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Association of Nurse Work Environment and Safety Climate on Patient Mortality: A Cross-sectional Study

Danielle M. Olds, MPH, PhD, RN,

Research Assistant Professor, University of Kansas Medical Center, School of Nursing, 3901 Rainbow Blvd. Mail Stop 4043, Kansas City, KS 66160 913 – 588 – 0426

Linda H. Aiken, PhD, RN,

Director, Center for Health Outcomes and Policy Research, The Claire M. Fagin Leadership Professor of Nursing, Professor of Sociology. University of Pennsylvania School of Nursing, Philadelphia, PA

Jeannie P. Cimiotti, PhD, RN, and

Director, Florida Blue Center for Health Care Quality, Associate Professor and Dorothy M. Smith Endowed Chair, University of Florida, Gainesville, FL

Eileen T. Lake, PhD, RN

Associate Director, Center for Health Outcomes and Policy Research, Jessie M. Scott Endowed Term Associate Professor in Nursing and Health Policy, Associate Professor of Sociology, University of Pennsylvania School of Nursing, Philadelphia, PA

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1. Introduction

More than 15 years after the publication of the Institute of Medicine's (IOM) landmark study estimating that medical error was among the five leading causes of death in the U.S. (IOM, 2000). A related IOM report, *Keeping Patients Safe: Transforming Nurse Work Environments* (IOM, 2004), concluded that good nurse work environments were essential building blocks for improving patient safety. Yet the patient safety movement has been more focused on improving the patient safety climate in hospitals than on "transforming" nurse work environments. A recent updated estimate of hospital mortality associated with medical error was 2.5 times greater than the 98,000 deaths estimated by the IOM in 1999 (Makary & Daniel, 2016). These observations raise an important question about whether nurse practice environments and patient safety climate are the same or different concepts.

Correspondence to: Danielle M. Olds.

Globally, healthcare errors and adverse events claim millions of lives each year and result in significant excess medical costs (Aranaz-Andrés et al., 2011; Hogan et al., 2015; James, 2013; Jha et al., 2013; Makary & Daniel, 2016). Hospital administrators, policy makers, and researchers have sought to identify modifiable factors that could decrease the morbidity and mortality associated with adverse events. The nurse work environment has long been established as an important, and modifiable, organizational trait that impacts patient outcomes (Aiken et al., 2011; Carthon et al., 2015; Cho et al., 2014; Clarke et al., 2002; Clarke, 2007; Estabrooks et al., 2005; Friese et al., 2008; Gunnarsdóttir et al., 2009; Kelly et al., 2014; Kirwan et al., 2013; Kutney-Lee et al., 2009; Lake et al., 2016; Lasater and Mchugh, 2016; Ma et al., 2015a, 2015b; Spence Laschinger and Leiter, 2006; Vahey et al., 2004). It is characterized as the set of "organizational characteristics of a work setting that facilitate or constrain professional nursing practice" (Lake, 2002). A professional nurse work environment is characterized as having adequate staffing, managerial support for nurses, and good nurse-physician relations. This environment encourages nurses to think critically about medical and nursing orders, make recommendations for the care plan, and offer advice about the best ways to care for a patient ("Magnet: Empowering nurses", 2005).

Research documents an association between the nurse work environment and patient mortality (Aiken et al., 2008; Aiken et al., 2011; Cho et al., 2014; Estabrooks et al., 2005; Friese et al., 2008; Kelly et al., 2014; Silber et al., 2016), failure to rescue (Aiken et al., 2008; Friese et al., 2008), readmissions (Carthon et al., 2015; Lasater and McHugh, 2016; Ma et al., 2015a), adverse patient events and complications (Friese et al., 2008; Lake et al., 2016; Spence Laschinger and Leiter, 2006), and nurse-rated quality of care (Aiken et al., 2008; Friese, 2005; Gunnarsdóttir et al., 2009; Lake et al., 2016; Ma et al., 2015b). The nurse work environment is a cornerstone of the American Nurses Credentialing Center's Magnet designation and is included as a nurse sensitive measure by the National Quality Forum (NQF). Because of the strong association between the nurse work environment and patient outcomes, the NQF endorsed the Practice Environment Scale of the Nursing Work Index (PES-NWI) in 2004, with renewed endorsements in 2009 and 2012 ("National Quality Forum", 2015).

Although there is a strong relationship between the nurse work environment and patient outcomes, the healthcare safety literature has instead largely focused on safety climate as a key organizational determinant of patient safety. Safety climate is the perception of the state of safety among individuals at a point in time (Zhang et al., 2002). It has been associated with adverse patient events and complications (Birkmeyer et al., 2013; Bonner et al., 2009; Davenport et al., 2007; Kline et al., 2008; Mardon et al., 2010; Singer et al., 2009; Taylor et al., 2012; Weaver et al., 2014; Weingart et al., 2004), length of stay (Huang et al., 2010), and readmissions (Hansen et al., 2011). Organizations such as the Joint Commission, the National Health Service in the United Kingdom, and the Canadian Council on Health Services Accreditation, either require or encourage hospitals to measure and improve their safety climate (Ginsburg et al., 2009; Pronovost et al., 2006).

Although nurses frequently report on safety climate, it does not fully capture the general working conditions of nurses. Safety climate is, by its nature, more narrowly focused on the perception of safety at a point in time (Zhang et al., 2002). The concept encompasses

specific elements of the organization that are thought to increase or decrease the incidence of adverse events and errors. Two studies have examined the relationship between work environment and how nurses grade the safety of their units or hospitals. Nurses in U.S. and European hospitals with better work environments were half as likely to give their hospitals a poor or failing safety grade (Aiken et al., 2012). Similarly, nurses in neonatal intensive care units with better work environments have lower odds of reporting a fair or poor grade for patient safety (Lake et al., 2016). However, to date there has not been an examination of work environment and safety climate.

Because both the work environment and safety climate have been endorsed by accrediting and credentialing agencies, many hospitals assess both organizational measures. The purpose of this study was to determine whether safety climate and the nurse work environment make comparable or distinct contributions to patient outcomes.

2. Methods

2.1. Study Design

This study examined nurse work environment, safety climate, and patient outcomes in 600 hospitals and uses a cross-sectional secondary analysis of merged data from three sources: 1) the *Multi-State Nursing Care and Patient Safety Study* nurse survey; 2) adult acute care administrative discharge data from state agencies; and 3) the American Hospital Association Annual Survey of Hospitals.

The hospitals studied included almost all acute non-federal hospitals in four large states: California, Florida, Pennsylvania, and New Jersey. Hospital characteristic data used for analyses were purchased from the American Hospital Association. Surveys were sent to large random samples of nurses from state licensure lists. On the surveys, nurses reported the hospitals where they worked. Hospitals were included if they were acute care non-federal hospitals that performed at least 50 surgical procedures per year and had at least 10 staff nurse respondents. These criteria were selected to generate reliable measures from nurse survey data and a sufficient volume of surgical care consistent with prior research (Aiken et al., 2011). The average number of nurse respondents per hospital in this analysis was 37. A significant, positive correlation was found between the number of respondents per hospital and the number of full-time-equivalent registered nurses per hospital from the American Hospital Association Annual Survey of Hospitals. This correlation suggests that representative samples of nurses were obtained in the hospitals.

Patient discharge data from 2006 were obtained from the Office of Statewide Healthcare Planning and Development in California, the Department of Health and Senior Services in New Jersey, and the Pennsylvania Health Care Cost Containment Council. Data from 2007 were obtained from the Agency for Health Care Administration in Florida. Patients were included if it was their index admission, they were: between 18 and 89; had a length of stay of at least one day; and had been hospitalized for general surgery (Diagnosis Related Groups (DRGs) 146–162, 164–167, 170–171, 191–201, 257–268, 285–293, and 493–494), orthopedic surgery (DRGs 209–211, 213, 216–219, 223–230, 232–234, 471, 491, 496–503, 519–520, 537–538, and 544–546), or vascular surgery procedures (DRGs 110–111, 113–

114, and 119–120). The selected DRGs represent common surgical procedures performed at most hospitals. Further, the selected DRGs allow comparability with previous studies of the nurse work environment and outcomes (Aiken et al., 2011; Aiken et al., 2008; Aiken et al., 2002).

Using state RN licensure lists and a modified Dillman method (Dillman, 2000), the *Multi-State Nursing Care and Patient Safety Study* survey was mailed to a large random sample of nurses in California, Pennsylvania, and New Jersey in 2006 and in Florida in 2007. The survey included items that assessed nursing work, demographics, and organization characteristics. The survey response rate was 39 percent; a survey of a random sample of non-respondents achieved a 91 percent response rate and revealed no response bias in items reported here (Smith, 2008). Both the parent study and the secondary analysis were approved by the Institutional Review Board of the University of Pennsylvania.

2.2. Theoretical Framework

For decades, Donabedian's Structure-Process-Outcome model has been important in studying healthcare quality (Donabedian, 1966). The Quality Health Outcomes Model (Mitchell, Ferketich, and Jennings, 1998), used to guide this analysis, builds upon the work of Donabedian but posits that system and patient factors mediate the relationship between clinical interventions and patient outcomes as presented in Figure 1.

2.3. Measures

2.3.1. Nurse Work Environment—The nurse work environment was assessed using the NQF endorsed PES-NWI, comprising five subscales: Nurse Participation in Hospital Affairs (9 items); Nursing Foundation for Quality of Care (10 items); Nurse Manager Ability, Leadership, and Support of Nurses (5 items); Collegial Nurse-Physician Relations (3 items); and Staffing and Resource Adequacy (4 items). Although we included a direct measure of nurse staffing in our study, the Staffing and Resource Adequacy subscale is broader than nurse staffing. It addresses nurse perceptions of enough staff to get the work done, opportunities to discuss patient care problems with other staff, adequate support services, and enough RNs to provide high quality care. The five subscales had high Cronbach's alphas (0.85–0.88) in this sample. Subscale items were scored on a four-point Likert scale where 1=strongly disagree and 4=strongly agree. PES-NWI scores were aggregated to hospital-level mean and scores were standardized for multivariate analyses. The ICC(1,*k*) was 0.82, indicating nurse-level responses could be aggregated to the hospital-level.

2.3.2. Safety Climate—The *Multi-State Nursing Care and Patient Safety Study* survey included seven-items from the Agency for Healthcare Research and Quality's Hospital Survey on Patient Safety Culture, a 51-item instrument (Sorra and Nieva, 2007). Given the length of the nurse survey and to minimize respondent burden, the investigators selected items to reflect a range of safety features of hospitals. These items assessed nurses' perceptions of safety-related issues at the time of the survey and were conceptualized as safety climate for this study. The items selected from the Hospital Survey on Patient Safety Culture were: 1) staff feel like their mistakes are held against them; 2) important patient care information is often lost during shift changes; 3) things "fall through the cracks" when

transferring patients from one unit to another; 4) staff feel free to question the decisions or actions of those in authority; 5) in this unit, we discuss ways to prevent errors from happening again; 6) we are given feedback about changes put into place based on event reports; and 7) the actions of hospital/organization management show that patient safety is a top priority. Item responses were based on the original five-point Likert scale where 1=strongly disagree and 5=strongly agree. For analyses, the percent positive score was calculated to facilitate comparisons with AHRQ benchmarks (Sorra et al., 2007). To calculate the percent positive score, each item's Likert response was coded one to five from least to most desirable. The two desirable responses were coded as positive, with the neutral and two undesirable responses coded as negative. Responses were then aggregated to the hospital-level as the mean percent positive score.

The psychometric properties of the seven safety climate items were evaluated through exploratory factor analysis, reliability testing, and convergent validity assessment. Exploratory factor analysis revealed a single factor with an Eigenvalue higher than 1.0 (Eigenvalue=2.56). All seven items were included and had factor loadings between 0.54 and 0.66. The seven-item safety climate scale had a Cronbach's alpha of 0.80; dropping any of the items would have lowered it (0.76 to 0.78). Convergent validity, using item-rest correlations, ranged from 0.45 to 0.58. Because the seven-item scale demonstrated a high Cronbach's alpha and each item had a high item-rest correlation, it was used to assess safety climate in this study. The intra-class correlation coefficient was evaluated at the hospital level to determine if there was significant similarity of individual responses within hospitals. A coefficient of 0.60 or higher is considered satisfactory (Glick, 1985). The ICC(1,*k*) of the safety climate measure was satisfactory (0.69).

2.3.3 Hospital Nursing Resources and Structural Characteristics—Nurses provided details on nursing resources, including unit staffing, educational preparation, and specialty. Nursing resources were aggregated to the hospital-level because surgical patients may receive nursing care in a variety of inpatient locations. Staffing was calculated as the number of patients on a respondent's unit divided by the total number of RNs working on the unit aggregated across respondents to a hospital-level mean. Education was calculated as the hospital-level proportion of nurses with at least a baccalaureate degree in nursing (BSN). Nurse specialty was classified as critical care, medical/surgical, or other.

The AHA Annual Survey was used to obtain data on hospital structural characteristics. Hospital bedsize was categorized as small (≤100 beds), medium (101–250 beds) or large (≥251 beds). For teaching intensity, hospitals were labeled as major teaching (at least one medical trainee per four beds), minor teaching (medical trainees present, but less than one per 4 beds), and non-teaching. Hospitals were classified as high-technology if they performed open-heart surgeries, solid organ transplantation, or both. This classification system has been used extensively in prior research on nurse work environments (Aiken et al., 2008; Kelly et al., 2011; Kutney-Lee et al., 2015; McHugh et al., 2016; Stimpfel et al., 2015).

2.3.4. Outcome Variable—Patient-level mortality was measured as in-hospital mortality. Mortality has been used in studies of the nurse work environment (Aiken et al., 2011; Cho et

al., 2015; Friese, Lake, Aiken, Silber, & Sochalski, 2008; Kutney-Lee et al., 2015; Silber et al., 2016) and in studies of patient safety climate (Berry et al., 2016; Huang et al., 2010). We focused on the hospital-level as the unit of analysis because the outcome of mortality could be related to the nursing care a patient experiences in multiple units throughout a facility during a hospital stay.

2.4. Analytic Procedure

Hospital-level data from the three sources were linked using a common hospital identification number. Analyses included descriptive statistics and multivariate logistic regression models. Relationships between independent variables were assessed using bivariate correlations. At the patient- and hospital-level, missing data were found to be less than 5%. Safety climate and the work environment were standardized and modeled separately and then jointly. The variance inflation factor was computed for the major variables in the joint model.

The mortality models also contained patient risk-adjustment factors, hospital structural characteristics, and hospital nursing resources. The Elixhauser Comorbidity Index was used for risk-adjustment and included 27 individual dummy variables indicating the presence or absence of pre-existing conditions based on codes from the *International Classification of Disease Version 9* (ICD-9) (Elixhauser et al., 1998). Additional covariates included surgical diagnosis, age, and sex. To account for differences in respondent work area, all models included the hospital-level proportion of nurse respondents from medical/surgical and intensive care units. The Huber-White sandwich estimator was used to account for the clustering of nurse responses within hospitals (Huber, 1967; Rogers, 1993; White, 1980). Stata 13 (StataCorp, College Station, TX) and SAS 9.4 (SAS Institute, Cary, NC) were used for data analyses.

3. Results

Data were available from 27,009 nurses working in 600 hospitals in the four states, with a mean of 36.8 nurses per hospital and a total of 852,974 patients (Table 1). Most hospitals were mid-sized and large non-teaching hospitals with low technology availability. Similar proportions of nurses had an associate degree or a bachelor's degree (~40%) as their highest nursing degree. A third worked in adult critical care or medical/surgical units. The remainder worked on a variety of unit types. Most patients were females (57%), with a median age of 60, and hospitalized for orthopedic surgery (54%). For the outcome of in-hospital mortality, there were 10,432 deaths for a rate of 10.3 per 1,000 patients.

Table 2 is a description of the hospital-level PES-NWI composite and subscales. The mean composite value was 2.68, tending toward the midpoint of 2.50, which indicates that respondents neither disagreed nor agreed that the organizational traits were present. In this sample, "Nursing Foundations for Quality of Care" had the highest mean of all the subscales (2.93). The subscale "Staffing and Resource Adequacy" had the lowest mean score (2.48). The hospital-level average percent positive safety climate scores for the composite and individual items are shown in Table 3. At the hospital-level on average, over half of the nurses gave a positive assessment of the safety climate. The most negative opinion was for

the item, “Staff feel like their mistakes are held against them.” This item is an indication of a punitive response to error. The item with the most positive respondents was, “In this unit, we discuss ways to prevent errors from happening again.” The favorable rating of this item represents feedback and communication about errors. These findings together may indicate that while error prevention is discussed, staff feel blamed for mistakes.

In separate analyses, the work environment and safety climate were significantly associated with mortality (Table 4). A one-standard deviation increase in the work environment and safety climate scales had similar statistically significant effects on the odds of mortality in the individual models (Odds Ratio=0.92 for Work Environment; Odds Ratio=0.92 for Safety Climate). However, in the joint model, the work environment variable remained significant and attenuated slightly to an Odds Ratio of 0.94, while the safety climate measure lost statistical significance. Multicollinearity was tested and the variance inflation factors were 3.60 for safety climate and 3.84 for work environment, below the threshold of 10 established by Cohen, Cohen, West, and Aiken (2003, p. 423).

4. Discussion

Safety climate and the work environment are organizational characteristics associated with patient mortality. In this study, we found that perceptions of safety climate did not predict patient mortality above and beyond the impact of the work environment. When modeled separately, poorer safety climate and poorer work environments were each associated with increased risk of mortality. However, when the variables were modeled together, the effect of the safety climate became nonsignificant, while that of the work environment continued to be a significant predictor of mortality.

Safety climate within the hospitals has been found in a previous study to be associated with mortality (Huang et al., 2010). This association between safety climate and mortality is thought to exist because hospitals with poor safety climate have higher rates of adverse safety events, which then result in preventable mortality (Mardon et al., 2010; Rosen et al., 2010; Singer et al., 2009; Taylor et al., 2012). However, this safety-focused concept is different from the concept of the work environment. The work environment extends beyond safety to encompass characteristics that support professional nursing practice, a conclusion reached in the Institute of Medicine’s report *Keeping Patients Safe: Transforming the Work Environment of Nurses* (IOM, 2004). Professional nursing practice allows nurses to provide the highest quality care to patients and is influenced by such things as nurses’ participation in hospital decisions; nursing care models and philosophies; the ability, support, and leadership of nurse managers; and the quality of relationships among nurses and physicians.

Strategies directed at changing organizational culture are thought to be the most effective and sustainable because the culture underlies and drives all the processes within an organization. Research suggests that Magnet is an intervention that improves work environments over time (Aiken et al., 2008; Kutney-Lee et al., 2015; Silber et al., 2016). It is noteworthy that Magnet recognition is rarely acknowledged as improving safety despite research findings that Magnet hospitals have better patient safety grades, scores on safety climate surveys, and characteristics, including managerial commitment to safety, error

communication, and error problem solving (Hughes et al., 2012; Kelly et al., 2011; McHugh et al., 2013).

More commonly, strategies to improve safety in organizations have included team training, administrators routinely walking around to speak with frontline staff about safety, education programs, and multicomponent interventions (Morello et al., 2013; Weaver et al., 2014, 2013). These have been deployed with mixed success in terms of changing the culture, impacting processes, and improving outcomes, particularly in the long term (Armour Forse et al., 2011; Morello et al., 2013; Weaver et al., 2013). Checklists, briefings, and debriefings are also common strategies to improve safety (Haynes et al., 2011; Hill et al., 2015). While the WHO Safe Surgery Saves Lives check-list may improve overall safety climate, no significant improvements have been found for key indices, including physicians and nurses working well together, team members speaking up if there is a problem, and personnel disregarding rules for the OR (Haynes et al., 2011). Many safety-focused interventions may not bring about the extensive organizational change that comes from empowering nurses to forge a strengthened culture of patient safety. Thus, to improve patient outcomes it would be beneficial for hospitals to improve the work environment in which nurses provide care. The PES-NWI can be used as a tool to specifically target aspects of the work environment for quality improvement.

The majority of the published literature focuses on organizational interventions to influence safety climate whereas our findings suggest the nurse work environment may have a greater impact on patient outcomes. Compared to research in safety climate and culture, very few interventions directed at the nurse work environment have been developed and tested; even so, there is evidence that the process of becoming a Magnet-recognized hospital is associated with improved practice environments and patient outcomes (Aitken et al., 2011; Gardner et al., 2009; Kutney-Lee et al., 2015; Warshawsky and Havens, 2011). An important area for future research includes studies evaluating effects on patient outcomes of interventions designed to improve the nurse work environment. This is particularly true given the amount of observational research indicating the positive relationship between a better work environment and nurse and patient outcomes (Aiken et al., 2011; Aiken et al., 2008; Clarke, 2007; Estabrooks et al., 2005; Friese, 2005; Friese et al., 2008; Gunnarsdóttir et al., 2009; Kutney-Lee et al., 2009; Spence Laschinger and Leiter, 2006; Vahey et al., 2004). Our use of the Quality Health Outcomes Model did not account for all the possible factors that could impact the work environment and patient outcomes, including certification and expertise, as well as burnout and psychological safety. Techniques such as structural equation modeling could be used to more fully describe relationships among system factors, patient characteristics, nursing care interventions, and patient outcomes.

4.1 Limitations

There are several limitations to consider when interpreting these results. First, the cross-sectional design of this study limits causal inference. Second, the inability to include out-of-hospital mortality may result in a smaller number of deaths than actually occurred. Because mortality is a distal outcome, it may not be as sensitive to changes in nursing care at the bedside as some other outcome measures. In a study of seven nurse-sensitive patient

outcomes, however, none were found to be significantly related to patient safety climate (Ausserhofer et al., 2013). The authors suggested that future research use 30-day mortality because of its higher reliability. Mortality does not have issues with present on admission and we were able to use a well validated risk-adjustment model (Silber et al., 2000; Silber, Rosenbaum, Schwartz, Ross, & Williams, 1995). Finally, there may be self-selection bias among those who responded to the survey and because nurses were asked about the work environment and the safety climate on the same survey, there may be some degree of same source bias.

4.2 Conclusions

More than 15 years after the Institute of Medicine's seminal report *To Err is Human* (IOM, 2000), patient safety progress has lagged expectations (Makary & Daniel, 2016; Kronick, Arnold, Brady, 2016). Leaders in patient safety have pointed to hospital safety culture as a key component to address the staggering mortality and morbidity associated with adverse events and errors in healthcare (Clancy, 2009; Wachter, 2010). While both safety climate and the work environment have been associated with patient mortality, we found that when these two aspects of the organization are considered together, safety climate is no longer a significant predictor, whereas the work environment remains so. This indicates that a comprehensive approach involving improving the environment in which nurses and others work could be an important strategy for improving hospital quality and safety. This article adds to the science by extending our understanding of the role of the work environment vis-à-vis safety climate in surgical patient mortality. Our findings provide additional empirical support for the conclusion of the Institute of Medicine (IOM, 2004) that creating work environments that fully support nursing practice are critical to improving the safety and quality of patient care.

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What is already known about the topic?

- The nurse work environment is associated with mortality, failure to rescue, readmissions, and nurse-reported care quality, among other important outcomes.
- Safety climate, i.e. the perception of the state of safety at a given point in time, has been associated with adverse events and complications, readmissions, and length of stay.
- To improve patient safety and outcomes, many interventions focus on patient safety climate, with less emphasis on improving the nurse work environment.

What this paper adds

- When considered together, nurse work environment is a significant predictor of patient mortality, while safety climate is not a significant predictor.
- To achieve the highest levels of safety and quality, hospitals should invest in creating an environment supportive of nurses' work, including adequate staffing, managerial support for nurses, and good relationships among nurses and physicians.

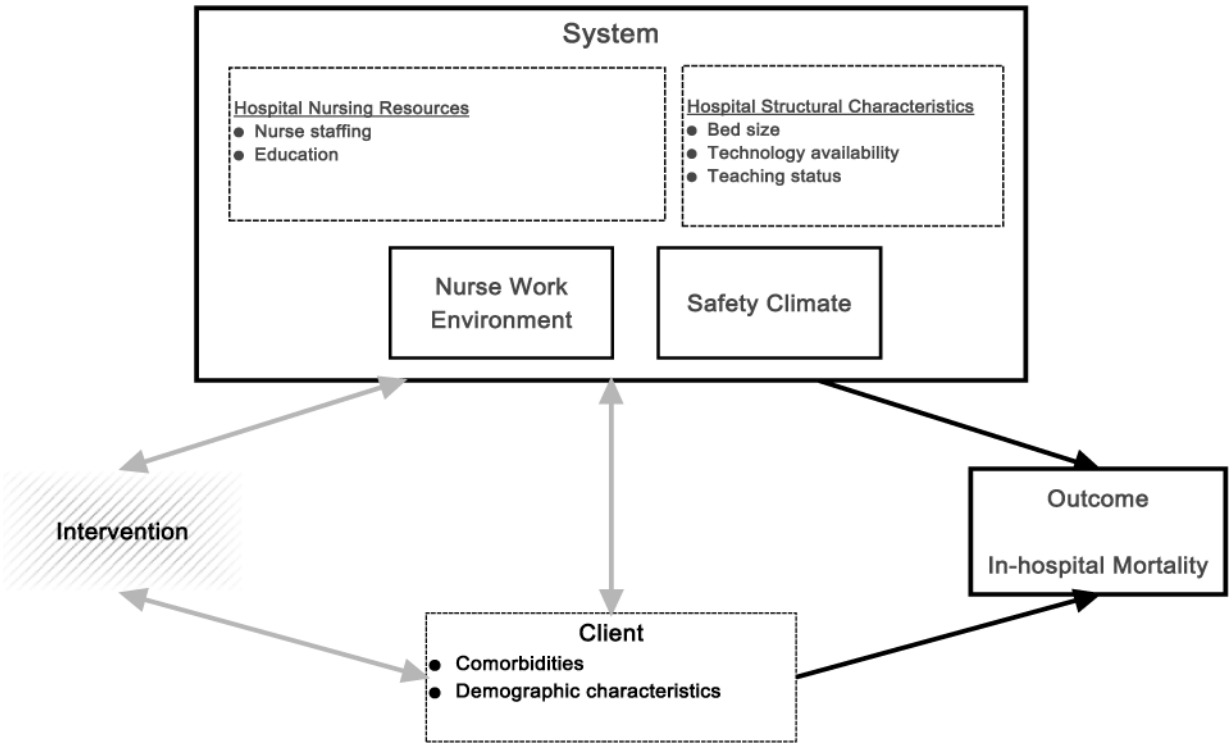

Figure 1. Theoretical Framework

Solid outline squares = Main study variables

Dashed outline squares = Control variables

Hatched squares = Unstudied variables

Black arrows = Study relationships

Gray arrows = Unstudied relationships

Table 1

Hospital (n=600), Nurse (n=27,009), and Patient (n=852,974) Sample Characteristics

	Categories	Number (%) or Mean (SD)
Hospitals by Bed Size	0–100 Beds	71 (12%)
	101–250 Beds	267 (44%)
	> 250 Beds	262 (44%)
Hospitals by Teaching Status	Non-teaching	311 (52%)
	Minor Teaching	244 (41%)
	Major Teaching	45 (7%)
Hospitals by Technology Availability	Low-technology	343 (57%)
	High-technology	257 (43%)
Hospitals by State	California	232 (39%)
	Florida	158 (26%)
	New Jersey	71 (12%)
	Pennsylvania	139 (23%)
Hospital-level Percent of Nurses with BSN or Higher		Mean: 38% (SD 14%)
Nurses by Highest Degree	Diploma	4,813 (19%)
	Associate's Degree	9,891 (39%)
	Baccalaureate Degree	10,206 (40%)
	Master's Degree	761 (3%)
	Doctoral Degree	7 (0.03%)
Nurses by State	California	8,529 (32%)
	Florida	5,882 (22%)
	New Jersey	5,918 (22%)
	Pennsylvania	6,680 (25%)
Nurses by Specialty Areas	Adult Critical Care	3,986 (17%)
	Adult Medical/Surgical	3,894 (16%)
	Other	16,074 (67%)
Hospital-level Staffing[a]		Mean: 5.3 (SD 1.4)
Patients by Sex	Female	485,230 (57%)
	Male	367,728 (43%)
Patients' Age		Mean: 59.1 (SD 17.5)
Patients by State	California	345,376 (40%)

	Categories	Number (%) or Mean (SD)
	Florida	224,298 (26%)
	New Jersey	91,827 (11%)
	Pennsylvania	191,473 (22%)
Patients by Procedure	General Surgery	363,296 (43%)
	Orthopedic Surgery	446,230 (52%)
	Vascular Surgery	43,448 (5%)

Note: May not total to full sample size due to missing values; may not total 100% due to rounding.

[a]Staffing is defined as the mean number of patients per nurse.

Table 2

Hospital-level PES-NWI Subscales

	Range	Mean (SD)
Composite	2.11–3.41	2.68 (0.23)
Nurse Participation in Hospital Affairs	1.67–3.38	2.18–3.52
Nursing Foundations for Quality of Care	2.54 (0.29)	2.93 (0.22)
Nurse Manager Ability, Leadership, and Support of Nurses	1.71–3.54	2.57 (0.28)
Collegial Nurse-Physician Relations	2.17–3.56	2.89 (0.22)
Staffing and Resource Adequacy	1.60–3.57	2.48 (0.31)

Note: Range is the hospital-level mean of items from the subscale. Items were scored 1, indicating the respondent “strongly disagrees” that the organizational characteristic is “present in the current job,” to 4, indicating” strongly agree.”

Table 3

Hospital-level Safety Climate Percent Positive Responses

	Range	Mean (SD)
Scale Composite	26.7%–92.3%	55.0% (8.7)
Staff feel like their mistakes are held against them.[a]	5.0%–76.9%	33.8% (11.7)
Important patient care information is often lost during shift changes.[a]	10.0%–100.0%	52.4% (11.8)
Things “fall between the cracks” when transferring patients from one unit to another.[a]	0.0%–100.0%	44.5% (12.4)
Staff feel free to question the decisions or actions of those in authority.	8.3%–84.0%	45.9% (13.4)
In this unit, we discuss ways to prevent errors from happening again.	40.0%–100.0%	77.1% (10.1)
We are given feedback about changes put into place based on event reports.	9.1%–100.0%	57.5% (13.7)
The actions of hospital/organization management show that patient safety is a top priority.	23.1%–100.0%	69.9% (14.6)

Note:

[a]indicates the item is reverse coded such that disagree and strongly disagree are positive (i.e., desirable) responses

Table 4

Multivariate Analyses

	e^{β}	SE	95% CI	P-value
Model 1: Work Environment	0.919	0.016	0.888, 0.950	< 0.001
Model 2: Safety Climate	0.923	0.016	0.893, 0.956	< 0.001
Model 3 (Joint): Work Environment	0.940	0.027	0.888, 0.996	0.035
Safety Climate	0.971	0.028	0.917, 1.028	0.316

Note: e^{β} is the odds ratio; SE is the robust standard error; 95% CI is the 95% Confidence Interval. Models included hospital bed size, technology availability, teaching status, hospital-level nurse staffing, hospital-level percentage of nurses with at least a BSN degree, percentage of respondents in medical/surgical and intensive care units, and patient pre-existing conditions, surgical DRG, age, and sex. Work Environment and Safety Climate are standardized variables.