

Work Environment and Operational Failures Associated With Nurse Outcomes, Patient Safety, and Patient Satisfaction

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Background: Operational failures, defined as the inability of the work system to reliably provide information, services, and supplies needed when, where, and to who, are a pervasive problem in U.S. hospitals that disrupt nurses' ability to provide safe and effective care.

Objectives: We examined the relationship between operational failures, patient satisfaction, nurse-reported quality and safety, and nurse job outcomes (e.g., burnout and job satisfaction) and whether differences in hospital work environments explained the relationship.

Methods: We conducted a cross-sectional analysis using population-based survey data from 11,709 registered nurses in 415 hospitals who participated in the RN4CAST-US nurse survey (2015–2016) and the 2016 Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey. The RN4CAST-US nurse survey focused on hospital quality and safety, job outcomes, and hospital work environments. The HCAHPS survey collected publicly reported patient data on their satisfaction with their care. Operational failures were evaluated using an eight-item composite measure that assessed missing supplies, orders, medication, missing/wrong patient diet, electronic documentation problems, insufficient staff, and time spent on workarounds and nonnursing tasks. Multilevel regression models were used to test the hypothesized relationships.

Results: Operational failures were associated with low patient satisfaction scores, poor quality and safety outcomes, and poor nurse job outcomes, and those associations were partly accounted for by hospital work environments.

Discussion: Operational failures prevent high-quality care and positive patient and nurse outcomes. Operational failures and the hospital work environment should be targeted simultaneously to maximize quality improvement efforts. Hospital leadership should work with frontline staff to identify and target the sources of operational failures in nursing units. Improvements to hospital work environments may reduce the occurrence of operational failures.

Key Words: nursing • operational failures • patient safety

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The Institute of Medicine's report "To Err Is Human: Building a Safer Health System" (Institute of Medicine, 2000) created an impetus for research on systems-level interventions to improve patient safety. This report estimated that as many as 98,000 individuals in the United States die each year as a result of preventable medical errors—many of which are attributable to operational failures (Institute of Medicine, 2000)—and the inability of the work system to reliably provide information, services, and supplies needed when, where, and

to who (Tucker, 2004). Twenty years later, operational failures (Hendrich et al., 2008; Tucker, 2004; Tucker et al., 2014; Tucker & Spear, 2006) and preventable medical harm related to operational failures (Bates & Singh, 2018) remain a pervasive problem in U.S. hospitals. On average, nurses encounter an operational failure once every 37 minutes (Tucker et al., 2014). Common operational failures in hospitals include missing medications and supplies, incorrect orders, broken equipment, and electronic documentation problems (Tucker, 2004).

In response to operational failures, healthcare professionals, such as nurses and physicians, often engage in workarounds—an intentional effort to create the desired result despite the obstacle (Halbesleben et al., 2010; Tucker et al., 2014) and circumvent safety protocols in order to complete necessary work (Hendrich et al., 2008; Tucker, 2004; Tucker et al., 2014; Tucker & Spear, 2006). When a nurse encounters an operational failure, they are faced with the decision of whether to perform a workaround. When a workaround is performed, it is often to complete a care task quicker than the established formal

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procedures, allowing for the progression to other tasks (Lalley, 2014). Some operational failures disrupt work processes so severely that the task can only be accomplished using a workaround or not at all. This decision may be influenced by several factors, including the sheer burden of operational failures in their respective care setting. Research has documented that, on average, nurses spend 10% of their time engaging in workarounds to address operational failures (Hendrich et al., 2008; Tucker, 2004). Although workarounds can solve the immediate problem, they also enable failures to reoccur if no attempt is made to address problems systematically. Workarounds can increase the risk of medical errors and limit the organizational leadership's observation of problems and thus efforts to remove the causes (Tucker et al., 2014; Tucker & Spear, 2006). Prior research suggests that operational failures are likely to correlate with low patient satisfaction, poor quality and safety outcomes for patients, and poor work experiences for clinicians who encounter such failures (Tucker, 2004). However, to date, no research has examined whether and how operational failures vary across hospitals or the factors that might mitigate or disrupt the effect of operational failures on outcomes for patients and clinicians across hundreds of hospitals. We also categorized operational failures as attributes of the organization, which is consistent with the suggestion that operational failures are system features, as well as their solutions (Institute of Medicine, 2000). Although prior research has documented many beneficial effects of positive work environments for patients and clinicians, it has not considered how the work environment and operational failures may relate to one another and the outcomes. Understanding these relationships is critical for identifying both the sources of operational failures and opportunities for hospital work system improvements to reduce the incidence of operational failures and any subsequent poor outcomes.

In this study, we focused on nurses because of the centrality and complexity of their roles in caring for patients whose conditions are continuously changing (Tucker & Spear, 2006), their dependence on operational systems to care for patients, and their well-documented exposure to frequent operational failures (Hendrich et al., 2008; Tucker, 2004; Tucker et al., 2014; Tucker & Spear, 2006). We also examined the work environment because hospital work environments vary considerably from one institution to the next and are associated with a wide range of quality and safety outcomes for patients (Aiken et al., 2008, 2011; Lasater & McHugh, 2016; Lee et al., 2018). Prior work defines a positive work environment for nurses as an organization that supports professional nursing through characteristics such as effective nurse leadership, nurse participation in hospital affairs, responsiveness to problems identified by frontline clinicians, and teamwork-oriented nurse–physician relationships (Lake, 2002). This study aimed to inspect the relationships between operational failures, hospital work environment, patient

satisfaction, nurse-reported quality, safety, and nurse job outcomes. Our hypotheses were as follows:

1. Operational failures are associated with lower patient satisfaction scores.
2. Operational failures are associated with poor nurse-reported job quality and safety outcomes.
3. Operational failures occur less frequently in positive work environments; thus, the association between operational failures and patient satisfaction and nurse outcomes may be partially accounted for by differences across hospital work environments.

METHODS

Study Design and Sample

We conducted a cross-sectional analysis of secondary data using population-based nurse survey data from the RN4CAST-US Study (2015–2016), hospital data from the American Hospital Association (AHA) Annual Survey (2015), and patient satisfaction data from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey (2016). The analytic sample included 11,709 registered nurses who participated in the RN4CAST-US survey in 415 hospitals in four states (California, Florida, New Jersey, and Pennsylvania), which also participated in the HCAHPS survey.

Data Source

Nurse survey data were collected as part of the RN4CAST-US survey between 2015 and 2016 in California, Florida, New Jersey, and Pennsylvania. Over 20% of U.S. hospital admissions occur in these four states. The survey was sent to a 30% random sample of nurses in participating hospitals in the four states. Surveys were mailed to nurses' home addresses; they requested detailed information about the quality and safety of care in their employing hospital, including validated measures of work environment and questions about the degree to which various operational failures were present in their work setting. Nurse responses were aggregated at the hospital level and linked to hospital organizational data from AHA and patient satisfaction data from the HCAHPS survey. A full description of the nurse survey methods is reported elsewhere (Lasater et al., 2019). Our sample was restricted to adult, nonfederal, acute care hospitals with at least 10 nurse respondents. We had an average of about 28 nurse respondents per hospital. We excluded survey respondents who were not staff nurses providing direct patient care.

The HCAHPS survey collected information on patients' hospital experiences in short-term, acute care hospitals. Eligible patients include adults receiving medical, surgical, or maternity care with an overnight stay or longer who are alive at discharge (Centers for Medicare & Medicaid Services [CMS], 2021). A random sample of these patients is surveyed after discharge (48 hours to 6 weeks postdischarge) using one of four modes of administration: mail, telephone, mixed, and interactive voice response (CMS, 2021). Per the CMS, these data are

risk-adjusted for patient mix and mode of administration and are publicly available on the Hospital Compare website (<https://www.medicare.gov/hospitalcompare/search.html>). The mean response rate across hospitals in this sample was 25.5%. Data from 2016 were used for this study to correspond as closely as possible with the timing of the nurse survey.

Measures

Operational Failures No standardized instrument was available to measure hospital operational failures; therefore, we used items from the nurse survey to develop a hospital composite measure of operational failures with good internal consistency. The nurse survey inquired about the degree to which various operational failures were present in nurses' hospital practice settings. Nurses were asked, "How frequently is your work interrupted or delayed by the following?" Six items were listed (missing supplies, missing orders, missing medications, missing/wrong patient diet, electronic documentation system problems or errors, and insufficient staff), and each was scored on a 3-point scale: "never," "rarely/occasionally," or "frequently." The survey also included two global items: "How much of your workday is spent on workarounds for the problems above?" and "How much of your day is spent on nonnursing tasks?" For each of the two global items, nurses could respond, "None of my day," "A small part of my day," or "A large part of my day." All items were measured on a scale of 1–3, with a higher score indicating more frequent operational failures. We created an eight-item composite measure of operational failures calculated as the mean of the six specific items and the two global items for each nurse. Nurses' composite scores were then aggregated at the hospital level to create a continuous hospital-level summary measure (Cronbach's $\alpha = .80$).

Work Environment Work environment was measured using the 31-item Practice Environment Scale of the Nursing Work Index (Lake, 2002) endorsed by the National Quality Forum. The Practice Environment Scale of the Nursing Work Index comprises five subscales: nurse participation in hospital affairs; nursing foundations for quality care; nurse manager ability, leadership, and support; staffing and resource adequacy; and nurse–physician relations. Nurses indicated the extent to which they agreed that factors related to each subscale were present in their hospitals using a 1–4 Likert scale, with a higher number indicating a more favorable work environment. Internal consistency coefficients (Cronbach's α) for the five subscales range from .71 to .84 (Lake, 2002). Intraclass correlation coefficients are within generally accepted values (.86–.96; Lake, 2002). Hospital-level work environment measures were created by aggregating nurses' responses to items within each subscale and calculating a continuous hospital-level summary measure ranging between 1 and 4 (Verran et al., 1995). We excluded the staffing and resource adequacy subscale from the composite work environment measure because of collinearity

with the operational failure survey item on the frequency of insufficient staff.

Patient Satisfaction The 29-item HCAHPS survey is reported as a set of 10 measures (six composite measures, two individual items, and two global items) related to communication with nurses and doctors, the responsiveness of hospital staff, the hospital environment's cleanliness and quietness, communication about medicine, discharge information, overall hospital rating, and whether they would recommend the hospital (CMS, 2021). All 10 measures were used in this study.

Nurse-Reported Quality and Safety Outcomes Nurse-reported quality and safety outcomes were measured in three domains: global quality measures, adverse events, and missed nursing care (Aiken et al., 2013; Ausserhofer et al., 2014; McHugh & Stimpfel, 2012). For global quality, nurses were asked to rate the quality of their unit as poor, fair, good, or excellent. This item was dichotomized as good/excellent versus poor/fair. Nurses were also asked to provide a safety grade for their hospital, which we dichotomized as poor/failing versus acceptable/very good/excellent. To assess the frequency of adverse events, which indicate unsafe care, nurses were asked how frequently four events occurred in their units: healthcare-associated infections, patient falls with injury, pressure ulcers, and medication errors. We dichotomized frequency as once a month or more often (1) versus a few times a year or fewer (0). To measure missed nursing care, we calculated the number of tasks (out of 13 listed in the survey) nurses reported being unable to complete because of time constraints on their last shift. We then created an indicator variable for whether seven or more tasks were not completed on the last shift (Ausserhofer et al., 2014). Dichotomization of outcomes was completed by collapsing categories after preliminary analyses revealed no significant associations between operation failures, work environments, and outcomes were lost as a result (Knoke & Burke, 1980; Sloane & Morgan, 1996).

Nurse Job Outcomes Nurse job outcomes measures in the survey included burnout, job dissatisfaction, and intent to leave (McHugh et al., 2011). Burnout was measured using the validated nine-item emotional exhaustion subscale of the Maslach Burnout Inventory (Maslach & Jackson, 1986). Consistent with published norms for burnout among health professionals, emotional exhaustion scores of 27 or above were considered high burnout (Maslach & Jackson, 1986). Job dissatisfaction was measured using a single item asking nurses how satisfied they are with their current positions, which we dichotomized as very dissatisfied/a little dissatisfied versus moderately satisfied/very satisfied. Finally, intent to leave—considered another indicator of dissatisfaction—was measured using a single item asking nurses if they intend to leave their current position within a year (yes/no).

Covariates We adjusted all statistical models for several hospital characteristics obtained from the 2015 AHA hospital survey: size, teaching status, and technology status. Hospital size was categorized by the number of beds: <100, 100–250, or >250. Teaching status was categorized as nonteaching (no residents or fellows), minor teaching (1:4 residents/fellows-to-bed ratio), and major teaching (>1:4). Hospitals with facilities for open-heart surgery, major organ transplants, or both were classified as high technology. The statistical models for nurse job outcomes and nurse-reported quality and safety outcomes controlled for nurse respondent characteristics, including age, gender, and education (bachelor's degree: yes/no). The statistical patient satisfaction models controlled for the hospital-specific HCAHPS response rate.

Statistical Analysis

The distributions of operational failures, work environments, other hospital characteristics, patient satisfaction, and nurse-reported outcomes were examined for the full sample, as well

as for the subsamples of hospitals in each nurse work environment category. Multilevel regression models were used to test the hypothesized relationships between operational failures, the nurse work environment, patient satisfaction, and nurse-reported outcomes. Nurse-reported outcomes were dichotomous outcomes measured at the individual level. Operational failures, the nurse work environment, and patient satisfaction were continuous hospital-level composite variables. For the nurse-reported outcomes, we used logistic regression models to estimate the association of operational failures with nurse-reported quality and safety outcomes and job outcomes before and after adjusting for nurse and hospital characteristics, including the hospital work environment. For the patient satisfaction measures, we used linear regression models to estimate the association of operational failures with 10 patient satisfaction measures before and after adjusting for hospital characteristics, including the hospital work environment. Analyses were performed in Stata Statistical Software (Release 15 [2017], StataCorp LLC, College Station, TX) using two-sided statistical

TABLE 1. Hospital Characteristics

Hospital characteristics	All (N = 415)	Nurse work environment		
		Poor (n = 104)	Mixed (n = 208)	Better (n = 103)
Nurse work environment composite score, mean (SD)	2.9 (0.2)	2.5 (0.1)	2.9 (0.1)	3.2 (0.1)
Collegial nurse–physician relations	3.1 (0.2)	2.9 (0.2)	3.1 (0.1)	3.3 (0.1)
Nursing foundations for quality of care	3.0 (0.2)	2.8 (0.1)	3.0 (0.1)	3.3 (0.1)
Nurse manager ability, leadership, and support of nurses	2.7 (0.3)	2.3 (0.2)	2.7 (0.2)	3.0 (0.2)
Nurse participation in hospital affairs	2.6 (0.3)	2.2 (0.2)	2.6 (0.2)	3.0 (0.2)
Hospital teaching status, n (%)				
None	169 (40.7%)	36 (34.6%)	76 (36.5%)	57 (55.3%)
Minor (1:4 resident-to-bed ratio)	200 (48.2%)	63 (60.6%)	108 (51.9%)	29 (28.2%)
Major (>1:4 resident-to-bed ratio)	46 (11.1%)	5 (4.8%)	24 (11.5%)	17 (16.5%)
Hospital technology status, n (%)				
Low	154 (37.1%)	43 (41.4%)	76 (36.5%)	35 (34.0%)
High	258 (62.2%)	60 (57.7%)	131 (63.0%)	67 (65.1%)
Bed size, n (%)				
<100	8 (1.9%)	2 (1.9%)	2 (1.0%)	4 (3.9%)
100–250	156 (37.6%)	48 (46.2%)	80 (38.5%)	28 (27.2%)
>250	251 (60.5%)	54 (51.9%)	126 (60.6%)	71 (68.9%)
State, n (%)				
California	168 (40.5%)	33 (31.7%)	85 (40.9%)	50 (48.5%)
Florida	110 (26.5%)	32 (30.8%)	54 (26.0%)	24 (23.3%)
New Jersey	45 (10.8%)	9 (8.7%)	22 (10.6%)	14 (13.6%)
Pennsylvania	92 (22.2%)	30 (28.9%)	47 (22.6%)	15 (14.6%)
HCAHPS response rate, mean (SD)	25.5 (6.2)	25.0 (6.3)	25.5 (6.6)	26.2 (5.5)

Note. Operational failures composite score and individual items are measured on a 1–3 scale, with a higher score indicating more frequent operational failures. Hospital-level measures of operational failures are created by aggregating nurses' responses to the six individual items and the two global items and calculating a continuous hospital-level summary measure (Cronbach's $\alpha = .80$). Work environment composite score and subscales are measured on a 1–4 scale, with a higher score indicating a more favorable work environment. Hospital-level measures of work environment are created by aggregating nurses' responses to items within each subscale and calculating a continuous hospital-level summary measure. The medians of the four subscales across all study hospitals were used to classify hospitals as having "better" (three subscales above the median), "mixed" (one or two subscales above the median), or "poor" (no subscales above the median) nurse work environments. HCAHPS = Hospital Consumer Assessment of Healthcare Providers and Systems.

tests with an α level of .05. Consent was obtained from the nurses participating in the RN4CAST-US. Patients' informed consent was waived because of deidentification of their data in the state discharge files. The University of Pennsylvania Institutional Review Board approved this study.

RESULTS

The final hospital sample included 415 institutions (Table 1). The average hospital composite score for nurse work environment was 2.9 ($SD = 0.2$). The work environment subscales rated highest to lowest included collegial nurse–physician relations (mean = 3.1); nursing foundations for quality of care (mean = 3.0); nurse manager ability, leadership, and support of nurses (mean = 2.7); and lastly, nurse participation in hospital affairs (mean = 2.6). Most hospitals in the sample were large, minor teaching institutions with high technological capabilities. A large proportion of the hospital sample is in California. The average HCAHPS response rate was 25.5% ($SD = 6.2\%$). These characteristics are also displayed by the subsamples of hospitals in each work environment category.

The final nurse sample included 11,709 individuals in 415 hospitals. The average nurse was 46.9 years old ($SD = 12.3$), was BSN-prepared (57.1%), and had worked a mean of 18.6 years ($SD = 13.0$) as a registered nurse and 12.8 years ($SD = 10.8$) at their current organization. The most common hospital practice setting among nurses surveyed was adult

medical–surgical units (26.5%). The operational failures that nurses reported most often (occurring “frequently”) were insufficient staff (42.2%) and missing supplies/broken equipment (34.9%). Nearly 3 in 10 nurses reported spending a large part of their day on nonnursing tasks (30.7%), and one in four reported spending a large part of their day on workarounds (27.5%).

The composite score of operational failures across the 415 hospitals ranged between 1.8 and 2.5, with a mean of 2.2 (Figure 1). Each bar in the figure represents a hospital, with poor nurse work environments denoted in red, mixed nurse work environments denoted in yellow, and best nurse work environments denoted in green. There is substantial variation in the scores of operational failures across all hospitals and work environments. Hospitals with the best work environments displayed lower operational failure scores than hospitals with poor work environments.

The percentage of patient agreement with various HCAHPS outcomes and nurse-reported outcomes are presented and compared across hospitals with good (top 25%), mixed (middle 50%), and poor (bottom 25%) nurse work environment scores in Table 2. Analyses of variance revealed that patients in hospitals with poor work environments significantly were less likely to agree with all 10 HCAHPS measures than those in mixed and poor nurse work environments ($p < .001$). Similarly, nurses in hospitals with poor work environments were significantly

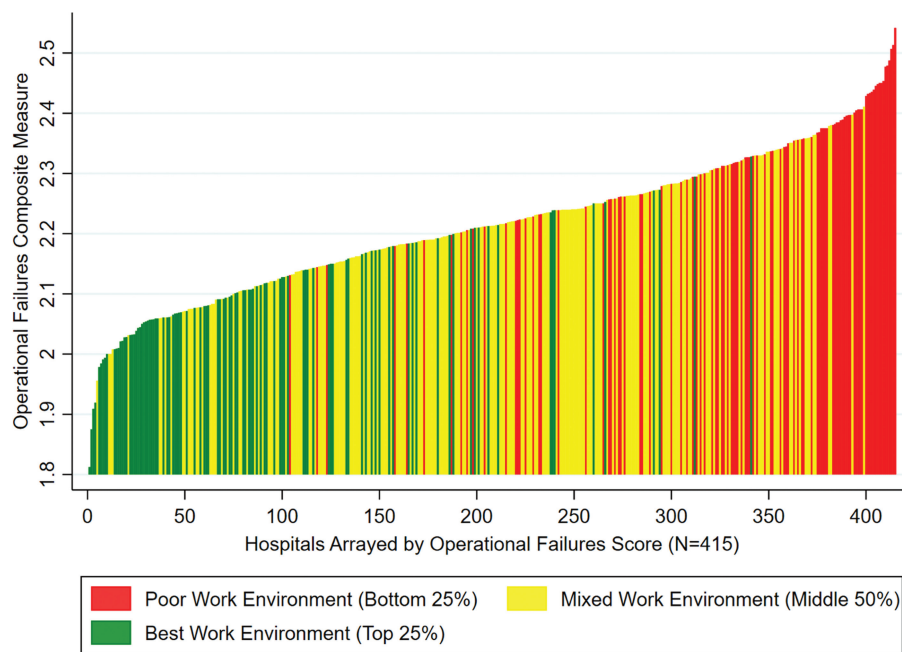


FIGURE 1. Hospital variation in operational failures by the Practice Environment Scale of the Nursing Work Index. Operational failures composite score and individual items are measured on a 1–3 scale, with a higher score indicating more frequent operational failures. Hospital-level measures of operational failures are created by aggregating nurses' responses to the six individual items and the two global items and calculating a continuous hospital-level summary measure (Cronbach's $\alpha = .80$). Work environment composite score and subscales are measured on a 1–4 scale, with a higher score indicating a more favorable work environment. Hospital-level measures of work environment are created by aggregating nurses' responses to items within each subscale and calculating a continuous hospital-level summary measure. The medians of the four subscales across all study hospitals were used to classify hospitals as having “better” (three subscales above the median), “mixed” (one or two subscales above the median), or “poor” (no subscales above the median) nurse work environments.

TABLE 2. Distribution of HCAHPS, Nurse-Reported Quality and Safety, and Job Outcomes by the Quality of the Nurse Work Environment

Outcomes	Nurse work environment			
	All	Poor	Mixed	Better
	(N = 415)	(n = 104)	(n = 208)	(n = 103)
	M (SD)	M (SD)	M (SD)	M (SD)
HCAHPS outcomes				
Patient gave a rating of 9 or 10 (high)	69.2 (7.2)	64.5 (6.1)	68.7 (6.4)	75.0 (5.9)
Patient would definitely recommend the hospital	70.4 (8.3)	64.9 (7.4)	69.9 (7.2)	77.2 (6.5)
Nurses always communicated well	76.8 (4.2)	75.0 (4.0)	76.5 (4.0)	79.5 (3.2)
Patients always received help as soon as they wanted	61.9 (5.7)	59.7 (5.8)	61.4 (5.4)	65.1 (4.8)
Always quiet at night	53.2 (7.0)	52.2 (6.8)	52.4 (6.6)	55.9 (7.2)
Doctors always communicated well	77.8 (3.4)	76.3 (3.8)	77.7 (3.0)	79.5 (2.8)
Room was always clean	69.7 (5.8)	67.6 (5.8)	69.3 (5.7)	72.7 (4.9)
Staff gave patients discharge information	85.7 (2.7)	84.7 (2.8)	85.7 (2.7)	86.8 (2.1)
Pain was always well controlled	68.6 (3.7)	66.9 (3.4)	68.3 (3.5)	70.7 (3.0)
Staff always explained medications	61.6 (3.9)	59.8 (4.0)	61.5 (3.8)	63.7 (3.0)
Nurse-reported job outcomes				
High burnout	31.7 (12.5)	40.6 (12.9)	31.9 (10.3)	22.4 (8.7)
Job dissatisfaction	22.0 (11.9)	32.2 (13.2)	21.3 (9.4)	13.1 (5.7)
Intent to leave	13.4 (8.8)	18.1 (10.2)	13.1 (8.1)	9.5 (6.2)
Nurse-reported quality and safety outcomes				
Poor/fair quality of unit	14.6 (11.1)	25.0 (11.4)	13.9 (8.6)	5.7 (5.0)
Poor or failing safety grade	10.6 (9.6)	19.1 (11.4)	9.6 (7.3)	4.3 (4.6)
Healthcare-associated infections monthly or more often	10.5 (8.1)	13.6 (9.6)	10.2 (7.5)	7.8 (6.1)
Patient falls with injury monthly or more often	6.7 (6.2)	9.1 (7.4)	6.5 (6.0)	4.5 (4.1)
Pressure ulcers monthly or more often	5.1 (5.5)	7.0 (6.3)	5.1 (5.6)	3.0 (3.5)
Medication errors monthly or more often	1.8 (3.0)	2.4 (3.4)	1.8 (2.9)	1.5 (2.7)
Seven or more tasks not completed on last shift	13.3 (9.0)	19.5 (10.9)	12.8 (7.3)	8.3 (6.0)

Note. Nurse-reported quality and safety outcomes are binary variables measured at the individual level. Values were multiplied by 100 to represent percent agreement. Operational failures and HCAHPS outcomes are measured at the hospital level. HCAHPS = Hospital Consumer Assessment of Healthcare Providers and Systems.

more likely to report six out of the seven poor quality and safety outcomes and experience high burnout, job dissatisfaction, and an intent to leave their current job within a year than those in mixed and poor nurse work environments ($p < .001$).

The adjusted parameter estimates indicating the association of operational failures and the nurse work environment with patient satisfaction—derived from models adjusted for differences in hospital characteristics and HCAHPS response rate—are reported in Table 3. These models estimate their effects individually and jointly. Operational failures were negatively associated with patient agreement for all 10 HCAHPS measures (Model 1, β coefficient range: $[-4.01, -0.56]$, $p < .001$ for all). Better work environments were positively associated with patient agreement for all 10 HCAHPS measures (Model 2, β coefficient range: $[0.63, 4.42]$, $p < .001$ for all). After adjustment for the hospital work environment in Model 3, the negative association of operational failures with patient agreement for 8 out of the 10 HCAHPS measures remained significant; however, the odds ratios (ORs) were attenuated when the work environment was included in the final model.

Finally, we report ORs indicating the association of operational failures and the nurse work environment with nurse-reported job and quality and safety outcomes. They were derived from models adjusted for differences in hospital and nurse characteristics and estimate their effects individually and jointly (Table 4). Operational failures were associated with higher odds of negative job outcomes and poor quality and safety outcomes (Model 1, OR range: $[1.24, 1.89]$, $p < .001$ for all). Better work environments were associated with lower odds of negative job outcomes and poor quality and safety outcomes (Model 2, OR range: $[0.52, 0.81]$, $p < .001$ for all). After adjustment for the hospital work environment (Model 3), the association of operational failures with nurse-reported job and quality and safety outcomes is attenuated. The association was rendered insignificant for the nurse-reported job outcomes, job dissatisfaction, and intent to leave.

DISCUSSION

Consistent with seminal work by Tucker (Tucker, 2004; Tucker et al., 2014; Tucker & Spear, 2006), we found that

TABLE 3. Adjusted Parameter Estimates for the Association of Operational Failures With HCAHPS Outcomes, Before and After Adjusting for the Work Environment

HCAHPS outcomes	Model 1		Model 2		Model 3	
	β (SE)	<i>p</i>	β (SE)	<i>p</i>	β (SE)	<i>p</i>
Patient gave a rating of 9 or 10 (high)						
Operational failures	-3.80 (0.26)	<.001			-2.10 (0.40)	<.001
Work environment			3.87 (0.28)	<.001	2.26 (0.42)	<.001
Patient would definitely recommend the hospital						
Operational failures	-4.01 (0.30)	<.001			-1.60 (0.46)	.001
Work environment			4.42 (0.33)	<.001	3.19 (0.51)	<.001
Nurses always communicated well						
Operational failures	-1.46 (0.17)	<.001			-0.54 (0.27)	.047
Work environment			1.64 (0.17)	<.001	1.23 (0.28)	<.001
Patients always received help as soon as they wanted						
Operational failures	-2.01 (0.24)	<.001			-1.44 (0.34)	<.001
Work environment			1.86 (0.26)	<.001	0.76 (0.38)	.045
Always quiet at night						
Operational failures	-1.42 (0.34)	<.001			-0.80 (0.51)	.120
Work environment			1.43 (0.35)	<.001	0.82 (0.52)	.118
Doctors always communicated well						
Operational failures	-1.05 (0.13)	<.001			-0.41 (0.20)	.041
Work environment			1.16 (0.14)	<.001	0.84 (0.22)	<.001
Room was always clean						
Operational failures	-2.52 (0.26)	<.001			-2.01 (0.36)	<.001
Work environment			2.22 (0.28)	<.001	0.68 (0.40)	.085
Staff gave patients discharge information						
Operational failures	-0.56 (0.10)	<.001			-0.20 (0.18)	.272
Work environment			0.63 (0.11)	<.001	0.48 (0.19)	.013
Pain was always well controlled						
Operational failures	-1.40 (0.13)	<.001			-0.79 (0.21)	<.001
Work environment			1.41 (0.14)	<.001	0.81 (0.22)	<.001
Staff always explained medications						
Operational failures	-1.31 (0.16)	<.001			-0.53 (0.24)	.031
Work environment			1.44 (0.18)	<.001	1.03 (0.27)	<.001

Note. Model 1: Operational failures; Model 2: Work environment; Model 3: Operational failures and work environment. The adjusted parameter estimates indicate the percentage of patient agreement. Work environment and operational failures are continuous variables measured at the hospital level. All models are adjusted for hospital characteristics (bed size, teaching status, technology status, and HCAHPS response rate). HCAHPS = Hospital Consumer Assessment of Healthcare Providers and Systems; SE = standard error.

nurses frequently encounter operational failures that interrupt patient care and require them to engage in workarounds. We also found that although nurses in all hospitals experienced operational failures, there was significant variation in the incidence of operational failures across hospitals. The variation in operational failures across hospitals was associated with lower patient satisfaction, poor nurse job outcomes (burnout, job dissatisfaction, and intent to leave), and poor quality and safety outcomes. Although previous work on this topic is based on a relatively small sample of hospitals, our findings confirm these associations in a representative sample of 415 hospitals in four large states. Operational failures were associated with poor outcomes across all nurse work environments. However, we found that operational failures occurred

less frequently in hospitals with positive nurse work environments. These findings suggest that although operational failures are common and interfere with high-quality care and positive patient and nurse outcomes, the nurse work environment is an important target to reduce the occurrence of operational failures.

Nearly a third of staff nurses reported that much of their time is spent on workarounds to address operational failures. Tucker et al. (2020) reported similar findings, with nurses reporting that each type of operational failure (e.g., supply item out of stock) occurs several times per shift and work-around behaviors are present halfway between “to a little extent” and “to a moderate extent” in the unit in which they work. Time lost on workarounds reduces the number of

TABLE 4. Odds Ratios for the Association of Operational Failures With Nurse-Reported Job and Quality and Safety Outcomes, Before and After Adjusting for the Work Environment

Nurse-reported outcomes	Model 1		Model 2		Model 3	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Job outcomes						
Burnout						
Operational failures	1.35 [1.29, 1.41]	<.001			1.09 [1.03, 1.16]	.003
Work environment			0.70 [0.67, 0.73]	<.001	0.75 [0.71, 0.80]	<.001
Job dissatisfaction						
Operational failures	1.40 [1.32, 1.48]	<.001			0.99 [0.93, 1.06]	.787
Work environment			0.64 [0.61, 0.67]	<.001	0.63 [0.59, 0.68]	<.001
Intent to leave						
Operational failures	1.24 [1.16, 1.33]	<.001			1.03 [0.94, 1.14]	.538
Work environment			0.76 [0.71, 0.82]	<.001	0.78 [0.71, 0.86]	<.001
Quality and safety outcomes						
Poor/fair quality of unit						
Operational failures	1.69 [1.58, 1.82]	<.001			1.11 [1.02, 1.22]	.017
Work environment			0.53 [0.49, 0.56]	<.001	0.57 [0.52, 0.63]	<.001
Poor or failing safety grade						
Operational failures	1.89 [1.76, 2.03]	<.001			1.42 [1.29, 1.56]	<.001
Work environment			0.52 [0.49, 0.56]	<.001	0.69 [0.62, 0.76]	<.001
Healthcare-associated infections monthly or more often						
Operational failures	1.29 [1.21, 1.39]	<.001			1.14 [1.03, 1.26]	.011
Work environment			0.77 [0.71, 0.82]	<.001	0.85 [0.76, 0.94]	.002
Patient falls with injury monthly or more often						
Operational failures	1.34 [1.23, 1.45]	<.001			1.13 [1.01, 1.28]	.038
Work environment			0.73 [0.68, 0.79]	<.001	0.81 [0.71, 0.91]	<.001
Pressure ulcers monthly or more often						
Operational failures	1.31 [1.29, 1.54]	<.001			1.17 [1.02, 1.35]	.027
Work environment			0.69 [0.64, 0.76]	<.001	0.78 [0.68, 0.90]	.001
Medication errors monthly or more often						
Operational failures	1.29 [1.14, 1.46]	<.001			1.27 [1.04, 1.54]	.019
Work environment			0.81 [0.71, 0.92]	.001	0.97 [0.79, 1.19]	.780
Seven or more tasks not completed on last shift						
Operational failures	1.54 [1.45, 1.63]	<.001			1.34 [1.24, 1.45]	<.001
Work environment			0.67 [0.63, 0.71]	<.001	0.84 [0.77, 0.91]	<.001

Note. Model 1: Operational failures; Model 2: Work environment; Model 3: Operational failures and work environment. Nurse-reported job and quality and safety outcomes are binary variables measured at the nurse level. Work environment and operational failures are continuous variables measured at the hospital level. All models are adjusted for nurse characteristics (age, gender, education [BSN: yes/no]) and hospital characteristics (bed size, teaching status, technology status). OR = odds ratio; CI = confidence interval.

times nurses spend with patients, limiting their ability to recognize and respond to patient deterioration. We found that operational failures were associated not only with global quality and safety measures but also with missed nursing care and adverse events. Nurses act as the hospital's first line of defense for early detection and prevention of adverse events (Kutney-Lee et al., 2009), and nurse surveillance encompasses monitoring, evaluation, and response to changes in patient status (Clarke & Aiken, 2003). When

a complication arises, the organization must be equipped to quickly mobilize resources to "rescue" the patient (Clarke & Aiken, 2003). Operational failures cause interruptions in patient care that reduce nurse surveillance capacity through loss of time and information.

Nurses can thrive in an environment with challenging patients; however, when they lack the resources necessary to perform their jobs, poor patient outcomes, job dissatisfaction, and burnout may result. The association of operational failures

with poor quality and safety parallels the association with nurse burnout, dissatisfaction, and intent to leave, suggesting that these issues cannot be addressed in isolation. Poor working conditions are the most commonly cited reason nurses leave their jobs (Estryn-Behar et al., 2010; Vu-Eickmann et al., 2018), and nurse burnout and job dissatisfaction preempt the intent to leave (Heinen et al., 2013). Like patient safety, clinician burnout and job dissatisfaction may be considered attributes of an organization; therefore, interventions to improve these outcomes—like interventions to address operational failures—should occur at the organizational level. Prospective studies are needed to examine whether organizational interventions or quality improvement initiatives to improve care processes in nursing units can effectively reduce the incidence of operational failures and improve patient and nurse outcomes.

Our findings suggest that positive hospital work environments are associated with fewer operational failures and less time spent on workarounds. The two subscales of hospital work environment rated lowest, on average, were nurse engagement in hospital affairs and nurse manager ability, leadership, and support of nurses. Hospital leadership can create structures that increase nurse autonomy and participation in organizational decision-making (Kramer et al., 2006). Autonomy encompasses not only control over clinical decision-making but also engagement in operational decisions about how care is delivered in nursing units (Kramer et al., 2006; Rao et al., 2017). Nurse managers and other hospital leadership can engage staff nurses at multiple levels through participation in shared governance and committees to implement process improvements in nursing units (Kramer et al., 2006; Rao et al., 2017). Hospitals that engage staff nurses in designing systems of care may be better equipped to recognize operational failures and develop strategies to address their root causes.

Limitations

The cross-sectional design of this study prevents us from establishing causal relationships between operational failures, hospital work environment, and patient and nurse outcomes. No standardized instrument was available to measure operational failures in hospitals; therefore, we used items from the nurse survey to develop a hospital composite measure of operational failures. We relied on nurses' subjective reports of operational failures; however, previous evidence demonstrates that nurse-reported quality of care measures provide a valid indication of differences in hospital quality (McHugh & Stimpfel, 2012; Smeds-Alenius et al., 2016). The combination of data sets spans 2 years and is not perfectly contemporaneous, which may limit the external validity of these findings. We also did not control for hospital Magnet designation, which may be associated with some of the characteristics examined in this study, such as the hospital work environment. Although we studied hundreds of hospitals in four states where about 20%

of admissions occur, it is possible that our findings would differ if we studied different states. Lastly, some of our variables are dichotomized for consistency with prior research and interpretability as a form of standardization because the percentage of nurses in some response categories can be small. Future research could further examine these relationships across more granular categorical subsets derived from the data.

Conclusion

Hospital leadership needs to change work environments to reduce operational failures, improve safety, increase nurse retention, and lower labor costs. Hospital leadership should engage nurses and other frontline staff to evaluate their work environments and identify potential areas for improvement. Beyond reductions in operational failures and safety, improvements in the work environment may also translate to reductions in penalties under various reimbursement programs, including pay-for-performance programs.

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