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Operational Failures Detected by Frontline Acute Care Nurses

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Abstract

Frontline nurses encounter operational failures (OFs), or breakdowns in system processes, that hinder care, erode quality, and threaten patient safety. Previous research has relied on external observers to identify operational failures; nurses have been passive participants in the identification of system failures that impede their ability to deliver safe and effective care. To better understand frontline nurses' direct experiences with operational failures in hospitals, we conducted a multi-site study within a national research network to describe the rate and categories

of operational failures detected by nurses as they provided direct patient care. Data were collected by 774 nurses working in 67 adult and pediatric medical-surgical units in 23 hospitals. Nurses systematically recorded data about operational failures encountered during 10 work shifts over a 20-day period. In total, nurses reported 27,298 operational failures over 4,497 shifts, a rate of 6.07 operational failures per shift. The highest rate of failures occurred in the category of Equipment/ Supplies, and the lowest rate occurred in the category of Physical Unit/ Layout. No differences in OF rate were detected based on hospital size, teaching status, or unit type. Given the scale of this study, we conclude that operational failures are frequent and varied across system processes, and that organizations may readily obtain crucial information about operational failures from frontline nurses. Nurses' detection of operational failures could provide organizations with rich, real-time information about system operations to improve organizational reliability.

Despite the pressing need to improve healthcare quality, efficiency, patient safety, and satisfaction (Corrigan, 2005; Kohn, Corrigan, & Donaldson, 1999), healthcare delivery systems struggle to make gains (Agency for Healthcare Research and Quality [AHRQ], 2015; Wachter, 2010). Heightened awareness of the functioning of healthcare systems and subsystems is required throughout the organization in order to achieve safe and effective care. Thought leaders suggest that, in addition to employing best clinical practices, organizations must address the processes of the delivery system, which can become more reliable by applying a high-reliability organization (HRO) framework (Chassin & Loeb, 2013; Edwards, 2016). HROs create an environment of “collective mindfulness,” in which all workers engage in detecting and reporting operational problems before they result in safety risk.

Mindfulness of operational aspects is crucial for frontline clinicians to reduce system failures and achieve high-reliability functioning (Chassin & Loeb, 2013). Frontline nurses in hospitals have an important role in healthcare system improvement due to their key position at the front line of care (Institute of Medicine [IOM], 2011). Because they interact with multiple systems during the course of a shift, frontline nurses are well-positioned to identify operational failures (OFs), or breakdowns in system processes that should reliably provide supplies, equipment, information, or human resources when, where, and to whom these are needed to complete the work (Tucker, Heisler, & Janisse, 2013; Tucker & Spear, 2006). Such failures can be related to problems in information, tools and equipment, materials and supplies, budgetary support, help from others, and work environment factors such as lighting or space (Gilboa, Shirom, Fried, & Cooper, 2008; Tucker, Heisler, & Janisse, 2013). OFs occur in work that is complex, like health care, and their solutions often require input from more than one unit within the organization (Gurses & Carayon, 2007; Hendrich, Chow, Skierczynski, & Luz, 2008; Tucker & Spear, 2006). The purpose of this study was to better understand frontline nurses' direct experiences with OFs.

Impact of Operational Failures

Researchers who have studied the interplay between nursing work and OFs have reported that these system problems impede performance and patient care and have implications for quality, safety, and cost (Tucker, 2004; Tucker, Heisler, & Janisse, 2013; Tucker, Singer,

Hayes, & Falwell, 2008; Tucker & Spear, 2006). For example, a seemingly small OF like insufficient linen on a clinical unit can interfere with nurses' ability to change soiled linens in a timely manner, an effort that is critical for maintaining skin integrity in incontinent patients. The internal supply chain for medication administration represents a particularly complex organizational operation. The chain starts with a provider order and ends with administration of the medication to the patient. Any breakdown in the chain, including an error in ordering, delivery of the wrong drug, route or dose, or delay in getting the medication to the proper unit leads to an OF that may have a significant negative impact on patient care, including delayed or missed medication doses or administration of the wrong drug or dose. As tallied by managers interacting with frontline nurses, OFs are frequent, occurring about once per hour per nurse during a work shift in medical-surgical units (Tucker, Singer, Hayes, & Falwell, 2008).

When OFs hinder processes of patient care, nurses depart from established practice and use a workaround to bypass the hindrance (Alter, 2014; DeBono, et al., 2013; Tucker, Heisler, & Janisse, 2013). Workarounds can be defined as “alternative, informally redesigned, and inconsistently applied work processes” (Halbesleben, Wakefield, & Wakefield, 2008, p.3). Ninety-five percent of OFs encountered by nurses are managed through workarounds (Halbesleben, Wakefield & Wakefield, 2008; Rathert, Williams, Lawrence, & Halbesleben, 2012; Spear & Schmidhofer, 2005). Workarounds thwart development of standardized system solutions to OFs by misdirecting efforts away from resolving the underlying problem (Tucker, Heisler, & Janisse, 2013). They enable the failure to recur, negatively affect reliability of work processes, and are lost opportunities to improve the work system (Halbesleben & Rathert, 2008; Murphy & Walls, 2008; Tucker & Edmondson, 2003).

OFs contribute to serious consequences for patients, including medication errors, wrong-patient procedures, and delayed care; these occur when the system fails to provide supplies, equipment, information, or human resources when and where needed by frontline nurses to provide care. They are known to contribute to errors, delayed care, and harm to patients (Halbesleben, Wakefield, & Wakefield, 2008; Jimmerson, Weber, & Sobek, 2005; Spear & Schmidhofer, 2005). OFs also contribute to work stress, lower performance (Gilboa, Shirom, Fried, & Cooper, 2008), and erosion of job satisfaction (Rathert, Willams, Lawrence, & Halbesleben, 2012).

Despite their cumulative impact, OFs prove difficult to address in practice because they are not a single, large problem but a broad set of small problems (Gurses & Carayon, 2007; 2009; Tucker, 2004). In a recent analysis of the impact of OFs on performance, only 14% of OFs arose from errors or insufficient training; instead, failures arose from multiple organizationally-driven factors, including insufficient workspace (29%), poor work process design (23%), and a lack of integration in the internal supply chains (23%; Tucker, Heisler, & Janisse, 2013).

Dealing with OFs is time-consuming for nurses and represents wasted resources for patients and hospitals: Between 10% (Gurses & Carayon, 2009; Hendrich, Chow, Skierczynski, & Lu, 2008; Tucker & Spear, 2006) and 12% (Tucker, Heisler, & Janisse, 2014) of nurses' time during a work shift is directed toward overcoming OFs. Direct observation of nurses' 8-hour

shift work showed that a failure was experienced every 37 minutes, and overcoming each of these failures delayed care by an average of 5.5 minutes (Tucker, Heisler, & Janisse, 2014).

Experts point to the underutilization of frontline nurses' experiences for system improvement and recommend leveraging their unique expertise to identify and resolve OFs (Tucker, Singer, Hayes, & Falwell, 2008; Needleman, et al, 2016). In many of the cited studies, OFs were identified and articulated by external researchers who observed nurses as they worked; failures were not identified by nurses themselves. There are few system-level measures to detect failures (Tucker & Edmondson, 2003; Tucker, Heisler & Janisse, 2013).

Given the importance of the frontline perspective for healthcare improvement, we asked: Can nurses detect and report operational failures themselves during the complex work of patient care, and if so, what do they report? We aimed to describe the rate and categories of OFs detected by nurses while providing direct patient care.

Methods

This prospective, cross-sectional descriptive study was conducted in multiple sites associated with a national research network focusing on improvement science (Improvement Science Research Network [ISRN], 2010). The study was aligned with one of the research network's national priorities, focusing on the priority entitled “high-performing clinical system and microsystem approaches to improvement” (Stevens & Ovretveit, 2013). The study was dubbed the “STAR-2 Study,” building on the original pilot study, *Small Troubles, Adaptive Responses* (*STAR*), part of the RWJF Interdisciplinary Nursing Quality Research Initiative (Newhouse, Bobay, Dykes, Stevens, & Titler, 2013). Study support was provided by the ISRN core center, using proven practices from practice-based research networks (Peterson, Lipman, Lange, Cohen, & Durako, 2012) and the science of team science (Hall, Feng, Moser, Stokols, & Taylor, 2008), as described below.

Recruitment, Setting, and Sample

Hospital sites were recruited through two open invitations via the virtual research network. Variation in hospital size and teaching status was sought. Clinical nurse leaders from clinical sites made formal applications; the application included a letter of support and commitment from the chief nursing officer. Each site designated a PI and a research collaborator, with specific roles in the conduct of the study and interpretation of results. Together, the group functioned as the Research Collaborative.

Sites were selected by a panel based on eligibility criteria as well as capacity and experience in research and collaborative academic-practice partnerships. Hospitals with 100 or more inpatient beds and at least three eligible medical-surgical clinical units were considered eligible. Eligible clinical units were identified as those that provided acute care broadly defined as medical-surgical services, including oncology, podiatry, neurology, cardiology, pediatric, obstetric, or gynecology services, with an average patient length of stay of 2 to 4 days. Each unit was required to employ a minimum of 20 full-time RNs and to have been in operation for at least 1 year.

Frontline nurses on those units were eligible to participate in this study if they held licensure as a registered nurse, provided direct patient care or mid-level management on the clinical unit, had at least 1 year of acute care nursing experience with a minimum of 6 months of continuous employment within the current clinical unit, were working 12-hour shifts, and consented to participate. Nurses who floated between units were not eligible to participate.

This process resulted in a study sample of 23 adult and pediatric hospital sites affiliated with the research network. The research partners were academic- and practice-based investigators from each of the 23 sites, who were assembled into the STAR 2 Research Collaborative, representing 15 states and the District of Columbia and 22 cities across the nation. Key characteristics of the sample of participating hospital sites are presented in Table 1. Of the 23 participating sites, the large majority (75.4%) indicated hospital size of over 300 beds. Most participating sites (78.2%) were teaching hospitals. Across the 67 medical-surgical units, almost 70% served adult populations; 26.1% served pediatric populations, and one unit combined adult and pediatric services.

Of the 2,482 eligible nurses in the 67 study units, 774 RNs (31.2%) on 67 medical-surgical units met eligibility criteria and participated. They reported OFs detected on 4,512 shifts, an average of 5.83 shifts per RN.

Protection of Human Subjects

The study was approved by the University of Texas Health Science Center San Antonio Institutional Review Board (IRB) as well as by the IRBs of the 23 participating hospitals. Variations in the IRB requirements across the sites have been reported (Patel, Stevens, & Puga, 2013).

Instruments and Data Collection

Data on real-time OFs were collected by RNs using the previously developed STAR Pocket Card. Each frontline RN recorded information about OFs encountered during 12-hour work shifts involving nursing practice, for a maximum of 10 shifts over a 20-day data collection period, using one Pocket Card report per shift. Following each work shift, RNs returned Pocket Cards to a collection box in a designated place on their unit.

The Pocket Cards were designed to be small enough to fit into a typical pocket and contained structured checklists to capture frequency and type of OFs encountered in daily nursing practice (Stevens & Ferrer, 2016). Categories of OFs were derived from observational research by Tucker, Singer, Hayes, and Falwell (2008) and included Equipment/Supplies, Information/Communication, Staffing/Training, Medication, Physical Unit/Layout, and Other. RNs had the option to write in a brief description that further defined the type of OF within the defined category. If an OF did not fit within one of the categories, participants were instructed to record the OF in the category of Other, with a brief description. To increase the likelihood that RNs were classifying OFs similarly, brief instructions and definitions were included on the reverse side of the Pocket Card, as indicated in Table 2. Hash marks to record the number of times an event occurred were permitted as a practical consideration due to limited space available to record the OF.

The data collection tool and approach were tested in previous research (Stevens & Ferrer, 2016), which yielded results on OF frequency comparable to Tucker's (2004) findings. Content validity was supported by verification in key informant interviews conducted with 18 staff (Stevens & Ferrer, 2016) and comparison to the Yorkshire contributory factors framework, derived from a systematic review of 83 studies of factors contributing to patient safety incidents in hospital settings (Lawton et al., 2012).

RNs received standardized education and materials prior to activation of the study. General examples for each of the categories were included in the educational materials, and face-to-face time was allowed for study participants to confirm they understood the examples. Categories and instructions for documenting the OFs were described and demonstrated during in-person sessions individually and in small groups. RNs had the opportunity to provide examples from their experience, and Site PIs confirmed interpretation of the five categories and use of the Pocket Card. Site PIs had multiple face-to-face encounters with clinical managers and frontline RNs to review materials (pocket cards and surveys) and the data collection process and to grant consent to participate. Clarification when needed to guide RNs in recording OFs was available to site collaborators through technical assistance from the study core (ISRN).

Study rigor across the sites was supported by best practices in virtual collaboration, team science, study progress monitoring, and protocol fidelity assessments (Bietz et al., 2012; Puga, Stevens, & Patel, 2013; Stevens, Puga, & Patel, 2012). For example, to assure fidelity to the research protocol, site principal PIs were supported by the network principal investigator and network coordinating team. Support included a protocol implementation kit providing detail on how to conduct the study, a central database to which all site data were uploaded, quality control audits on data, IRB templates, open email and telephone communication, and ample assistance for managing, uploading, and cleaning data. Members utilized a field guide that noted preferred practices and principles of successful investigative team functioning. Monthly Research Collaborative meetings across sites were held to reinforce fidelity to the design and movement toward study completion.

Statistical Analysis

Hospital characteristics available for analysis were limited to information included on the demographic data form and eligibility criteria. Because the study focus was on system issues, characteristics of the site were emphasized, and information about registered nurse (RN) characteristics was not collected.

Descriptive statistics were used to summarize characteristics of the sample sites and OF reports (Pocket Cards). Frequency and distributions for each type of OF were tabulated across the 67 units engaged in the study. Rates of OFs per 12-hour shift were calculated for all study units. Independent *t*-tests were performed to determine differences in OFs based on site characteristics (size, population served, and teaching status).

Results

Frequencies of each type of OF as well as OF rate were examined by hospital size (100-500 beds versus more than 500 beds), teaching status (teaching versus non-teaching hospital), and population served on the unit (adult versus pediatric). All 23 hospitals reported OFs in all six categories. No differences in OFs by hospital characteristics were noted, which may reflect the small sample of 23 hospitals. Frequency of OFs was tallied across all sites; rate of OFs was calculated as OFs per nurse per shift.

RNs reported a total of 27,298 OFs across the sites over 4,497 12-hour shifts. On average, RNs reported a rate of 6.07 (SD=7.10) OFs per shift. The highest OF rate was reported in the Equipment/Supplies category (1.59). Examples of these OFs included broken equipment for obtaining vital signs and providing electronic documentation of patient information, non-functioning infusion pumps, and missing supplies. Frequency of other OF types were Information/Communication (1.08), Medication (1.06), Other (.92), Staffing/Training (.90), and Physical Unit/Layout (.50). Frequency, proportion, and rate of nurse-detected OFs are presented in Table 3.

Discussion

This study represents the first large-scale engagement of frontline nurses in real time detection of OFs that detract from clinical care. Previously, evidence on OFs was discovered through non-nurse observation. RNs can detect latent failures that otherwise are not observable and therefore remain unknown to the organization. RNs independently detected operational failures using a real-time, low technology data capture approach during their work shifts. Better care demands scrutiny of system performance; detection of OFs is as crucial as scrutiny of individual provider actions and patient outcomes (Lawton, et al., 2012). A “mindful infrastructure” proposed by high-reliability organizations requires heightened sensitivity to operations because the early indicators of failure often appear as small glitches in operations (Weick & Sutcliffe, 2015). As frontline RNs were invited to report on barriers to care via the Pocket Card, a new opportunity for providing operational data to management was created. The high rate of RN self-reported OFs (6.07 OFs per 12-hour shift) may reflect increased organizational mindfulness.

Results supported the persistent prevalence and broad array of operational failures across the United States that thwart the efficiency and safety of nursing care. The OF types were consistent with those reported in current literature using other methods. Similar to findings of Tucker, Heisler, and Janisse (2014), OFs were reported across all categories – such as missing supplies, equipment or information; the causes of which are thought to be multifactorial. Equipment/Supplies comprised the category with the greatest frequency of OFs. Of particular concern is the high rate of OFs related to medication administration because of the potential for patient harm. The complexity of delivery of medication requires multi-departmental involvement to deliver medications reliably. Traditional quality improvement efforts are designed to identify and address only a few significant issues thought to contribute to a high proportion of the problems, based on the Pareto Principle (Juran & De Feo, 2010). The broad range of OFs and diffuse nature of their causes make it

unlikely that traditional quality improvement efforts will successfully address them. The failures arise from multiple organization-based factors, including lack of integration across departments in the system (Tucker, Heissler & Jannise, 2014).). Removing system failures will require deliberate cross-functional efforts to redesign work processes so that they are aligned with nurses' work needs and patient care flow (Tucker, Heisler, & Janisse, 2013; Tucker, Heisler & Janisse, 2014).

The high frequency of OFs reported in this study for every shift by every RN suggests that care delivery operations are at suboptimal levels. OFs and the effort and time required to overcome them create inefficiency and take valuable time away from patient care. OFs consume 10% of nurses' time (Hendrich, Chow, Skierczynski, & Lu, 2008; Tucker, 2004). More nursing time per patient results in better patient outcomes (Needleman, et al., 2011), and OFs require an average of 5.5 minutes to overcome (Tucker, Heisler, & Janisse, 2013). If the average number of OFs per shift demonstrated in this study (6.07 per nurse per shift) occurs among 20 nurses on a given unit during a 24-hour day, 668 minutes of nurse time (over 11 hours) may be wasted in addressing OFs during each 24-hour period on each clinical unit.

These data are subject to limitations. The cross-sectional design captured data during one 20-day span of time, and it cannot be assumed that similar circumstances exist at all other times. Also, the data collection cards, while small enough to be portable, limited the amount of detail that nurses recorded about OFs. The specifics of each OF were harder to capture than the frequency. It is noted that the OF category Other represented a large proportion of OFs; additional classifications may be necessary to capture all types of OFs that RNs encounter.

The nurses' reporting likely depended on individual initiative, unit culture of accountability, and awareness (Tucker, Singer, Hayes, & Falwell, 2008), which were not accounted for and may have led to underestimation of the true occurrence of problems. Frontline clinicians are highly focused on clinical excellence, but organizational and managerial structures and processes may be insufficient to fully identify operational reliability issues at the front line. The results may therefore be more valid as a description of the type of operational failures on a given unit rather than as an estimate of the true rate of operational failures. Staff on a unit form a social network or microsystem that influences perceptions of operational failures, so that staff may be predisposed to notice or report certain types of failures more frequently (DeBono, et al., 2013).

Organizational variables may have influenced OF reporting. Examples include hospital setting (rural vs. urban), work environment (e.g., strength of culture of patient safety, or Magnet vs. non-Magnet hospital), technological resources (e.g., presence of automated medication dispensing cabinets), and differences in resources on day and night shifts. Finally, the operational failure data are useful only to the extent that they can be shown to drive meaningful quality improvement. Identifying operational failures is only the first step in a sequence that leads to effective interventions for system improvement and redesign. Frontline engagement to improve nurses' access to support, resources, and information

would be fruitful in terms of positive effects on nurses' job satisfaction and the quality of care they are able to deliver.

The results of this multi-site study can serve as a foundation for further research, coupled with efforts to engage frontline nurses in quality improvement (e.g., Pearson, Needleman, Beckman, & Han, 2015). Development of the Pocket Card could focus on content validity assessment with expanded categories. Study of OFs within the context of nurses' work environment and culture of patient safety could lead to valuable insights about hospital performance.

Conclusions

Operational failures are commonly encountered by RNs delivering patient care at the front line. They occur in many aspects of a hospital system's processes, obstructing the delivery of care. Managers can readily obtain crucial information about operational failures from frontline nurses to improve system operations. Operational failures should be monitored on a routine basis to achieve high reliability in healthcare delivery.

A frontline- and manager-partnered approach to detection will likely unearth improvement opportunities. Frontline nurses' intimate knowledge of OFs can be leveraged to inform improvements in operations and achieve reliable healthcare systems. Systematic detection of system failures could lead to improved quality (patient outcomes), enhanced organizational reliability, and reduced nurse time wasted in overcoming operational failures. Detecting OFs at the front line enables a shift in organizational culture from one where it is common to solve only the immediate hindrance through workarounds to one where it is normative to solve the failure as a system problem. These efforts can create organizational learning environments that are sensitive and responsive to system shortcomings and the many hassles that sap the morale and efficiency of the nursing workforce and pose risks to quality and patient safety. Nurses' detection of OFs provides practice-based data that can be used to drive system transformation.

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Table 1
Characteristics of Participating Hospital Sites (N=23)

	Site Characteristics	*n*	*%*
Number of beds	100-300	4	17.3
	301-500	9	39.1
	>500	10	43.5
Teaching hospital status	Teaching	18	78.2
	Non-Teaching	5	21.7
Patent Population	Adult	16	69.6
	Pediatric	6	26.1
	Combined	1	4.3

Table 2

Operational Failure Categories, Definitions*, and Reported Examples of Pocket Card Entries

Category	Definition Used in Study	Examples
Equipment/Supplies	Missing, broken, insufficient, or inappropriate for patient and staff needs	Automated vital sign machine missing Correct size BP cuff not available IV pump not working Computers slow IV pump not working Computers slow
Physical Unit/Layout	Difficult for providers to observe patients, insufficient storage space, insufficient heating and cooling, cleanliness for infection control	Distance too great between rooms of assigned patients Inadequate space in patient room to accommodate equipment and family Cleanliness of unit poor Medication room layout not efficient
Information/Communication	Poor information flow between providers, including verbal orders, illegible written orders, excessive or redundant documentation, documentation errors, patient identification	Unable to read providers orders Physician not returning calls Lack of advance notice about patient's need for equipment/ supplies Miscommunication or incomplete information across care team members
Staffing/Training	Insufficient orientation and in-services, staff scheduling issues, uncertainty about protocols and policies	Inadequate RN staff to address patient census No support staff to perform duties Staff unsure of how to do concurrent IV's Lack of adherence to patient care schedule No lunch break
Medication	Communication/documentation, equipment/supplies, administering	Medication missing or mislabeled in automated drug dispensing system Delay in response from pharmacy
Other	OFs that do not fit into the five categories or other breakdowns that interfere with completing the work	Lack of transportation for delivery of specimen to lab Lack of supplies requested by patient's family

* Instructions provided: Record problems, defined as disruptions in ability to execute a prescribed task, by using hash marks (𝍸) to indicate the number of times a problem occurs on your shift, classified into the provided categories.

Table 3

Frequency, Proportion, and Rate of Operational Failures (OF) by Category (N=27,298)

Category of OF	Frequency	% of Total OFs	Rate of OF per Shift[a]
Equipment/ Supplies	7164	26.24	1.59
Information/ Communication	4861	17.81	1.08
Medication	4765	17.46	1.06
Other	4155	15.22	0.92
Staffing/ Training	4082	14.95	0.90
Physical Unit/ Layout	2271	8.32	0.50
Total	27298	100.00	6.07

[a]Denominator = OFs in all 4,497 12-hour shifts