding of the current study was that effects of individual-level BSN education on nurse perceptions of quality of care differed across hospitals. Furthermore, the finding of significant interaction between individual-level and hospital-level nurse education indicated the potential importance of baccalaureate nursing education on quality of care in hospitals, supporting the IOM's (2011) recommendation to promote higher levels of nurse education for improved health outcomes. This finding suggests that hospital policies requiring new nurses to have a baccalaureate degree would better serve patients and hospitals (Aiken et al., 2011).

As was the case with RNs' education levels, the study results indicated that both individual- and hospital-level nurse experience were not significant predictors for nurse-reported

patient adverse events or quality of care. Effects of nurse experience on patient outcomes have been inconsistent in previous studies. For example, while investigators found that units with more experienced nurses had lower rates of medication errors and patient falls in U.S. hospitals (Blegen et al., 2001), other U.S. studies found no significant effect of hospital-level nurse experience on patient safety outcomes (Aiken et al., 2003; Kutney-Lee et al., 2013). In addition, individual-level nurse experience was not associated with Swedish nurses' assessment of patient safety (Alenius, Tishelman, Runesdotter, & Lindqvist, 2013), and longer nursing experience was not associated with Iranian nurses' perceptions of patient adverse events (Abadi et al., 2016). A noteworthy finding of the current study was that the effect of individual-level nurse experience on nurse-reported quality of care varied across different hospitals. However, no significant interactions were found between the random effect and the hospital characteristics examined. Therefore, currently unidentified or unmeasured hospital characteristics (such as training provided for care quality) should be explored to better understand the cross-level interaction between individual-level nurse experience and hospital characteristics.

Based on the study findings, nurses' educational background and years of experience may have limited impact on their perceptions of patient adverse events and quality of care in their hospitals. Rather, such perceptions may be more greatly impacted by the existing systems of their hospital settings such as a culture of safety (Joint Commission, 2016). The inconsistent findings of the studies conducted to date regarding the effects of nurse education and experience on patient safety and quality of care warrant further investigation of these effects.

Limitations

This study has limitations that should be acknowledged. A primary limitation of the study is its reliance on cross-sectional data; consequently, the results cannot establish causality

among variables. Also, because the study involved secondary analysis of a BC nurse dataset obtained using self-report questionnaires, the data are inherently subjective. Although the occurrences of patient adverse events reported by nurses could not be objectively verified, previous researchers have demonstrated that nurses are reliable sources of information for measuring patient outcomes and quality of care (Aiken, Clarke, & Sloane, 2002; Lake et al., 2016; McHugh & Stimpfel, 2012). Nurses are reliable reporters of such outcomes because they are in regular, close contact with patients due to their involvement in all aspects of patient care (McHugh & Stimpfel, 2012). Moreover, nurse report-based evidence has been effectively used in research linking organizational characteristics to patient safety outcomes and quality of care in various settings across many countries (Aiken et al., 2011; Aiken et al., 2013; Cho et al., 2016; Kang, Kim, & Lee, 2014; Lake et al., 2016). Finally, although administrative data were used to control for differences across hospitals, it is possible that unknown or unmeasured factors (e.g., the presence of hospital safety culture improvement programs) could have contributed for the associations found in this study.

Conclusion

This study makes significant contributions to the existing body of knowledge regarding the positive effect of organizational safety culture on patient adverse events and quality of care. Quality and safety can vary considerably across healthcare organizations, but safety culture appears to be a key organizational factor underlying reduction of patient adverse events and improvement of quality of care. As shown in this study, there is room for improvement in safety culture, patient safety, and quality of care in BC acute care hospitals. With the current healthcare emphasis on continuous quality improvement, it is vital that healthcare organizations strive to improve their safety culture by creating environments where healthcare providers can trust each

other, work collaboratively, and share accountability for patient safety and care quality (Joint Commission, 2016). Improving safety culture in healthcare organizations may be a promising strategy for substantially reducing patient adverse events and improving quality of care.

References

Abadi, M. B. H., Akbari, H., Akbari, H., Gholami-Fesharaki, M., & Ghasemi, M. (2016). The association of nursing workloads, organizational, and individual factors with adverse patient outcome. *Iranian Red Crescent Medical Journal,* doi:10.5812/ircmj.43444

Aiken, L. H., Clarke, S. P., Cheung, R. B., Sloane, D. M., & Silber, J. H. (2003). Educational levels of hospital nurses and surgical patient mortality. *Journal of American Medical Association, 290*(12), 1617-1623. doi:10.1001/jama.290.12.1617

Aiken, L. H., Sloane, D. M., Bruyneel, L., Van den Heede, K., Griffiths, P., Busse, R., . . . Lesaffre, E. (2014). Nurse staffing and education and hospital mortality in nine European countries: A retrospective observational study. *The Lancet, 383*(9931), 1824-1830. doi:http://dx.doi.org/10.1016/S0140-6736(13)62631-8

Aiken, L. H., Cimiotti, J. P., Sloane, D. M., Smith, H. L., Flynn, L., & Neff, D. F. (2011). Effects of nurse staffing and nurse education on patient deaths in hospitals with different nurse work environments. *Medical Care, 49*(12), 1047-1053. doi:10.1097/MLR.0b013e3182330b6e

Aiken, L. H., Clarke, S. P., & Sloane, D. M. (2002). Hospital staffing, organization, and quality of care: Cross-national findings. *Nursing Outlook, 50*(5), 187-194. doi:10.1067/mno.2002.126696

Aiken, L. H., Clarke, S. P., Sloane, D. M., Lake, E. T., & Cheney, T. (2008). Effects of hospital care environment on patient mortality and nurse outcomes. *The Journal of Nursing Administration, 38*(5), 223-229. doi:10.1097/01.NNA.0000312773.42352.d7

Aiken, L. H., Sermeus, W., Van den Heede, K., Sloane, D. M., Busse, R., McKee, M., . . . Kutney-Lee, A. (2012). Patient safety, satisfaction, and quality of hospital care: Cross

sectional surveys of nurses and patients in 12 countries in Europe and the united states. *BMJ, 344*, e1717. doi:10.1136/bmj.e1717

Aiken, L. H., Sloane, D. M., Bruyneel, L., Van den Heede, K., Sermeus, W., & RN4CAST Consortium. (2013). Nurses' reports of working conditions and hospital quality of care in 12 countries in Europe. *International Journal of Nursing Studies, 50*(2), 143-153. doi:10.1016/j.ijnurstu.2012.11.009

Aiken, L. H., Sloane, D. M., Clarke, S., Poghosyan, L., Cho, E., You, L., . . . Aungsuroch, Y. (2011). Importance of work environments on hospital outcomes in nine countries. *International Journal for Quality in Health Care, 23*(4), 357-364. doi:10.1093/intqhc/mzr022

Alenius, L. S., Tishelman, C., Runesdotter, S., & Lindqvist, R. (2013). Staffing and resource adequacy strongly related to RNs' assessment of patient safety: A national study of RNs working in acute-care hospitals in Sweden. *BMJ Quality & Safety,* doi:10.1136/bmjqs-2012-001734

Ausserhofer, D., Schubert, M., Desmedt, M., Blegen, M. A., De Geest, S., & Schwendimann, R. (2013). The association of patient safety climate and nurse-related organizational factors with selected patient outcomes: A cross-sectional survey. *International Journal of Nursing Studies, 50*(2), 240-252. doi:10.1016/j.ijnurstu.2012.04.007

Blegen, M. A., Goode, C. J., Park, S. H., Vaughn, T., & Spetz, J. (2013). Baccalaureate education in nursing and patient outcomes. *Journal of Nursing Administration, 43*(2), 89-94. doi:10.1097/NNA.0b013e31827f2028

Blegen, M. A., Vaughn, T. E., & Goode, C. J. (2001). Nurse experience and education: Effect on quality of care. *Journal of Nursing Management, 31*, 33-39.

Canadian Institute for Health Information. (2016a). Peer group methodology. Retrieved from https://www.cihi.ca/en/types-of-care/hospital-care/acute-care/peer-groups-in-the-electronic-discharge-abstract-database

Canadian Institute for Health Information. (2016b). Regulated nurses, 2014. Retrieved from https://secure.cihi.ca/estore/productFamily.htm?locale=en&pf=PFC2898&lang=en

Cho, E., Chin, D. L., Kim, S., & Hong, O. (2016). The relationships of nurse staffing level and work environment with patient adverse events. *Journal of Nursing, 48*(1), 74-82. doi:10.1111/jnu.12183

Cho, E., Sloane, D. M., Kim, E. Y., Kim, S., Choi, M., Yoo, I. Y., . . . Aiken, L. H. (2015). Effects of nurse staffing, work environments, and education on patient mortality: An observational study. *International Journal of Nursing Studies, 52*(2), 535-542. doi:10.1016/j.ijnurstu.2014.08.006

Choi, J., & Boyle, D. K. (2014). Differences in nursing practice environment among US acute care unit types: A descriptive study. *International Journal of Nursing Studies, 51*(11), 1441-1449.

Coetzee, S. K., Klopper, H. C., Ellis, S. M., & Aiken, L. H. (2013). A tale of two systems--nurses practice environment, well being, perceived quality of care and patient safety in private and public hospitals in south Africa: A questionnaire survey. *International Journal of Nursing Studies, 50*(2), 162-173. doi:10.1016/j.ijnurstu.2012.11.002

Doll, W. J., Xia, W., & Torkzadeh, G. (1994). A confirmatory factor analysis of the end-user computing satisfaction instrument. *MIS Quarterly, 18*, 453-461.

Donabedian, A. (1988). The quality of care: How can it be assessed? *Journal of American Medical Association, 260*(12), 1743-1748.

Donabedian, A. (1966). Evaluating the quality of medical care. *The Milbank Memorial Fund Quarterly, 44*(3), Suppl:166-206.

Friese, C. R., Lake, E. T., Aiken, L. H., Silber, J. H., & Sochalski, J. (2008). Hospital nurse practice environments and outcomes for surgical oncology patients. *Health Services Research, 43*(4), 1145-1163. doi:10.1111/j.1475-6773.2007.00825.x

Hair, J. F., Anderson, R. E., Babin, B. J., & Black, W. C. (Eds.). (2010). *Multivariate data analysis: A global perspective* (7th ed.). Upper Saddle River, NJ: Pearson.

Hofmann, D. A., & Mark, B. (2006). An investigation of the relationship between safety climate and medication errors as well as other nurse and patient outcomes. *Personnel Psychology, 59*(4), 847-869.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1-55.

Hwang, J. I., & Hwang, E. J. (2011). Individual and work environment characteristics associated with error occurrences in Korean public hospitals. *Journal of Clinical Nursing, 20*(21-22), 3256-3266. doi:10.1111/j.1365-2702.2011.03773.x

Institute of Medicine. (2001). *Crossing the quality chasm: A new health system for the 21st century*. Washington, D.C.: National Academy Press.

Institute of Medicine. (2003). *Keeping patients safe: Transforming the work environment of nurses*. Washington, D.C: National Academies Press.

Joint Commission. (2016). Patient safety system. *Https://Www.Jointcommission.Org/Assets/1/18/PSC_for_Web.Pdf*, , June, 2017.

Kang, J. H., Kim, C. W., & Lee, S. Y. (2014). Nurse-perceived patient adverse events and nursing practice environment. *Journal of Preventive Medicine and Public Health = Yebang Uihakhoe Chi, 47*(5), 273-280. doi:10.3961/jpmph.14.019

Karsh, B. T., & Brown, R. (2010). Macroergonomics and patient safety: The impact of levels on theory, measurement, analysis and intervention in patient safety research. *Applied Ergonomics, 41*(5), 674-681. doi:10.1016/j.apergo.2009.12.007

Karsh, B. T., Holden, R. J., Alper, S. J., & Or, C. K. (2006). A human factors engineering paradigm for patient safety: Designing to support the performance of the healthcare professional. *Quality & Safety in Health Care, 15 Suppl 1*, i59-i65. doi:10.1136/qshc.2005.015974

Kirwan, M., Matthews, A., & Scott, P. A. (2013). The impact of the work environment of nurses on patient safety outcomes: A multi-level modelling approach. *International Journal of Nursing Studies, 50*(2), 253-263. doi:10.1016/j.ijnurstu.2012.08.020

Kozlowski, S. W. J., & Klein, K. J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In K. J. Klein, & S. W. J. Kozlowski (Eds.), *Multilevel theory, research and methods in organizations: Foundations, extensions, and new directions* (pp. 3-90). San Francisco, CA: Jossey-Bass.

Krapohl, G., Manojlovich, M., Redman, R., & Zhang, L. (2010). Nursing specialty certification and nursing-sensitive patient outcomes in the intensive care unit. *American Journal of Critical Care, 19*(6), 490. doi:10.4037/ajcc2010406

Kutney-Lee, A., Sloane, D. M., & Aiken, L. H. (2013). An increase in the number of nurses with baccalaureate degrees is linked to lower rates of postsurgery mortality. *Health Affairs, 32*(3), 579-586. doi:10.1377/hlthaff.2012.0504

Lake, E. T. (2002). Development of the practice environment scale of the nursing work index. *Research in Nursing & Health, 25*(3), 176-188. doi:10.1002/nur.10032

Lake, E. T., Hallowell, S. G., Kutney-Lee, A., Hatfield, L. A., Del Guidice, M., Boxer, B. A., . . . Aiken, L. H. (2016). Higher quality of care and patient safety associated with better NICU work environments. *Journal of Nursing Care Quality, 31*(1), 24-32. doi:10.1097/NCQ.0000000000000146

Laschinger, H., & Leiter, M. P. (2006). The impact of nursing work environments on patient safety outcomes: The mediating role of burnout/engagement. *Journal of Nursing Administration, 36*(5), 259-267. doi:00005110-200605000-00019

Lee, S. E., & Scott, L. (2016). Hospital nurses' work environment characteristics and patient safety outcomes: A literature review. *Western Journal of Nursing Research,* doi:10.1177/0193945916666071

Lucero, R. J., Lake, E. T., & Aiken, L. H. (2010). Nursing care quality and adverse events in US hospitals. *Journal of Clinical Nursing, 19*(15-16), 2185-2195.

Luke, D. A. (2004). *Multilevel modeling*. Thousand Oaks: SAGE Publications, Inc. doi:http://dx.doi.org/10.4135/9781412985147

Mant, J. (2001). Process versus outcome indicators in the assessment of quality of health care. *International Journal for Quality in Health Care, 13*(6), 475-480.

Mardon, R. E., Khanna, K., Sorra, J., Dyer, N., & Famolaro, T. (2010). Exploring relationships between hospital patient safety culture and adverse events. *Journal of Patient Safety, 6*(4), 226-232. doi:10.1097/PTS.0b013e3181fd1a00

McCusker, J., Dendukuri, N., Cardinal, L., Laplante, J., & Bambonye, L. (2004). Nursing work environment and quality of care: Differences between units at the same hospital. *International Journal of Health Care Quality Assurance, 17*(6), 313-322.

McHugh, M. D., & Stimpfel, A. W. (2012). Nurse reported quality of care: A measure of hospital quality. *Research in Nursing & Health, 35*(6), 566-575.

McHugh, M. D., & Lake, E. T. (2010). Understanding clinical expertise: Nurse education, experience, and the hospital context. *Research in Nursing & Health, 33*(4), 276-287. doi:10.1002/nur.20388

Nantsupawat, A., Srisuphan, W., Kunaviktikul, W., Wichaikhum, O., Aungsuroch, Y., & Aiken, L. (2011). Impact of nurse work environment and staffing on hospital nurse and quality of care in Thailand. *Journal of Nursing Scholarship, 43*(4), 426-433. doi:10.1111/j.1547-5069.2011.01419.x

National Quality Forum. (2006). *Safe practice for better healthcare*. Washington, DC: National Quality Forum.

Park, S. H., Blegen, M. A., Spetz, J., Chapman, S. A., & De Groot, H. (2012). Patient turnover and the relationship between nurse staffing and patient outcomes. *Research in Nursing & Health, 35*(3), 277-288. doi:10.1002/nur.21474

Patankar, M. S., Brown, J. P., Sabin, E. J., & Bigda-Peyton, T. G. (2012). The safety culture pyramid. *Safety culture: Building and sustaining a cultural change in aviation and healthcare* (pp. 1-24). Burlington, VT: Ashgate Publishing Company.

Poghosyan, L., Clarke, S. P., Finlayson, M., & Aiken, L. H. (2010). Nurse burnout and quality of care: Cross-national investigation in six countries. *Research in Nursing & Health, 33*(4), 288-298. doi:10.1002/nur.20383

Ridley, R. T. (2008). The relationship between nurse education level and patient safety: An integrative review. *Journal of Nursing Education, 47*(4), 149-156. doi:10.3928/01484834-20080401-06

Sammer, C. E., Lykens, K., Singh, K. P., Mains, D. A., & Lackan, N. A. (2010). What is patient safety culture? A review of the literature. *Journal of Nursing Scholarship, 42*(2), 156-165. doi:10.1111/j.1547-5069.2009.01330.x

Sermeus, W., Aiken, L. H., Van den Heede, K., Rafferty, A. M., Griffiths, P., Moreno-Casbas, M. T., . . . RN4CAST consortium. (2011). Nurse forecasting in Europe (RN4CAST): Rationale, design and methodology. *BMC Nursing, 10* doi:10.1186/1472-6955-10-6

Singer, S., Lin, S., Falwell, A., Gaba, D., & Baker, L. (2009). Relationship of safety climate and safety performance in hospitals. *Health Services Research, 44*(2 Pt 1), 399-421. doi:10.1111/j.1475-6773.2008.00918.x

Sochalski, J. (2004). Is more better?: The relationship between nurse staffing and the quality of nursing care in hospitals. *Medical Care, 42*(2 Suppl), II67-II73. doi:10.1097/01.mlr.0000109127.76128.aa

Stalpers, D., de Brouwer, B. J., Kaljouw, M. J., & Schuurmans, M. J. (2015). Associations between characteristics of the nurse work environment and five nurse-sensitive patient outcomes in hospitals: A systematic review of literature. *International Journal of Nursing Studies, 52*(4), 817-835. doi:10.1016/j.ijnurstu.2015.01.005

Van Bogaert, P., Timmermans, O., Weeks, S. M., van Heusden, D., Wouters, K., & Franck, E. (2014). Nursing unit teams matter: Impact of unit-level nurse practice environment, nurse work characteristics, and burnout on nurse reported job outcomes, and quality of care, and

patient adverse events--across-sectional survey. *International Journal of Nursing Studies, 51*(8), 1123-1134. doi:10.1016/j.ijnurstu.2013.12.009

Van de Pol, M., & Wright, J. (2009). A simple method for distinguishing within- versus between-subject effects using mixed models. *Animal Behaviour, 77*, 753-758. doi:10.1016/j.anbehav.2008.11.006

Zuniga, F., Ausserhofer, D., Hamers, J. P., Engberg, S., Simon, M., & Schwendimann, R. (2015). Are staffing, work environment, work stressors, and rationing of care related to care workers' perception of quality of care? A cross-sectional study. *Journal of the American Medical Directors Association, 16*(10), 860-866. doi:10.1016/j.jamda.2015.04.012

Table I

Descriptive Statistics for Individual Nurse Characteristics (*N* = 1,053)

Characteristic	*Mean (SD)*	*n (%)*
Age (years)	41.94 (12.44)	
Years worked as a nurse	14.28 (10.69)	
Gender		
Male		20 (1.90)
Female		1,033 (98.10)
Job status		
Full-time		585 (55.61)
Part-time		278 (26.43)
Casual		189 (17.97)
Highest nursing education		
Diploma		361 (34.28)
Bachelor's or Master's		692 (65.72)
Unit type		
Medical and surgical		460 (44.06)
Intensive care		116 (11.11)
Emergency		130 (12.45)
Operating/recovery room		94 (9.00)
Other		244 (23.37)

Note. SD = standard deviation.

Table II

Results for Work Environment, Organizational Safety Culture, Patient Adverse Events, and Quality of Care (*N* = 1,053)

Variable	n (%)	Mean (SD)	Cronbach's α	*F-statistic*[a]	ICC (1)[b]
Work environment		2.49 (0.13)	0.91	$F(63,958) = 1.77^{***}$	0.05
Organizational safety culture		2.94 (0.24)	0.76	$F(63,989) = 2.14^{***}$	0.07
Patient adverse events					
Administration of wrong medication, time, or dose					
Never	209 (19.90)				
A few times a year or less	494 (47.05)				
Once a month or less	146 (13.90)				
A few times a month	104 (9.90)				
Once a week	36 (3.43)				
A few times a week	47 (4.48)				
Everyday	14 (1.33)				
Fall with injury					
Never	347 (33.02)				
A few times a year or less	377 (35.87)				
Once a month or less	174 (16.56)				
A few times a month	90 (8.56)				
Once a week	32 (3.04)				
A few times a week	31 (2.95)				
Everyday	0 (0.00)				
Urinary tract infection					
Never	275 (26.39)				
A few times a year or less	328 (31.48)				
Once a month or less	198 (19.00)				
A few times a month	160 (15.36)				
Once a week	49 (4.70)				
A few times a week	27 (2.59)				
Everyday	5 (0.48)				

Quality of care	2.99 (0.63)

Note. ICC = intraclass correlation; SD = standard deviation.

[a] Between-hospital variance: *F*-statistic from a one-way variance analysis (ANOVA) should yield a significant result at $p < 0.05$ (Ausserhofer et al., 2013).

[b] Describes how strongly responses of nurses in the same hospital resemble each other: ICC (1) should have values between 0.05 and 0.30 (Ausserhofer et al., 2013).

***$p < 0.001$.

Table III

Multilevel Ordinal Logistic Regression on Patient Adverse Events and Multilevel Linear Regression on Quality of Care

	Wrong medication, time, or dose[a] (N^c =1,042)	Fall with injury[a] (N^c=1,042)	Urinary tract infection[a] (N^c=1,033)	Quality of care[b] (N^c=1,044)
	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Coefficient (SE)
Individual Nurse Characteristics				
Nurse education	1.56 (0.98-2.25)	1.26 (0.87-1.81)	1.34 (0.95-1.89)	-0.06 (0.05)
Nurse experience	1.00 (0.99-1.02)	1.00 (0.98-1.01)	1.00 (0.99-1.02)	0.01 (0.01)
Hospital Characteristics				
Nurse education (% BSN)	0.41 (0.09-1.82)	0.64 (0.14-2.93)	0.64 (0.15-2.75)	0.28 (0.27)
Nurse experience (mean years)	1.00 (0.93-1.07)	1.03 (0.96-1.10)	0.99 (0.93-1.06)	0.01 (0.01)
Work environment (ref. unfavorable)				
Mixed	1.11 (0.77-1.62)	0.72 (0.49-1.05)	0.98 (0.68-1.43)	0.50 (0.08)
Favorable	1.30 (0.62-2.71)	0.65 (0.31-1.36)	0.48 (0.23-1.00)	0.02 (0.15)
Organizational safety culture	0.36 (0.16-0.80)*	0.42 (0.18-0.96)*	0.40 (0.18-0.86)*	0.36 (0.14)*

Note. BSN = bachelor of science in nursing; CI = confidence interval; ref = reference; SE = standard error.

[a] A separate two-level model was developed for each outcome using multilevel ordinal logistic regression.

[b] A two-level model was developed for the outcome using multilevel linear regression.

[c] Variations in the total nurse sample are due to missing data.

*$p < 0.05$.

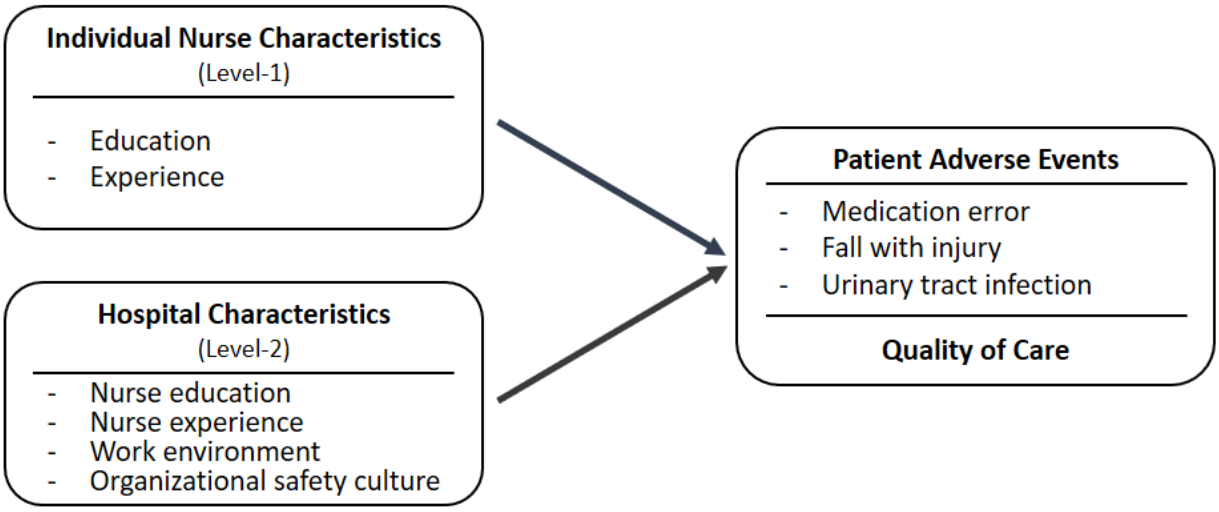

Figure 1. Study conceptual framework

II. RELATIONSHIP BETWEEN SAFETY CULTURE AND OUTCOMES FOR PATIENT SAFETY AND CARE QUALITY: A LITERATURE REVIEW

Background

Patient safety is a one of the principal quality concerns in healthcare organizations (Institute of Medicine [IOM], 2001), as it is a critical first step in enhancing quality of care (IOM, 1999). The IOM (1999) emphasized the importance of creating a culture of safety in healthcare organizations to improve patient safety and quality of care. Safety culture has been defined as "the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management" (Health and Safety Commission Advisory Committee, 1993). Subsequent to the IOM reports, a number of literature reviews on safety culture, patient safety, and quality of care have been published. However, these reviews have focused on review of measures (Halligan & Zecevic, 2011; Pumar-Méndez, Attree, & Wakefield, 2015; Singla, Kitch, Weissman, & Campbell, 2006) and dimensions of the concept of safety culture (Sammer et al., 2010) rather than on the relationship between safety culture and outcomes for patient safety and care quality.

DiCuccio (2015) recently published a systematic review of patient safety culture and nurse-sensitive outcomes. She reviewed studies in which "patient/family satisfaction or direct patient outcome measures" were measured and excluded studies that used "healthcare professionals' perceptions of patient safety outcomes" (DiCuccio, 2015). Although DiCuccio's emphasis on objective measures of nurse-sensitive patient outcomes is reasonable, many researchers have used self-report surveys to measure healthcare professionals' perceptions of patient safety and care quality outcomes. Healthcare professionals are likely to be the first to

observe safety issues in their organizations, and thus examining their views on patient safety and quality of care is important (Verbeek-Van Noord, Wagner, Van Dyck, Twisk, & De Bruijne, 2014). Additionally, researchers have convincingly demonstrated that as healthcare professionals, nurses are reliable reporters of information for assessing outcomes for patient safety and care quality (Aiken et al., 2002; Lake et al., 2016; McHugh & Stimpfel, 2012); this is not surprising because nurses are involved in all aspects of patient care and thus routinely have close contact with patients (McHugh & Stimpfel, 2012). Therefore, review of studies using healthcare professionals' perceptions of patient safety and care quality outcomes is necessary to more fully understand the relationship between safety culture and these outcomes.

Moreover, Dicuccio (2015) stated that her review did not include some important patient outcomes such as pressure ulcers and urinary tract infections. With the growing awareness of the effect of safety culture on outcomes for patient safety and quality of care, it is important to examine a broader range of patient safety and care quality outcomes and how they are related to safety culture in hospitals. Such examination will provide a clearer understanding of the relationships among these concepts. Thus, the aims of this paper are to provide an integrative review of the literature on the relationship between safety culture and outcomes for patient safety and care quality in hospital settings and to identify areas warranting future study.

Method

The literature search method recommended by Garrard (2011) was used to conduct this integrative review. Relevant peer-reviewed articles were identified through searches of six electronic databases: CINAHL, Google Scholar, PsycINFO, PubMed, Scopus, and Web of Science. Key search terms included *safety culture, culture of safety, safety climate, patient outcome, adverse event, patient safety, quality, care quality,* and *quality of care*. Although

"safety culture" and "safety climate" are distinct concepts, researchers have used the terms interchangeably in the healthcare literature (Groves, 2014); therefore, both terms were used as key words for the literature search. Furthermore, ancestry approaches were used to find additional articles for review.

Under the inclusion criteria, studies were included when (a) relationships between safety culture and outcomes for patient safety and care quality in hospital settings were examined; (b) safety culture was measured as an independent variable; (c) publication occurred between 1999 and 2017, thus reflecting progress in research on patient safety and quality of care after the IOM reports; and (d) the English language was used. Studies were excluded if they (a) did not examine clear relationships between safety culture and patient safety or care quality outcomes in hospital settings and (b) were specific to particular diseases.

Using the key search terms and their combinations, a total of 1,232 titles were identified for initial screening. These titles were reviewed for their overall relevance in hospital settings; after irrelevant and duplicate titles were removed, 67 titles remained for abstract review. An abstract was excluded if it failed to meet any of the inclusion criteria. After abstract review, 21 studies addressing relationships between safety culture and patient safety and/or care quality outcomes in hospital settings remained for full-text reading. Under the exclusion criteria, four studies were excluded. Finally, 17 studies were selected for integrative review based on the study criteria. Figure 2 shows a flowchart of the study selection process.

The quality of each study reviewed was evaluated based on a quality assessment and validity tool adapted from previously published systematic literature reviews (Bae, 2011; Cummings et al., 2010; Lee & Scott, 2016). The adapted tool contained 13 questions applied to assess individual study's design, sample, measurement, and statistical analysis. With this tool, 12

items were scored as either 0 (not met) or 1 (met), and one item addressing measurement of safety culture was scored as 2 (objective), 1 (self-report), or 0 (not met). Based on the total points received, the 17 studies fell into one of three quality categories: high (10-14), medium (5-9), and low (0-4). All 17 studies reviewed were assessed to be of medium methodological quality. The quality assessment of the reviewed studies is summarized in Table IV.

Findings

Characteristics of Studies Reviewed

The 17 studies meeting the inclusion criteria were fully reviewed, and their characteristics are summarized in Table V. Nine studies were conducted in the U.S. (Abrahamson, Hass, Morgan, Fulton, & Ramanujam, 2016; Brown & Wolosin, 2013; Davenport, Henderson, Mosca, Khuri, & Mentzer, 2007; Fan et al., 2016; Hofmann & Mark, 2006; Huang et al., 2010; Mardon et al., 2010; Singer et al., 2009; Thomas-Hawkins & Flynn, 2015); five in the European countries of Switzerland, Sweden, Ireland, Austria, Germany, and the Netherlands (Alenius et al., 2013; Ausserhofer et al., 2013; Kirwan et al., 2013; Valentin, Schiffinger, Steyrer, Huber, & Strunk, 2013; Verbeek-Van Noord et al., 2014); one in Lebanon (El-Jardali, Dimassi, Jamal, Jaafar, & Hemadeh, 2011); one in Jordan (Saleh, Darawad, & Al-Hussami, 2015); and one in Korea (Hwang & Hwang, 2011). All the studies had cross-sectional research designs.

Among the 17 studies reviewed, only two research teams identified a theory or theoretical framework, such as the nursing organization and outcome model (Aiken et al., 2002), that was used to investigate the relationship between safety culture and outcomes for patient safety and care quality in hospitals (Ausserhofer et al., 2013; Thomas-Hawkins & Flynn, 2015).

Levels of analysis varied in the 17 studies. Specifically, data were analyzed at the

individual level in five studies (Alenius et al., 2013; Hwang & Hwang, 2011; Saleh et al., 2015; Thomas-Hawkins & Flynn, 2015; Verbeek-Van Noord et al., 2014), at the unit level in five studies (Abrahamson et al., 2016; Brown & Wolosin, 2013; Fan et al., 2016; Hofmann & Mark, 2006; Huang et al., 2010), at both the individual and unit levels in three studies (Ausserhofer et al., 2013; Kirwan et al., 2013; Valentin et al., 2013), and at the hospital level in four studies (Davenport et al., 2007; El-Jardali et al., 2011; Mardon et al., 2010; Singer et al., 2009).

Safety Culture

In the 17 studies reviewed, investigators used the terms "safety culture" and "safety climate" interchangeably. "Safety culture" was used in 11 studies (Abrahamson et al., 2016; Alenius et al., 2013; Brown & Wolosin, 2013; El-Jardali et al., 2011; Fan et al., 2016; Huang et al., 2010; Kirwan et al., 2013; Mardon et al., 2010; Saleh et al., 2015; Thomas-Hawkins & Flynn, 2015; Verbeek-Van Noord et al., 2014), the term "safety climate" was used in four studies (Davenport et al., 2007; Hofmann & Mark, 2006; Hwang & Hwang, 2011; Valentin et al., 2013), and both terms were used in two studies (Ausserhofer et al., 2013; Singer et al., 2009). In seven of the 17 studies, researchers assessed the concept of safety culture in workplaces using only nurse perceptions (Alenius et al., 2013; Ausserhofer et al., 2013; Hofmann & Mark, 2006; Hwang & Hwang, 2011; Kirwan et al., 2013; Saleh et al., 2015; Thomas-Hawkins & Flynn, 2015), whereas in 10 studies, the concept was measured using perceptions of nurses, physicians, and/or other hospital staff (Abrahamson et al., 2016; Brown & Wolosin, 2013; Davenport et al., 2007; El-Jardali et al., 2011; Fan et al., 2016; Huang et al., 2010; Mardon et al., 2010; Singer et al., 2009; Valentin et al., 2013; Verbeek-Van Noord et al., 2014).

In the reviewed studies, the concept of safety culture was measured using various self-administered questionnaires. The most commonly used measure was the AHRQ Hospital Survey

on Patient Safety Culture (HSOPSC) (Abrahamson et al., 2016; Brown & Wolosin, 2013; El-Jardali et al., 2011; Fan et al., 2016; Mardon et al., 2010; Saleh et al., 2015; Verbeek-Van Noord et al., 2014), followed by the Safety Attitudes Questionnaire (SAQ) (Davenport et al., 2007; Huang et al., 2010; Hwang & Hwang, 2011). One research team each used the Patient Safety Climate in Healthcare Organizations (Singer et al., 2009), the Safety Organizing Scale (SOS) (Ausserhofer et al., 2013), and the Vienna Safety Climate Questionnaire (Valentin et al., 2013). Some researchers used part of a full questionnaire. Five items from the HSOPSC were used in one study (Kirwan et al., 2013) and seven items in another (Alenius et al., 2013), and one HSOPSC dimension was used in one study (Thomas-Hawkins & Flynn, 2015). Also, a combination of nine items from the Safety Climate Scale and 13 items from the Error Orientation Questionnaire was used in one study (Hofmann & Mark, 2006).

Outcomes for Patient Safety and Care Quality

As shown in Table V, outcomes for patient safety and care quality were measured using a large number of variables in the studies reviewed. Specifically, 28 types of patient safety and care quality outcomes were identified; the most common outcomes measured were medication errors and overall perception of patient safety.

Regarding the sources of data used to measure patient safety and care quality outcomes, some outcomes came from hospital staff and patients who were surveyed (Fan et al., 2016; Hofmann & Mark, 2006; Huang et al., 2010; Singer et al., 2009), while other outcomes were drawn from administrative datasets such as hospital databases (Abrahamson et al., 2016; Ausserhofer et al., 2013; El-Jardali et al., 2011; Thomas-Hawkins & Flynn, 2015). For instance, in some studies, medication error was measured using nurse-reported frequencies of medication error (Ausserhofer et al., 2013; Hwang & Hwang, 2011; Thomas-Hawkins & Flynn, 2015), while

in other studies, data on medication error were derived from hospital medical records (Hofmann & Mark, 2006).

Relationships between Safety Culture and Outcomes for Patient Safety and Care Quality

Safety culture is a complex concept, and thus to integrate the findings of the 17 studies reviewed, the findings were categorized into 12 domains adapted from subscales of the HSOPSC (AHRQ, 2009) and SAQ (Sexton et al., 2006) as well as overall safety culture. The 12 domains are managers' support and actions for patient safety, organizational commitment to patient safety, organizational learning and continuous improvement, non-punitive response to error, feedback and communication openness, staffing adequacy, teamwork within units, teamwork across units, hospital handoffs and transitions, job satisfaction, working conditions, and stress recognition. In the following subsections, study findings are discussed with regard to relationships between safety culture and outcomes for patient safety and/or care quality; these relationships are summarized in Table VI.

Overall Safety Culture. Among the 17 studies reviewed, eight examined associations between overall safety culture and outcomes for patient safety and care quality. In five studies, negative associations were found between overall safety culture and outcomes. For example, a higher level of safety culture was associated with fewer occurrences of patient falls, bloodstream infections, and pneumonia (Ausserhofer et al., 2013); a lower hospital-acquired pressure ulcer rate (Brown & Wolosin, 2013); lower rates of PSI (Mardon et al., 2010; Singer et al., 2009); and fewer medication or dislodgement errors (Valentin et al., 2013). In one study, a positive association was found between overall safety culture and nurse-reported patient safety; specifically, a higher level of safety culture was related to better patient safety in medical and surgical nursing units (Kirwan et al., 2013).

Across several studies, inconsistent findings were observed for the relationship between overall safety culture and outcomes for patient safety and care quality. For instance, some researchers found that higher levels of safety culture were associated with fewer medication errors (Hofmann & Mark, 2006; Hwang & Hwang, 2011), whereas others found that the association was not significant (Ausserhofer et al., 2013). Moreover, higher levels of safety culture were significantly associated with fewer urinary tract infections in one study (Hofmann & Mark, 2006) but not in another (Ausserhofer et al., 2013). Finally, in one study, a higher level of safety culture was related to higher levels of patient satisfaction (Hofmann & Mark, 2006), but no significant relationship was found in another (Ausserhofer et al., 2013).

Managers' Support and Actions for Patient Safety. Managers' support and actions for patient safety refers to staff perceptions of managers' consideration of staff suggestions for improving patient safety, managers' attention to patient safety problems, their support for staff to provide better patient care, and their praise for staff for following patient safety procedures (Agency for Healthcare Research and Quality, 2009; Sexton et al., 2006). As shown in Table VI, nine research teams examined the associations between this domain and outcomes for patient safety and care quality. Managers' support and actions for patient safety was negatively associated with patient fall rates (Brown & Wolosin, 2013) and surgical site infection rates (Fan et al., 2016), and the domain was positively related to overall patient safety (Saleh et al., 2015). No significant relationship was found between managers' support and actions for patient safety and PSI (Mardon et al., 2010), morbidity (Davenport et al., 2007), length of stay (Huang et al., 2010), or patients' overall hospital experience and recommendation of the hospital (Abrahamson et al., 2016).

Inconsistent findings were observed for associations between managers' support and

actions for patient safety and outcomes for patient safety and care quality. For example, among three studies, higher levels of support and action for patient safety on the part of managers were related to lower mortality rate (Huang et al., 2010), positive staff perceptions of patient safety (El-Jardali et al., 2011), and better patient safety (Saleh et al., 2015). However, in other studies, these relationships were not significant (Davenport et al., 2007; Saleh et al., 2015; Verbeek-Van Noord et al., 2014).

Organizational Commitment to Patient Safety. Organizational commitment to patient safety refers to staff perceptions of strong organizational commitment to patient safety, including creating a culture to improve patient safety and showing that patient safety is a top priority (Agency for Healthcare Research and Quality, 2009; Sexton et al., 2006). Relationships between this domain and outcomes for patient safety and care quality were examined in five studies. This domain was positively related to overall patient safety (Alenius et al., 2013; Verbeek-Van Noord et al., 2014) and negatively associated with length of stay (Huang et al., 2010). No significant association of organizational commitment to patient safety was found with PSI (Mardon et al., 2010), mortality rate (Davenport et al., 2007; Huang et al., 2010), or morbidity rate (Davenport et al., 2007).

Organizational Learning and Continuous Improvement. Organizational learning and continuous improvement refers to staff perceptions that they are actively doing things to improve patient safety and that mistakes have led to positive changes which are evaluated for their effectiveness (AHRQ, 2009). Five studies examined the associations between this domain and outcomes for patient safety and care quality. Higher staff perceptions of this domain were related to lower PSI rates (Mardon et al., 2010), lower surgical site infection rates (Fan et al., 2016), and better patient safety (Saleh et al., 2015).

Inconsistent results were found for the relationship between organizational learning and continuous improvement and one patient safety outcome. Specifically, higher staff perceptions of the domain were positively associated with their perceptions of patient safety in one study (El-Jardali et al., 2011), but the relationship was not found to be significant in another study (Saleh et al., 2015). No significant association was found between the domain and patients' overall hospital experience or patients' recommendation of the hospital (Abrahamson et al., 2016).

Non-punitive Response to Error. Non-punitive response to error refers to staff perceptions that their mistakes are not held against them and that mistakes are not recorded in their personnel file (AHQR, 2009). Seven studies examined associations between this domain and outcomes for patient safety and care quality. In one study, positive staff perceptions of non-punitive response to error were related to lower surgical site infection rates (Fan et al., 2016).

Inconsistent findings were observed for the relationship between the domain and two patient safety outcomes. While higher nurse perceptions of non-punitive response to error were associated with lower patient safety in one study (Alenius et al., 2013), two other studies found no significant association (Saleh et al., 2015; Verbeek-Van Noord et al., 2014). In addition, although positive staff perceptions of non-punitive response to error were associated with positive perceptions of patient safety in one study (El-Jardali et al., 2011), the association was not significant in another (Saleh et al., 2015). No significant relationship was found between non-punitive response to error and PSI rates (Mardon et al., 2010), patients' hospital experience, or patients' recommendation of the hospital (Abrahamson et al., 2016).

Feedback and Communication Openness. Feedback and communication openness refers to staff perceptions of being informed about errors, receiving feedback about changes put into place based on event reports, discussing ways to prevent errors, speaking up freely if they

see something that may negatively affect patient care, and feeling free to question those with more authority (AHRQ, 2009). Six studies examined associations between the domain and outcomes for patient safety and care quality; among them, a significant association was found in four studies. Positive staff perceptions of feedback and communication openness were related to lower surgical site infection rates (Fan et al., 2016), better patient safety (Alenius et al., 2013; Saleh et al., 2015), and a positive hospital experience for patients (Abrahamson et al., 2016). No significant findings were observed for the relationship between feedback and communication openness and PSI rates (Mardon et al., 2010), staff perceptions of patient safety (Saleh et al., 2015), or patients' recommendation of the hospital (Abrahamson et al., 2016).

Staffing Adequacy. Staffing adequacy refers to staff perceptions of having adequate staff to handle the workload and work hours in order to provide the best patient care (AHQR, 2009). Associations between staffing adequacy and outcomes for patient safety and care quality were examined in five studies. One study indicated that improved staffing adequacy was related to lower PSI rates (Mardon et al., 2010).

Inconsistent findings were observed between staffing adequacy and two patient safety outcomes. Specifically, improved staffing adequacy was associated with positive staff perceptions of patient safety in one study (El-Jardali et al., 2011), but this association was not significant in another (Saleh et al., 2015). Moreover, while some researchers found that improved staffing adequacy was associated with better patient safety (Saleh et al., 2015), others found no significant association (Verbeek-Van Noord et al., 2014). No significant relationship was found between staff perceptions of staffing adequacy and surgical site infection rates (Fan et al., 2016).

Teamwork within Units. Teamwork within units refers to staff perceptions of quality of

collaboration and support between unit personnel (Agency for Healthcare Research and Quality, 2009; Sexton et al., 2006). Nine studies examined associations between the domain and outcomes for patient safety and care quality outcomes; among them, a significant relationship was found in five studies. Positive staff perceptions of teamwork within units were associated with lower patient fall rates (Brown & Wolosin, 2013), lower PSI rates (Mardon et al., 2010), lower surgical site infection rates (Fan et al., 2016), and a positive hospital experience for patients (Abrahamson et al., 2016).

Inconsistent findings were observed for the relationship between teamwork within units and one patient safety outcome. Specifically, while a negative relationship was found between the domain and staff perceptions of patient safety in one study (El-Jardali et al., 2011), the relationship was not significant in another (Saleh et al., 2015). No significant association was found between teamwork within units and mortality rates (Davenport et al., 2007; Huang et al., 2010), morbidity rates (Davenport et al., 2007), length of stay (Huang et al., 2010), overall patient safety (Saleh et al., 2015; Verbeek-Van Noord et al., 2014), patients' overall hospital experience, or patients' recommendation of the hospital (Abrahamson et al., 2016).

Teamwork across Units. Teamwork across units refers to staff perceptions of cooperation and coordination between hospital units to provide the best patient care (AHRQ, 2009). Four studies examined associations between the domain and outcomes for patient safety and care quality outcomes; among them, a significant association was found in three studies. Positive staff perceptions of teamwork across hospital units were related to lower rates of PSI (Mardon et al., 2010) and surgical site infection (Fan et al., 2016).

Inconsistent findings were observed for the relationship between this domain and overall patient safety. In one study, positive staff perceptions of teamwork across hospital units were

associated with better patient safety (Verbeek-Van Noord et al., 2014), but this association was not significant in another (Saleh et al., 2015). No significant relationship was found between teamwork across hospital units and staff perceptions of patient safety (Saleh et al., 2015).

Hospital Handoffs and Transitions. Hospital handoffs and transitions refers to staff perceptions that important patient care information is transferred across hospital units and during shift changes (AHRQ, 2009). Five studies examined the associations between this domain and patient safety and care quality outcomes; among them, a significant association was found in two studies. Positive staff perceptions of hospital handoffs and transitions were related to fewer occurrences of skipped or shortened dialysis treatment, vascular access infection and thrombosis, bleeding from vascular access, and complaints from patients and families (Thomas-Hawkins & Flynn, 2015).

Inconsistent findings were observed for the relationship between hospital handoffs and transitions and staff perceptions of patient safety. Positive staff perceptions of this domain were associated with positive staff perceptions of patient safety in one study (El-Jardali et al., 2011), whereas the relationship was not significant in another (Saleh et al., 2015). No significant association was found between the domain and medication errors, patient falls, dialysis hypotension, emergency room use, hospital admission, vascular access infiltration (Thomas-Hawkins & Flynn, 2015), surgical site infection rates (Fan et al., 2016), or overall patient safety (Saleh et al., 2015; Verbeek-Van Noord et al., 2014).

Job Satisfaction. Job satisfaction refers to staff perceptions of their work experience (Sexton et al., 2006). Two studies examined associations between job satisfaction and outcomes for patient safety and care quality, but no significant association was found. Specifically, no significant relationship was found between job satisfaction and mortality rate (Davenport et al.,

2007; Huang et al., 2010), morbidity rate (Davenport et al., 2007), or length of stay (Huang et al., 2010).

Working Conditions. Working conditions refers to staff perceptions of their work environment (Sexton et al., 2006). Associations between working conditions and outcomes for patient safety and care quality were examined in two studies, but no significant relationship was found. The studies indicated that working conditions were not associated with mortality rate (Davenport et al., 2007; Huang et al., 2010), morbidity rate (Davenport et al., 2007), or length of stay (Huang et al., 2010).

Stress Recognition. Stress recognition refers to staff acknowledgement of how their performance is influenced by stressors (Sexton et al., 2006). Two studies examined associations between stress recognition and outcomes for patient safety and care quality, but no significant association was found. Specifically, no significant relationship was found between stress recognition and mortality rate (Davenport et al., 2007; Huang et al., 2010), morbidity rate (Davenport et al., 2007), or length of stay (Huang et al., 2010).

Discussion

This study was conducted to provide an integrative review of the literature on the associations between safety culture and patient safety and care quality outcomes in hospital settings. The most notable finding of this review was the large quantity of non-significant and inconsistent relationships presented in the studies. Specifically, in the 17 studies reviewed, 87 associations were identified; they included 52 non-significant associations and 14 associations for which inconsistent findings were observed (see Table VI). Many factors could have contributed to these non-significant and inconsistent results. Possible contributing factors and recommendations for future research are discussed below.

All 17 studies reviewed used a cross-sectional design. Study results obtained using a cross-sectional design cannot establish causal associations between safety culture and patient safety and care quality outcomes in hospitals. In addition, most studies were conducted in the U.S. Therefore, future researchers should consider conducting longitudinal studies involving more varied populations to more fully examine the associations.

Among the 17 studies, only two were guided by a theory or theoretical framework. One possible reason for the lack of a theory or framework is that the association between safety culture and patient outcomes may not be theoretically linear or may be affected by multiple mediators (Groves, 2014). However, a valid theory can provide structures to guide researchers in selecting important variables, collecting data on these variables, and examining the relationships among them, which would prevent significant model misspecification in statistical analyses (Karsh & Brown, 2010). In addition, because a theory or framework justifies investigation of relationships between constructs, use of a testable theory or framework could help investigators to design research to better examine associations between safety culture and outcomes for patient safety and care quality in hospitals. Therefore, investigators should consider using an appropriate theory or framework to guide studies of such associations, as this approach could allow them to consolidate research findings in such a way that the associations could be more clearly understood.

The terms “safety culture” and “safety climate” were used interchangeably in the studies reviewed, but they are distinct concepts. As in this review, other authors found substantial variations in the use of these terms and their definitions in a review of 139 healthcare articles (Halligan & Zecevic, 2011). Safety culture is a subset of organizational culture and refers to shared values, beliefs, and patterns of behavior regarding patient safety among the members of

an organization (Feng, Bobay, & Weiss, 2008; Halligan & Zecevic, 2011). On the other hand, safety climate is a measurable component of safety culture and refers to attitudes and perceptions of individuals within an organization at a given time (Halligan & Zecevic, 2011). This semantic inconsistency in the literature could result in lack of clarity with regard to the concepts being studied. Concepts are abstractions of observable phenomena, and researchers should clearly define the concepts of interest in a given study. If researchers use different conceptual definitions, their operational definitions will also differ, as operational definitions should be congruent with conceptual definitions (Polit & Beck, 2012). The operationalization of a concept indicates measurement of the concept, and thus interchangeable use of the terms "safety culture" and "safety climate" could lead to inaccurate concept measurement, thus resulting in inconsistent findings among studies. Therefore, in future studies of safety culture, researchers should make every effort to employ consistent, clearly defined terminology.

In the studies reviewed, seven self-administered questionnaires were used to measure the concept of safety culture. Among them, only HSOPSC, SAQ, and SOS have been shown to be psychometrically sound (Nieva & Sorra, 2003; Sexton et al., 2006; Vogus & Sutcliffe, 2007). Use of reliable and valid instruments in research is essential to generate meaningful data. If data are not psychometrically credible, research findings cannot be considered credible either (Furr & Bacharach, 2014). Use of psychometrically unsound safety culture measures may have resulted in some of the inconsistent findings observed in the studies reviewed, making it more difficult to establish significant associations. Therefore, efforts should be made to improve the robustness of existing safety culture measures and to develop a psychometrically sound tool for accurately measuring the concept.

The patient safety and care quality outcomes measured in the 17 studies were highly

heterogeneous, as 28 types of outcomes were identified. In addition, researchers used different sources of data to measure particular patient safety outcomes. For example, while some investigators used objective measures of the occurrence of medication errors (Hofmann & Mark, 2006), others used subjective measures of this outcome (Ausserhofer et al., 2013; Hwang & Hwang, 2011). As another example, data on patient falls was retrieved from an administrative database in one study (Brown & Wolosin, 2013), whereas this outcome was measured using survey data in another (Ausserhofer et al., 2013). The considerable differences in studies' data sources could have led to some of the inconsistent findings observed in this review, thus limiting our understanding of the association between safety culture and patient safety and care quality outcomes. In addition, using subjective measures for these outcomes can raise the risk of common method variance by using a single survey to assess both safety culture and outcome perceptions (Groves, 2014). Also, use of a survey raises concerns about the validity and accuracy of self-reporting (Polit & Beck, 2012). For this reason, some researchers have chosen to use presumably objective measures such as patient charts or incident reports to measure patient safety and care quality outcomes. However, objective measures can be inaccurate, unreliable, or conceptually invalid due to reporting bias (Groves, 2014). Therefore, when different data sources are used, researchers should acknowledge the potential impact of the differing sources on their findings. Moreover, in future studies, researchers should try to use consistent data sources when investigating associations between safety culture and outcomes for patient safety and care quality.

Among the 17 studies reviewed, substantial differences were observed in units of analysis (e.g., individual staff member, nursing unit, and hospital) and thus in levels of data measurement and aggregation. When assessing safety culture, it is essential to determine exactly which units of

analysis and levels of aggregation are most appropriate (Pumar-Méndez et al., 2015). Multiple levels exist in healthcare systems, and variables at different levels can impact outcomes differently in such systems. Therefore, proper determination of units of analysis is important because it impacts statistical inferences and thus data interpretations (Kozlowski & Klein, 2000). To guide these determinations, it would be helpful to use or develop a theory explaining how patient safety and care quality outcomes may be related to safety culture in hospital settings. Such a theory could guide investigators in deciding how best to examine the relationship—that is, in selecting appropriate sampling and data collection methods, measuring important variables at levels where the theory places the variables, and employing appropriate statistical analyses (Karsh & Brown, 2010). An appropriate theory can also improve understanding of the relationship between safety culture and outcomes for patient safety and care quality by minimizing data interpretation biases. Therefore, researchers should consider using or developing a relevant theory to guide their exploration of this relationship, which will in turn provide a clearer understanding of the relationship.

Several limitations of this integrative review should be noted. First, this review was limited to safety culture and patient safety and care quality outcomes in hospital settings, and thus its findings may not be generalizable to other healthcare settings. Moreover, most studies included in this review were conducted in U.S. hospitals; therefore, its findings may not be applicable to hospitals in other countries. In addition, this review included only studies published in English, and this approach may have excluded relevant evidence published in other languages. Finally, despite the extensive searches performed, some relevant studies may have been unintentionally excluded from this review.

Conclusion

This integrative review provides comprehensive information about the state of research on associations between safety culture and outcomes for patient safety and care quality in hospital settings. All 17 studies reviewed had a cross-sectional design, and the review revealed semantic inconsistencies between use of "safety culture" and "safety climate," frequent lack of use of a theory or theoretical framework, limited use of valid measures, and methodological variations. Notably, the review revealed a large array of non-significant and inconsistent relationships among the study results that may have arisen from a variety of factors. Based on the review findings, researchers examining associations between safety culture and outcomes for patient safety and care quality should consider using a longitudinal design, a theoretical framework, and psychometrically sound instruments to measure the concepts. In addition, researchers using differing methodologies and data sources should acknowledge the potential effect of their use on study findings. Finally, based on an appropriate theoretical framework, future researchers should determine the most suitable sampling and data collection methods, units of analysis, levels of data measurement and aggregation, and statistical analyses to determine associations between safety culture and outcomes for patient safety and care quality.

References

Abrahamson, K., Hass, Z., Morgan, K., Fulton, B., & Ramanujam, R. (2016). The relationship between nurse-reported safety culture and the patient experience. *Journal of Nursing Administration, 46*(12), 662-668. doi:10.1097/NNA.0000000000000423

Agency for Healthcare Research and Quality. (2009). Hospital survey on patient safety culture. Retrieved from http://www.ahrq.gov/sites/default/files/wysiwyg/professionals/quality-patient-safety/patientsafetyculture/hospital/resources/hospscanform.pdf

Aiken, L. H., Clarke, S. P., & Sloane, D. M. (2002). Hospital staffing, organization, and quality of care: Cross-national findings. *Nursing Outlook, 50*(5), 187-194. doi:10.1067/mno.2002.126696

Alenius, L. S., Tishelman, C., Runesdotter, S., & Lindqvist, R. (2013). Staffing and resource adequacy strongly related to RNs' assessment of patient safety: A national study of RNs working in acute-care hospitals in sweden. *BMJ Quality & Safety*, doi:10.1136/bmjqs- 2012-001734

Ausserhofer, D., Schubert, M., Desmedt, M., Blegen, M. A., De Geest, S., & Schwendimann, R. (2013). The association of patient safety climate and nurse-related organizational factors with selected patient outcomes: A cross-sectional survey. *International Journal of Nursing Studies, 50*(2), 240-252. doi:10.1016/j.ijnurstu.2012.04.007

Bae, S. (2011). Assessing the relationships between nurse working conditions and patient outcomes: Systematic literature review. *Journal of Nursing Management, 19*(6), 700-713.

Brown, D. S., & Wolosin, R. (2013). Safety culture relationships with hospital nursing sensitive metrics. *Journal for Healthcare Quality, 35*(4), 61-74.

Cummings, G. G., MacGregor, T., Davey, M., Lee, H., Wong, C. A., Lo, E., . . . Stafford, E. (2010). Leadership styles and outcome patterns for the nursing workforce and work environment: A systematic review. *International Journal of Nursing Studies, 47*(3), 363-385.

Davenport, D. L., Henderson, W. G., Mosca, C. L., Khuri, S. F., & Mentzer, R. M.,Jr. (2007). Risk-adjusted morbidity in teaching hospitals correlates with reported levels of communication and collaboration on surgical teams but not with scale measures of teamwork climate, safety climate, or working conditions. *Journal of the American College of Surgeons, 205*(6), 778-784.

DiCuccio, M. H. (2015). The relationship between patient safety culture and patient outcomes: A systematic review. *Journal of Patient Safety, 11*(3), 135-142. doi:10.1097/PTS.0000000000000058

El-Jardali, F., Dimassi, H., Jamal, D., Jaafar, M., & Hemadeh, N. (2011). Predictors and outcomes of patient safety culture in hospitals. *BMC Health Services Research, 11*, 45. doi:10.1186/1472-6963-11-45

Fan, C. J., Pawlik, T. M., Daniels, T., Vernon, N., Banks, K., Westby, P., . . . Makary, M. A. (2016). Association of safety culture with surgical site infection outcomes. *Journal of the American College of Surgeons, 222*(2), 122-128. doi:10.1016/j.jamcollsurg.2015.11.008

Feng, X., Bobay, K., & Weiss, M. (2008). Patient safety culture in nursing: A dimensional concept analysis. *Journal of Advanced Nursing, 63*(3), 310-319. doi:10.1111/j.1365-2648.2008.04728.x

Furr, R. M., & Bacharach, V. R. (2014). *Psychometrics: An introduction* (2nd ed.). Los Angeles: Sage.

Groves, P. S. (2014). The relationship between safety culture and patient outcomes: Results from pilot meta-analyses. *Western Journal of Nursing Research, 36*(1), 66-83. doi:10.1177/0193945913490080

Halligan, M., & Zecevic, A. (2011). Safety culture in healthcare: A review of concepts, dimensions, measures and progress. *BMJ Quality & Safety, 20*(4), 338-343. doi:10.1136/bmjqs.2010.040964

Health and Safety Commission Advisory Committee. (1993). *Organizing for safety: Third report of the ACSNI (advisory committee on the safety of nuclear installations) study group on human factors*. Sudbury, England: HSE Books.

Hofmann, D. A., & Mark, B. (2006). An investigation of the relationship between safety climate and medication errors as well as other nurse and patient outcomes. *Personnel Psychology, 59*(4), 847-869.

Huang, D. T., Clermont, G., Kong, L., Weissfeld, L. A., Sexton, J. B., Rowan, K. M., & Angus, D. C. (2010). Intensive care unit safety culture and outcomes: A US multicenter study. *International Journal for Quality in Health Care, 22*(3), 151-161. doi:10.1093/intqhc/mzq017

Hwang, J. I., & Hwang, E. J. (2011). Individual and work environment characteristics associated with error occurrences in korean public hospitals. *Journal of Clinical Nursing, 20*(21-22), 3256-3266. doi:10.1111/j.1365-2702.2011.03773.x

Institute of Medicine. (1999). *To err is human: Building a safer health system*. Washington, D.C: National Academy Press.

Institute of Medicine. (2001). *Crossing the quality chasm: A new health system for the 21st century*. Washington, D.C.: National Academy Press.

Karsh, B. T., & Brown, R. (2010). Macroergonomics and patient safety: The impact of levels on theory, measurement, analysis and intervention in patient safety research. *Applied Ergonomics, 41*(5), 674-681. doi:10.1016/j.apergo.2009.12.007

Kirwan, M., Matthews, A., & Scott, P. A. (2013). The impact of the work environment of nurses on patient safety outcomes: A multi-level modelling approach. *International Journal of Nursing Studies, 50*(2), 253-263. doi:10.1016/j.ijnurstu.2012.08.020

Kozlowski, S. W. J., & Klein, K. J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In K. J. Klein, & S. W. J. Kozlowski (Eds.), *Multilevel theory, research and methods in organizations: Foundations, extensions, and new directions* (pp. 3-90). San Francisco, CA: Jossey-Bass.

Lake, E. T., Hallowell, S. G., Kutney-Lee, A., Hatfield, L. A., Del Guidice, M., Boxer, B. A., . . . Aiken, L. H. (2016). Higher quality of care and patient safety associated with better NICU work environments. *Journal of Nursing Care Quality, 31*(1), 24-32. doi:10.1097/NCQ.0000000000000146

Lee, S. E., & Scott, L. (2016). Hospital nurses' work environment characteristics and patient safety outcomes: A literature review. *Western Journal of Nursing Research,* doi:10.1177/0193945916666071

Mardon, R. E., Khanna, K., Sorra, J., Dyer, N., & Famolaro, T. (2010). Exploring relationships between hospital patient safety culture and adverse events. *Journal of Patient Safety, 6*(4), 226-232. doi:10.1097/PTS.0b013e3181fd1a00

McHugh, M. D., & Stimpfel, A. W. (2012). Nurse reported quality of care: A measure of hospital quality. *Research in Nursing & Health, 35*(6), 566-575.

Nieva, V. F., & Sorra, J. (2003). Safety culture assessment: A tool for improving patient safety in healthcare organizations. *Quality & Safety in Health Care, 12 Suppl 2*, ii17-23.

Polit, D. F., & Beck, C. T. (2012). *Nursing research: Generating and assessing evidence for nursing practice* (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Pumar-Méndez, M. J., Attree, M., & Wakefield, A. (2015). Methodological aspects in the assessment of safety culture in the hospital setting: A review of the literature. *Nurse Education Today, 34*(2), 162-170.

Saleh, A. M., Darawad, M. W., & Al-Hussami, M. (2015). The perception of hospital safety culture and selected outcomes among nurses: An exploratory study. *Nursing & Health Sciences, 17*(3), 339-346.

Sammer, C. E., Lykens, K., Singh, K. P., Mains, D. A., & Lackan, N. A. (2010). What is patient safety culture? A review of the literature. *Journal of Nursing Scholarship, 42*(2), 156-165. doi:10.1111/j.1547-5069.2009.01330.x

Sexton, J. B., Helmreich, R. L., Neilands, T. B., Rowan, K., Vella, K., Boyden, J., . . . Thomas, E. J. (2006). The safety attitudes questionnaire: Psychometric properties, benchmarking data, and emerging research. *BMC Health Services Research, 6*(1), 44.

Singer, S., Lin, S., Falwell, A., Gaba, D., & Baker, L. (2009). Relationship of safety climate and safety performance in hospitals. *Health Services Research, 44*(2 Pt 1), 399-421. doi:10.1111/j.1475-6773.2008.00918.x

Singla, A. K., Kitch, B. T., Weissman, J. S., & Campbell, E. G. (2006). Assessing patient safety culture: A review and synthesis of the measurement tools. *Journal of Patient Safety, 2*(3), 105-115.

Thomas-Hawkins, C., & Flynn, L. (2015). Patient safety culture and nurse-reported adverse events in outpatient hemodialysis units. *Research and Theory for Nursing Practice, 29*(1), 53-65.

Valentin, A., Schiffinger, M., Steyrer, J., Huber, C., & Strunk, G. (2013). Safety climate reduces medication and dislodgement errors in routine intensive care practice. *Intensive Care Medicine, 39*(3), 391-398. doi:10.1007/s00134-012-2764-0

Verbeek-Van Noord, I., Wagner, C., Van Dyck, C., Twisk, J. W., & De Bruijne, M. C. (2014). Is culture associated with patient safety in the emergency department? A study of staff perspectives. *International Journal for Quality in Health Care, 26*(1), 64-70. doi:10.1093/intqhc/mzt087

Vogus, T. J., & Sutcliffe, K. M. (2007). The safety organizing scale: Development and validation of a behavioral measure of safety culture in hospital nursing units. *Medical Care, 45*(1), 46-54. doi:10.1097/01.mlr.0000244635.61178.7a

Table IV

Summary of Quality Assessment of Reviewed Studies

	Number of articles	
Design	No	Yes
1. Was the study longitudinal (other than cross-sectional)?	17	0
2. Was probability sampling used?	12	5
Sample		
1. Was sample size justified?	14	3
2. Was sample drawn from more than one site?	0	17
3. Was anonymity protected?	0	17
4. Was response rate more than 60%?	14	3
Measurement		
Safety Culture (independent variable)		
1. Was safety culture measured reliably?	0	17
2. Was safety culture measured using a valid instrument?	14	3
Patient Safety and Care Quality Outcomes (dependent variable)		
1. Were patient and quality outcomes measured rather than self-reported staff perception?[a]	9	8
2. Were patient safety and care quality outcomes measured using a valid instrument?	11	6
3. Was a theoretical model/framework used for guidance?	15	2
Statistical Analysis		
1. If multiple outcomes were studies, were correlations analyzed?	14	3
2. Were outliers managed?	16	1

Note. Adapted from Cummings et al., 2010.

[a] This item scored 2 points. All others scored 1 point.

Table V

Characteristics of Reviewed Studies

Author (year)	Sample/Setting	Design	Safety Culture Measure	Unit of Analysis	Analytic Technique	Outcome
Hofmann & Mark (2006)	N nurses= 1,127 N units= 80 N hospital= 42 U.S.	Cross-sectional Correlational Predictive	9 items from SCS & 13 items from EOQ[a]	Nursing unit (medical-surgical)	Negative binomial regression, Linear regression	Medication error[b] Urinary tract infections[b] Patient satisfaction[a]
Davenport *et al*. (2007)	N physicians= 1,881 N nurses= 3,432 N hospitals= 52 U.S.	Cross-sectional	SAQ[a]	Hospital	Logistic regression	Mortality[b] Morbidity[b]
Singer *et al*. (2009)	N clinicians= 18,223 N hospitals= 91 U.S.	Cross-sectional Predictive	PSCHO[a]	Hospital	Negative binomial regression, Backward stepwise regression	Patient safety indicators[b]
Huang *et al*. (2010)	N ICU staff= 4,934 N units= 30 U.S.	Cross-sectional	SAQ[a]	Nursing unit (ICU)	Clustered logistic regression	Mortality[b] Length of stay[b]
Mardon *et al*. (2010)	N staff= 56,480 N hospitals= 179 U.S.	Cross-sectional Secondary	HSOPSC[a]	Hospital	Multiple regression	Patient safety indicators[b]
El-Jardali *et al*. (2011)	N staff=6,807 N hospitals= 68 Lebanon	Cross-sectional	HSOPSC[a]	Hospital	Generalized estimating equations, Linear mixed regression	Perception of patient safety[a]
Hwang & Hwang (2011)	N nurses=2,116 N hospitals=33 Korea	Cross-sectional Descriptive Correlational	SAQ[a]	Individual	Multiple logistic regression	Medication error[a]

Table V
(Continued)

Author (year)	Sample	Design	Safety Culture Measure	Unit of Analysis	Analytic technique	Outcome
Alenius *et al.* (2013)	N nurses = 9,236 N hospitals = 79 Sweden	Cross-sectional	7 items from HSOPSC[a]	Individual	Multivariate proportional odds model	Overall patient safety grade[a]
Ausserhofer *et al.* (2013)	N nurses = 1,633 N patients = 997 N units = 132 N hospitals = 35 Swiss	Cross-sectional	SOS[a]	Individual, Nursing unit (medical, surgical, and medical-surgical)	Logistic regression	Medication error[a] Urinary tract infection[a] Patient fall[a] Bloodstream infection[a] Pneumonia[a] Patient satisfaction[a]
Brown & Wolosin (2013)	N units = 37 N hospitals = 9 U.S.	Cross-sectional Secondary	HSOPSC[a]	Nursing unit	Pearson product-moment correlations Linear regression	Patient fall[b] Patient fall with injury[b] Hospital-acquired pressure ulcers stage or greater[b]
Kirwan *et al.* (2013)	N nurses = 1,397 N units = 108 N hospitals = 30 Ireland	Cross-sectional	5 items from HSOPSC[a]	Individual, Nursing unit (medical and surgical)	Multilevel modeling	Overall patient safety grade[a]
Valentin *et al*. (2013)	N nurses = 549 N physicians = 185 N patients = 795 N units = 57 Austria, Germany, and Switzerland	Cross-sectional Prospective Observational	VSCQ[a]	Individual, Nursing unit (ICU)	Logistic regression	Medication or dislodgement errors[a]: endotracheal tube or cannula, central venous line, urinary catheter, enteral nutrition probe, or drains
Verbeek-Van Noord *et al.* (2014)	N nurses = 480 N physicians = 159 N units = 33 Netherlands	Cross-sectional	HSOPSC[a]	Individual	Backward prediction linear mixed model	Overall patient safety grade[a]

Table V
(Continued)

Author (year)	Sample	Design	Safety culture measure	Unit of Analysis	Analytic technique	Outcome
Saleh *et al.* (2015)	N nurses = 242 Jordan	Cross-sectional Descriptive Correlational	HSOPSC[a]	Individual	Pearson correlation analysis	Perception of patient safety[a]
Thomas-Hawkins *et al.* (2015)	N nurses = 422 U.S.	Cross-sectional	Hospital handoffs & transitions domains of HSOPSC[a]	Individual	Logistic regression models	Medication error[a] Fall without injury[a] Fall with injury[a] Dialysis hypotension[a] Skipped dialysis treatment[a] Shortened dialysis treatment[a] Vascular access infection[a] Vascular access infiltration[a] Vascular access thrombosis[a] Bleeding from vascular access[a] Complaints from patient/family[a] Emergency room use[a] Hospital admission[a]
Abrahamson *et al.* (2016)	N units = 135 N hospitals = 45 U.S.	Cross-sectional Secondary	HSOPSC[a]	Nursing unit (medical, medical-surgical, pediatric, ICU, obstetric, and acute rehabilitation)	Multivariate mixed-effects regression model	Patients' overall hospital experience[a] Patients' recommendation of hospital[a]
Fan *et al.* (2016)	N staff = 1,926 N units = 7 N hospitals = 7 U.S.	Cross-sectional	HSOPSC[1a]	Nursing unit (surgical)	Multivariate linear regression models Pearson's correlation	Surgical site infection[b]

Note. AHRQ = Agency for Healthcare Research and Quality; EOQ = Error Orientation Questionnaire; HSOPSC = Hospital Survey on Patient Safety Culture; ICU = intensive care unit; PSCHO = Patient Safety Climate in Healthcare Organizations; SAQ = Safety Attitudes Questionnaire; SCS = Safety Climate Scale; SOS = Safety Organizing Scale; VSCQ = Vienna Safety Climate Questionnaire.
[a] survey data. [b] administrative data

Table VI

Relationships between Safety Culture and Outcomes for Patient Safety and Care Quality

Safety Culture Domain	Outcomes for Patient Safety and Care Quality	Relationship	Study
Overall safety culture	Medication error	Negative	Hofmann & Mark (2006)
			Hwang & Hwang (2011)
		N/S	Ausserhofer et al. (2013)
	Patient fall	N/S	Ausserhofer et al. (2013)
			Brown & Wolosin (2013)
	HPU	Negative	Brown & Wolosin (2013)
	Bloodstream infection	N/S	Ausserhofer et al. (2013)
	Pneumonia	N/S	Ausserhofer et al. (2013)
	Urinary tract infection	Negative	Hoffman & Mark (2006)
		N/S	Ausserhofer et al. (2013)
	Medication or dislodgement error	Negative	Valentin et al. (2013)
	Patient safety indicator	Negative	Mardon et al. (2010)
			Singer et al. (2009)
	Overall patient safety	Positive	Kirwan et al. (2013)
	Patient satisfaction	Positive	Hofmann & Mark (2006)
		N/S	Ausserhofer et al. (2013)
Managers' support and actions for patient safety	Patient fall	Negative	Brown & Wolosin (2013)
	Mortality	N/S	Davenport et al. (2007)
		Negative	Huang et al. (2010)
	Patient safety indicator	N/S	Mardon et al. (2010)
	Surgical site infection	Negative	Fan et al. (2016)
	Morbidity	N/S	Davenport et al. (2007)
	Length of stay	N/S	Huang et al. (2010)
	Perception of patient safety	Positive	El-Jardali et al. (2011)
		N/S	Saleh et al. (2015)
	Overall patient safety	N/S	Verbeek-Van Noord et al. (2014)
		Positive	Saleh et al. (2015)
	Patients' overall hospital experience	N/S	Abrahamson et al. (2016)
	Patients' recommendation of hospital	N/S	Abrahamson et al. (2016)

Table VI
(continued)

Safety Culture Domain	Outcomes for Patient Safety and Care Quality	Relationship	Study
Organizational commitment to patient safety	Patient safety indicator	N/S	Mardon et al. (2010)
	Mortality	N/S	Davenport et al. (2007) Huang et al. (2010)
	Morbidity	N/S	Davenport et al. (2007)
	Length of stay	Negative	Huang et al. (2010)
	Overall patient safety	Positive	Alenius et al. (2013) Verbeek-Van Noord et al. (2014)
Organizational learning and continuous improvement	Patient safety indicator	Negative	Mardon et al. (2010)
	Surgical site infection	Negative	Fan et al. (2016)
	Perceptions of patient safety	Positive N/S	El-Jardali et al. (2011) Saleh et al. (2015)
	Overall patient safety	Positive	Saleh et al. (2015)
	Patients' overall hospital experience	N/S	Abrahamson et al. (2016)
	Patients' recommendation of hospital	N/S	Abrahamson et al. (2016)
Non-punitive response to error	Patient safety indicator	N/S	Mardon et al. (2010)
	Surgical site infection	Negative	Fan et al. (2016)
	Perceptions of patient safety	Positive N/S	El-Jardali et al. (2011) Saleh et al. (2015)
	Overall patient safety	Negative N/S	Alenius et al. (2013) Verbeek-Van Noord et al. (2014) Saleh et al. (2015)
	Patients' overall hospital experience	N/S	Abrahamson et al. (2016)
	Patients' recommendation of hospital	N/S	Abrahamson et al. (2016)
Feedback and communication Openness	Patient safety indicator	N/S	Mardon et al. (2010)
	Surgical site infection	Negative	Fan et al. (2016)
	Perception of patient safety	N/S	Saleh et al. (2015)

Table VI
(continued)

Safety Culture Domain	Outcomes for Patient Safety and Care Quality	Relationship	Study
Feedback and communication Openness (cont'd)	Overall patient safety	Positive	Alenius et al. (2013) Verbeek-Van Noord et al. (2014) Saleh et al. (2015)
	Patients' overall hospital experience	Positive	Abrahamson et al. (2016)
	Patients' recommendation of hospital	N/S	Abrahamson et al. (2016)
Staffing Adequacy	Patient safety indicator	Negative	Mardon et al. (2010)
	Surgical site infection	N/S	Fan et al. (2016)
	Perceptions of patient safety	Positive N/S	El-Jardali et al. (2011) Saleh et al. (2015)
	Overall patient safety	N/S Positive	Verbeek-Van Noord et al. (2014) Saleh et al. (2015)
Teamwork within units	Patient fall	Negative	Brown & Wolosin (2013)
	Patient safety indicator	Negative	Mardon et al. (2010)
	Surgical site infection	Negative	Fan et al. (2016)
	Mortality	N/S	Davenport et al. (2007) Huang et al. (2010)
	Morbidity	N/S	Davenport et al. (2007)
	Length of stay	N/S	Huang et al. (2010)
	Perceptions of patient safety	Negative N/S	El-Jardali et al. (2011) Saleh et al. (2015)
	Overall patient safety	N/S	Verbeek-Van Noord et al. (2014)
	Patients' overall hospital experience	N/S	Abrahamson et al. (2016)
	Patients' recommendation of hospital	N/S	Abrahamson et al. (2016)
Teamwork across units	Patient safety indicator	Negative	Mardon et al. (2010)
	Surgical site infection	Negative	Fan et al. (2016)
	Perception of patient safety	N/S	Saleh et al. (2015)
	Overall patient safety	Positive N/S	Verbeek-Van Noord et al. (2014) Saleh et al. (2015)

Table VI
(continued)

Safety Culture Domain	Outcomes for Patient Safety and Care Quality	Relationship	Study
Hospital handoffs and transitions	Medication error	N/S	Thomas-Hawkins et al. (2015)
	Patient fall	N/S	Thomas-Hawkins et al. (2015)
	Surgical site infection 0	N/S	Fan et al. (2016)
	Skipped dialysis treatment	Negative	Thomas-Hawkins et al. (2015)
	Shortened dialysis treatment	Negative	Thomas-Hawkins et al. (2015)
	Vascular access infection	Negative	Thomas-Hawkins et al. (2015)
	Vascular access infiltration	N/S	Thomas-Hawkins et al. (2015)
	Vascular access thrombosis	Negative	Thomas-Hawkins et al. (2015)
	Bleeding from vascular access	Negative	Thomas-Hawkins et al. (2015)
	Complaints from patient/family	Negative	Thomas-Hawkins et al. (2015)
	Emergency room use	N/S	Thomas-Hawkins et al. (2015)
	Hospital admission	N/S	Thomas-Hawkins et al. (2015)
	Perceptions of patient safety	Positive N/S	El-Jardali et al. (2011) Saleh et al. (2015)
	Overall patient safety	N/S	Verbeek-Van Noord et al. (2014) Saleh et al. (2015)
Job satisfaction	Mortality	N/S	Davenport et al. (2007) Huang et al. (2010)
	Morbidity	N/S	Davenport et al. (2007)
	Length of stay	N/S	Huang et al. (2010)
Working conditions	Mortality	N/S	Davenport et al. (2007) Huang et al. (2010)
	Morbidity	N/S	Davenport et al. (2007)
	Length of stay	N/S	Huang et al. (2010)
Stress Recognition	Mortality	N/S	Davenport et al. (2007) Huang et al. (2010)
	Morbidity	N/S	Davenport et al. (2007)
	Length of stay	N/S	Huang et al. (2010)

Note. HPU = Hospital-acquired Pressure Ulcer; N/S = Non-significant

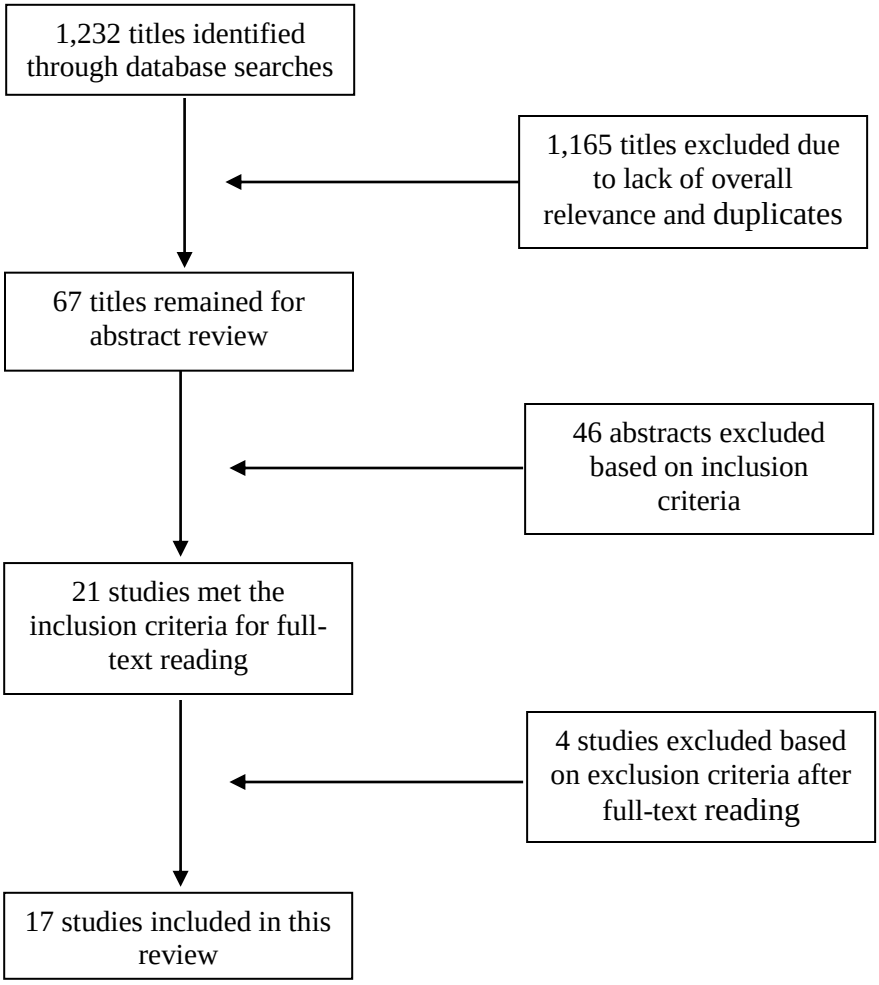

Figure 2. Study selection process

APPENDIX

UNIVERSITY OF ILLINOIS
AT CHICAGO

Office for the Protection of Research Subjects (OPRS)
Office of the Vice Chancellor for Research (MC 672)
203 Administrative Office Building
1737 West Polk Street
Chicago, Illinois 60612-7227

Determination Notice

Research Activity Does Not Involve "Human Subjects"

October 21, 2016

Seung Eun Lee, MSN
Women, Child, & Family Health Science
845 S. Damen Avenue
Room 1146, M/C 802
Chicago, IL 60612
Phone: (347) 348-8904

RE: **Research Protocol # 2016-1003**

"Effects of individual nurse and hospital characteristics on patient adverse events and quality of care: A multilevel analysis"

Sponsor(s): None

Dear Seung Eun Lee:

The above proposal was reviewed on October 21, 2016 by OPRS staff/members of IRB #7. From the information you have provided, the proposal does not appear to involve "human subjects" as defined in 45 CFR 46. 102(f).

The specific definition of human subject under 45 CFR 46.102(f) is:

Human subject means a living individual about whom an investigator (whether professional or student) conducting research obtains

(1) data through intervention or interaction with the individual, or

APPENDIX (continued)

(2) identifiable private information.

Intervention includes both physical procedures by which data are gathered (for example, venipuncture) and manipulations of the subject or the subject's environment that are performed for research purposes. *Interaction* includes communication or interpersonal contact between investigator and subject. *Private information* includes information about behavior that occurs in a context in which an individual can reasonably expect that no observation or recording is taking place, and information which has been provided for specific purposes by an individual and which the individual can reasonably expect will not be made public (for example, a medical record). Private information must be individually identifiable (i.e., the identity of the subject is or may readily be ascertained by the investigator or associated with the information) in order for obtaining the information to constitute research involving human subjects.

Specifically, this research will involve a secondary analysis of de-identified data initially collected for the British Columbia nurse survey in 2014 and the analysis of publicly available information initially collected for the 2013- 2014 period maintained by the Canadian Institute for Health Information.

All the documents associated with this proposal will be kept on file in the OPRS and a copy of this letter is being provided to your Department Head for the department's research files.

If you have any questions or need further help, please contact the OPRS office at (312) 996-1711 or me at (312) 355-2908.

Sincerely,

Charles W. Hoehne, B.S., C.I.P.
Assistant Director, IRB #7
Office for the Protection of Research Subjects

cc: Barbara McFarlin, Women, Child, & Family Health Science, M/C 802
Catherine Vincent, Women, Child, & Family Health Science, M/C 802

VITA

NAME Seung Eun Lee

EDUCATION

2017	Ph.D., Nursing Science University of Illinois at Chicago, Chicago, Illinois
2014	M.S., Nursing Science University of British Columbia, Vancouver, Canada
2003	B.S., Nursing Science Yonsei University, Seoul, Korea

PROFESSIONAL EXPERIENCE

2016	Clinical Practice Data Analyst, Institute for Health Care Innovation University of Illinois at Chicago, Chicago, Illinois
2016	Teaching Assistant, Global Health Leadership Office University of Illinois at Chicago
2014-2016	Teaching Assistant, College of Nursing University of Illinois at Chicago
2014	Registered Nurse, Operating Room NYU Langone Medical Center, New York, NY
2012-2014	Registered Nurse, Operating Room University of British Columbia Hospital, Vancouver, Canada
2011	Public/Community Health Care Manager Mapo-gu Office, Seoul, Korea
2009-2011	Registered Nurse, Operating Room Mount Sinai Hospital, Toronto, Canada
2007-2008	Medicaid Case Manager Seodaemun-gu Office, Seoul, Korea
2003-2006	Registered Nurse, Cardiovascular Department and Operating Room Yonsei University Medical Center, Seoul, Korea

HONORS/AWARDS/SCHOLARSHIPS

2017	GKNF-USA Scientific Scholarship Global Korean Nursing Foundation
2016-2017	Johnson & Johnson/AACN Minority Nurse Faculty Scholarship American Association of Colleges of Nursing
2016-2017	Board of Trustee Scholarship, University of Illinois at Chicago
2016	Student Presenter Award, University of Illinois at Chicago
2016	North America Yonsei Nursing College Alumni Scholarship, North America Yonsei Nursing College Alumni Scholarship Foundation
2016	Academy of International Leadership Development Award, University of

	Illinois at Chicago
2016	Graduate Student Nurses Organization Travel Award, University of Illinois at Chicago
2015	Health Professional Student Council Travel Grant, University of Illinois at Chicago
2015	Chieko Onoda Scholarship, University of Illinois at Chicago
2012	Entry Award, University of British Columbia, Vancouver, Canada
2001-2002	Outstanding Academic Achievement Scholarship, Yonsei University, Seoul, Korea

PUBLICATIONS

Lee, S.E., & Dahinten, S. (2016). Psychometric evaluation of the McCloskey/Mueller Satisfaction Scale. *Japan Journal of Nursing Science, 13*(4), 487-495

Dahinten, S., **Lee, S.E.**, & MacPhee, M. (2016). Disentangling the relationships between staff nurses' workplace empowerment and job satisfaction. *Journal of Nursing Management, 24*(8), 1060-107

Lee, S.E., & Scott, L. (2016). Hospital nurses' work environment characteristics and patient safety outcomes: A literature review. *Western Journal of Nursing Research*, DOI: 10.1177/0193945916666071

Lee, S.E., Vincent, C., & Finnegan, L. (2016). A critique of the Theory of Unpleasant Symptoms. *Advances in Nursing Scienc*e, DOI: 10.1097/ANS.0000000000000014

ORAL PRESENTATIONS

Lee, S.E., Dahintne, S., & MacPhee, M. Job satisfaction among staff nurses in relation to leader empowering behaviors, structural empowerment, and psychological empowerment, ICN Conference 2015, Seoul, Korea, June 2015

Lee, S.E. Global nursing, Woosong University, Daejeon, Korea, 2010

POSTER PRESENTATIONS

Lee, S.E., Scott, L. D., & Park, C., G. Impacts of individual nurse and unit safety culture characteristics on nurse perceptions of patient safety: A multilevel modeling approach, GKNF International Nursing Conference, Chicago, USA, July 2017

Lee, S.E., Vincent, C., & Finnegan, L. A critique of the Theory of Unpleasant Symptoms, MNRS Conference 2016, Milwaukee, USA, March 2016

LICENSES AND CERTIFICATIONS

2017	Registered Nurse, Massachusetts (In processing)
2016	Certificate in Patient Safety, Error Science, and Full Disclosure, University of Illinois at Chicago
2016	Registered Professional Nurse, Illinois
2016	Advanced Cardiac Life Support Certification, American Heart Association

2011	Registered Nurse, British Columbia, Canada
2009	Registered Nurse, Ontario, Canada
2009	Musculoskeletal Disorders Prevention Education Program and Patient Handling, Mount Sinai Hospital, Toronto, Canada
2008	Child Abuse and Maltreatment/Neglect, Access Continuing Education Center
2008	Infection Control, Access Continuing Education Center
2006	Registered Professional Nurse, New York
2003	Registered Nurse, Ministry for Health, Korea
2003	School Nurse and Qualified Teacher, Yonsei University, Seoul, Korea

PROFESSIONAL AFFILIATIONS

2016-present	Phi Kappa Phi Honor Society
2016-present	Academy Health
2014-present	Sigma Theta Tau International Honor Society of Nursing
2011-2013	College of Registered Nurses of British Columbia, Canada
2009-2012	College of Nurses of Ontario, Canada
2007-2008	Korea Association of Medicaid Case Managers
2004-2006	Korea Association of Operating Room Nurses
2003-2006	Seoul Nurses Association
2003-present	Korean Nurses Association