



Association of nurse work environment and safety climate on patient mortality: A cross-sectional study



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ABSTRACT

Background: There are two largely distinct research literatures on the association of the nurse work environment and the safety climate on patient outcomes.

Objective: To determine whether hospital safety climate and work environment make comparable or distinct contributions to patient mortality.

Design: Cross-sectional secondary analysis of linked datasets of Registered Nurse survey responses, adult acute care discharge records, and hospital characteristics.

Setting: Acute care hospitals in California, Florida, New Jersey, and Pennsylvania.

Participants: The sample included 600 hospitals linked to 27,009 nurse survey respondents and 852,974 surgical patients.

Methods: Nurse survey data included assessments of the nurse work environment and hospital safety climate. The outcome of interest was in-hospital mortality. Data analyses included descriptive statistics and multivariate random intercept logistic regression.

Results: In a fully adjusted model, a one standard deviation increase in work environment score was associated with an 8.1% decrease in the odds of mortality (OR 0.919, $p < 0.001$). A one-standard deviation increase in safety climate score was similarly associated with a 7.7% decrease in the odds of mortality (OR 0.923, $p < 0.001$). However, when work environment and safety climate were modeled together, the effect of the work environment remained significant, while safety climate became a non-significant predictor of mortality odds (OR 0.940, $p = 0.035$ vs. OR 0.971, $p = 0.316$).

Conclusions: We found that safety climate perception is not predictive of patient mortality beyond the effect of the nurse work environment. To advance hospital safety and quality and improve patient outcomes, organizational interventions should be directed toward improving nurse work environments.

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.

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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, 2003), 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 and Daniel, 2016). These observations raise an important question about whether nurse practice environments and patient safety climate are the same or different concepts.

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 and 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., 2008b, 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., 2008b; 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., 2008a, 2008b; 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, 2008b, 2002).

Using state RN licensure lists and a modified Dillman method (Dillman, 2000), the *Multi-State Nursing Care and Patient Safety Study*

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