

Reducing Hospital Errors: Interventions that Build Safety Culture

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Abstract

Hospital errors are a seemingly intractable problem and continuing threat to public health. Errors resist intervention because too often the interventions deployed fail to address the fundamental source of errors: weak organizational safety culture. This review applies and extends a theoretical model of safety culture that suggests it is a function of inter-related processes of enabling, enacting, and elaborating that can reduce hospital errors over time. In this model, enabling activities help shape perceptions of safety climate, which promotes enactment of safety culture. We then classify a broad array of interventions as enabling, enacting, or elaborating a culture of safety. Our analysis, which is intended to guide future attempts to both study and more effectively create and sustain a safety culture, emphasizes that isolated interventions are unlikely to reduce the underlying causes of hospital errors. Instead, reducing errors requires systemic interventions that address the interrelated processes of safety culture in a balanced manner.

INTRODUCTION

Scholarly and practitioner interest in hospital errors—errors that result from poorly designed and managed systems and are attributable to the actions of multiple organizational participants who deviate from organizationally specified rules and procedures (50)—took hold more than a decade ago with the Institute of Medicine’s landmark report, *To Err Is Human: Building a Safer Health System* (74). However, despite a great deal of academic research and practitioner experimentation, hospital errors continue to present a seemingly intractable public health problem (78), the dimensions of which may be greater than initially imagined (18).

A hospital’s inability to reduce these errors stems from their organizational (123) and systemic (134) nature, meaning that they are integrated into complex and interrelated structures and processes to which individuals throughout the hospital contribute. Their causes reside in the organization’s culture—its assumptions, values, attitudes, and patterns of behavior (130). Errors are intractable when a culture de-emphasizes safety and instead prioritizes competing concerns (e.g., cost, efficiency) that can produce errors (182). A safety culture consists of the shared values, attitudes, and patterns of behavior regarding safety (i.e., concern about errors and patient harm that may result from the process of care delivery) (124). Culture may vary within organizations and among their units and by professional disciplines. Safety climate, a related construct, refers to shared perceptions of existing safety policies, procedures, and practices (183). In other words, safety climate reflects the extent to which the organization values and rewards safety relative to other competing priorities as demonstrated through organizational policies and leader behavior (181). The expression of safety climate in specific and identifiable policies and practices means that it captures “surface features” of a safety culture (36).

The goal of this review is to provide a public health and management audience with

an understanding of how a broad array of interventions may be combined to reduce hospital errors. Our review focuses specifically on hospital errors because this is where the bulk of intervention efforts have been directed and where the measurement of errors is most developed. To distinguish our review from other excellent recent reviews of interventions designed to reduce organizational errors in the health care context (34, 176), we focus explicitly on interventions that reduce errors by directly or indirectly impacting safety culture. This allows us to categorize these activities using a theoretical model that shows how interventions may work together to shape safety climate and safety culture in a process that reduces hospital errors over time. We focus on culture rather than errors themselves in recognition of the importance of culture as a basic mechanism through which patient safety is achieved (21). A deeper understanding of the cultural underpinnings of errors provides a more organizational and systemic foundation for reducing them.

An Enabling, Enacting, and Elaborating Model of Safety Culture

We focus on safety culture as the foundation upon which hospitals can reduce errors by preventing and learning from them (120). That is, a well-developed safety culture seeks to resolve the underlying causes of errors. To date, however, the ways in which interventions shape safety culture have been imprecisely specified. Our review employs a recently developed conceptual framework (164) to suggest that existing interventions tend to target one of three aspects of safety culture—enabling, enacting, or elaborating—that when taken together create a process with the potential to reduce hospital errors over time. Enabling refers to leader actions that emphasize safety, enacting includes frontline actions to surface and resolve threats to safety, and elaborating means systematically reflecting on and learning from performance (164). In turn, new enabling interventions may be selected on the basis of evolving needs and hospital culture. Thus, cycles of enabling,

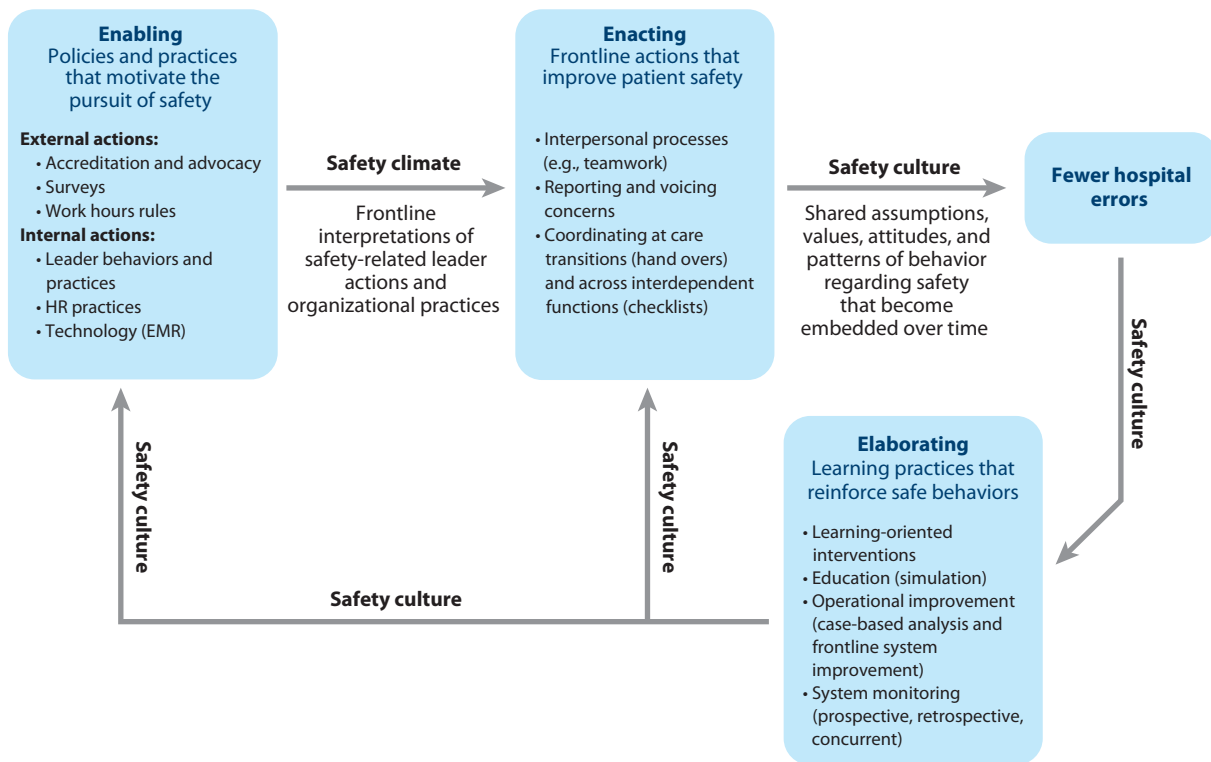


Figure 1

A cultural approach to reducing hospital errors. EMR, electronic medical record; HR, human resources. Adapted from Reference 164.

enacting, and elaborating continue iteratively in an evolutionary process.

In applying this model to a comprehensive set of interventions, we make two important refinements. First, we find that enabling occurs not only through hospital leaders but also through external actors (e.g., activists and quasi-regulatory agencies). Second, we posit that these enabling activities shape frontline workers' perceptions of safety climate and thereby promote the enactment of safety culture. **Figure 1** depicts our theoretical model, which highlights the interrelationships among interventions that enable, enact, and elaborate a culture of safety to reduce hospital errors. The arrows in this model indicate that climate and culture are dynamic processes.

In this review, we organize disparate research on discrete interventions to reduce hospital errors and apply and extend an inte-

grative model to highlight distinctions among the interventions' objectives. Our primary contribution is the conceptual categorization of interventions and the identification of relationships among them. This is important because the fragmented nature of prior research on hospital errors provides an inadequate foundation for practitioners to pursue more than piecemeal solutions. Our analysis also provides researchers with a richer, theoretically grounded framework for understanding how interventions combine to reduce hospital errors. We offer practitioners a guide to more effectively creating and sustaining safety culture. Our review suggests that isolated interventions that enable, enact, or elaborate a culture of safety are unlikely to reduce the underlying causes of hospital errors. Instead, hospital errors require interventions that simultaneously address all three aspects of culture rather than only one.

This review represents a broad, albeit not comprehensive, review of research published in the management and health services literatures on interventions attempting to reduce hospital errors. More specifically, in ABI/ProQuest, PsycINFO®, and PubMed, we searched on the terms “safety” or “error” and “culture” in a set of leading management, psychology, health services, health care management, and medical journals (see **Supplemental Appendix** online. Follow the Supplemental Material link from the Annual Reviews home page at <http://www.annualreviews.org>), focusing on articles published during the most active period of research on hospital errors (between 2000 and early 2012). We identified 593 articles. By reviewing the abstracts of these articles, we derived a list of intervention types. We next assigned these intervention types to an element of the conceptual model so that each type of intervention was classified primarily as enabling, enacting, or elaborating a safety culture. We also looked for interventions that might not fit in the conceptual model. Then, the authors and a research assistant each reviewed a third of the papers to assign each one to the applicable intervention type or types. We conducted a second review to confirm the assignments. At each stage, the group discussed interventions or papers that raised questions and jointly resolved their classification. This allowed us to supplement and refine our list of intervention types and the relationships among them. **Table 1** below summarizes the literature in each category (e.g., enabling) and subdomain (e.g., technology). We describe the interventions designed to promote each of the elements of the conceptual framework in turn.

ENABLING

Enabling a safety culture means motivating the goal of reducing hospital errors, directing attention to and prioritizing safety, and creating a context within which frontline caregivers can enact safer practices. In reviewing these interventions, two sets of mechanisms emerged: (a) external motivators, such as regulators and

advocacy organizations, and (b) internal motivators, such as leaders and organizational practices.

External Motivators

Researcher and practitioner interest in safety culture as a key source for reducing hospital errors took hold with the Institute of Medicine’s *To Err Is Human* (74) and subsequent reports. These early efforts to induce action tried to establish the scope of the problem (e.g., the number of deaths resulting from hospital errors) so as to motivate remedial actions (19, 74). The search for more accurate measures of the scope of the problem continues (18). Administrative data such as the Agency for Healthcare Research and Quality’s patient safety indicators (91) provide another source of data intended to fuel change; however, some evidence suggests that they do not predict individual hospital performance (171).

Although only suggestive, there are indications that external actors can influence hospital error reduction. For example, The Joint Commission on Accreditation of Healthcare Organizations has influenced hospital-level patient safety initiatives (27), as have advocacy organizations such as the Institute for Healthcare Improvement, the National Patient Safety Foundation, and the Lucian Leape Institute. Collaboratives, such as the Pittsburgh Regional Health Initiative, also spur hospital-level efforts to reduce hospital errors (143). The Institute for Healthcare Improvement’s national and international initiatives, such as the 100,000 Lives Campaign, establish goals and provide a model for spreading improvement practices to reduce hospital errors (90).

Other research suggests external forces, e.g., tort reform, may induce hospitals to focus on reducing errors (4); however, the evidence of their efficacy is mixed (24). Legislatures and other policy-setting bodies are external forces that affect health care delivery through rules regarding practices shown to compromise safety, e.g., extended-duration work shifts (greater than 12.5 h) (83). Regulations that eliminated

Table 1 Interventions designed to enable, enact, and elaborate safety culture and reduce hospital errors

Intervention category or subdomain	Range and types of studies	Summary of findings	Examples of research gaps and further investigation needed	References for sample articles
Enabling				
External motivators	There is little systematic investigation, but there are some suggestive case studies.	Accrediting bodies (the Joint Commission), advocacy organizations (e.g., the Institute for Healthcare Improvement), and collaboratives (e.g., Pittsburgh Regional Health Initiative) can spur the pursuit of safety and adoption of safer practices.	Influence of external motivators on leader cognition and action from direct, empirical assessments Effects of external motivators on new practices and other innovations	Accreditation (27) Collaboratives (143)
Internal motivators: leader characteristics and behaviors	Most studies use cross-sectional survey design with some case-control studies.	Studies show leader practices (e.g., executive WalkRounds), behaviors (e.g., inclusiveness), and characteristics (transformational leadership) positively impact safety climate.	Use different aspects of safety climate in multiple studies Simultaneous examination of leader characteristics and behaviors Identification of the conditions under which leader practices are successful	Leadership WalkRounds (38) Transformational leadership (92) Leader inclusiveness (105)
Internal motivators: HR practices	Studies predominantly use cross-sectional survey design.	Bundles of HR practices as well as individual practices (e.g., staffing levels) are associated with aspects of safety climate and fewer hospital errors.	The use of consistent, dependent variables across studies Stronger research designs	Staffing (102) HR practices (117)
Internal motivator: information technology	Most studies use a pre/post-intervention design. Numerous case studies also exist.	Studies of computerized physician order entry (<i>a</i>) showed mixed results for adverse drug events, (<i>b</i>) showed a small positive effect on patient safety, and (<i>c</i>) are promising for bar code verification and medication reconciliation, but such studies are limited.	Studies that explicitly measure and model organizational context and organizational readiness for the use of information technology	CPOE (93) Bar code verification (116)
Internal motivator: safety climate	Most studies have a cross-sectional survey design. There are some case-control intervention studies.	Consistent positive effects of a safety climate have been found on a range of outcomes related to hospital errors, including infections, treatment errors, patient safety indicators, readmissions, error reporting, and safety grades. Safety climate varies across units, professions, and organizational levels, affecting outcomes.	The use of similar specifications of safety climate, i.e., survey items and modeling strategies Longitudinal investigations to assess the effects of change on outcomes and to document how hospitals can use information about safety climate to reduce hospital errors	Variation and relationship with outcomes (57, 63)
Enacting				
Effective interpersonal	Most studies are quasi	Selected interpersonal behaviors (mindful organizing and	Additional construct validation and differentiation of related	Relational coordination (7)

(Continued)

Table 1 (Continued)

Intervention category or subdomain	Range and types of studies	Summary of findings	Examples of research gaps and further investigation needed	References for sample articles
<p>processes: teamwork, mindful organizing, relational coordination, and patient involvement</p>	<p>experimental with pre/post-test design. Many are controlled. Some use mixed methods, incorporating interviews alongside surveys or other quantitative measures. A few case studies and qualitative studies exist.</p>	<p>relational coordination) are related to preventing hospital errors and quality performance. Ineffective interpersonal processes yield negative consequences, and organizational conditions (e.g., culture and human factors) and practices (e.g., hiring, training, rewards) can promote more effective interpersonal processes. Interventions to promote more effective teamwork improve quality, quantity, and perception of desired behaviors.</p>	<p>concepts Direct evidence linking interventions to reductions in medical errors</p>	<p>Patient involvement (62) Mindful organization (163) Teamwork (166)</p>
<p>Reporting and voicing concerns</p>	<p>Studies have a predominantly cross-sectional survey design. Some are questionnaire and some scenario based. There are a handful of case studies and longitudinal, pre/post-intervention studies.</p>	<p>Substantial underreporting occurs among clinicians. Different reporting systems yield complementary insights. Conditions that promote reporting include psychological safety, responsiveness, and closure. Willingness to voice concerns correlates with reduced hospital errors.</p>	<p>Additional research that specifically addresses effects of reporting and voicing concerns on learning and hospital errors over time Studies of the conditions under which learning is more likely to occur</p>	<p>Complementary insights (80) Underreporting (108)</p>
<p>Coordination at care transitions and across interdependent functions: checklists, standardized protocols, and others</p>	<p>There is a large mix of pre/post-intervention studies, sometimes controlled, and a handful of case studies and cross-sectional observational studies, with one claims-based analysis.</p>	<p>Checklists and structured communication improve safe practices and reduce M&M; however, implementation varies.</p>	<p>Longitudinal, randomized, and controlled studies of intervention effectiveness Studies that directly examine how supportive (e.g., climate) and inhibiting conditions interact with specific protocols to reduce hospital errors</p>	<p>Checklists (59) Hand overs (110)</p>

(Continued)

Table 1 (Continued)

Intervention category or subdomain	Range and types of studies	Summary of findings	Examples of research gaps and further investigation needed	References for sample articles
Elaborating				
Learning-oriented interventions	These studies are predominantly case controlled or qualitative with a handful of cross-sectional survey studies and a small number of longitudinal studies.	Learning can improve performance and prevent future errors. Studies identify facilitators (e.g., psychological safety) and barriers (e.g., ambiguous threats) to learning and recommend strategies that promote learning in groups and organizations.	Descriptions of factors that promote or undermine learning Identification of interventions that create the conditions that promote effective learning and demonstrations of their ability to reduce future errors Investigations of how and under what conditions these interventions affect the processes of enabling and enacting	Longitudinal study (148) Learning from reported errors (150)
Education	The studies are of predominantly pre-/posttest design with a large number of studies taking a mixed methods approach. There are a handful of qualitative studies.	Education is a popular technique, alone or in combination with other interventions, to reduce medical errors. Simulation is an increasingly popular mode of education.	Multiple descriptive studies Studies of the comparative effectiveness of differing educational interventions for shaping culture and reducing hospital errors over time Studies of the organizational factors that enhance or inhibit educational interventions	Education alone (47) Multimode including simulation (140)
Operational improvements: industrial techniques, frontline systems improvement, and infrastructure improvement	The studies are predominantly of pre-/posttest design, often employing mixed methods. There are a fair number of cross-sectional survey studies and a limited number of longitudinal studies, often with limited sample sizes.	Hospitals have successfully applied principles from industrial production to improve process reliability. Frontline workers are uniquely positioned to identify and resolve problems that contribute to hospital errors but tend to compensate for rather than resolve them. Thus, frontline involvement in systemic improvement must be fostered. Internal committees and external collaboratives provide motivation and resources to support sustained improvement activity. Such infrastructure has been associated with performance improvement.	Literature lacks information about comprehensive, sustainable programs that show how longitudinal improvement can be achieved Studies involving infrastructure improvements and their effects on hospital errors	Operational improvement (69) External infrastructure (104) Internal infrastructure (115) Frontline system improvement (157)

(Continued)

Table 1 (Continued)

Intervention category or subdomain	Range and types of studies	Summary of findings	Examples of research gaps and further investigation needed	References for sample articles
System monitoring: prospective, retrospective, and concurrent reviews	These studies in general use cross-sectional, pre-/post-survey or intervention longitudinal designs with some case studies.	Prospective (e.g., FMEA), retrospective (e.g., root cause analysis, M&M), and concurrent (e.g., compliance monitoring) analytical strategies are used to identify and prioritize the means to prevent future hazards. Results often depend on whether hospitals conduct these activities in a nonpunitive manner.	Studies of direct evidence of impact on hospital errors Studies of prospective and concurrent processes for influencing safety culture and reducing errors	Concurrent (85) Prospective (94) Retrospective (152)

Abbreviations: CPOE, computerized physician order entry; FMEA, failure mode and effects analysis; HR, human resources; M&M, mortality and morbidity.

extended work shifts and reduced the number of hours worked per week reduced attention failures (84) and serious medical errors by interns (79), but subsequent duty-hour reforms have had no impact on safety outcomes (126).

There is some evidence that using published research to guide practice (158) and ongoing practitioner partnerships with leading researchers [e.g., Michigan’s Keystone Initiative (118)] builds safety culture and reduces hospital errors. There is also growing use of surveys to measure, motivate, and direct initiatives to improve safety climate and reduce hospital errors (107).

Internal Motivators

Leader characteristics and behaviors.

Leader characteristics and behaviors work to reduce hospital errors through enabling and shaping perceptions of safety climate. Transformational leadership—providing an inspiring vision and fostering identification with it—is the leader characteristic most strongly associated with improving safety culture and safety outcomes (92), and transformational leadership can also be taught (96).

A wide array of leader behaviors and their impact on safety climate and hospital errors

have been explored. The personal practice of leaders has a strong and consistent impact on safety climate. For example, leaders who personally disseminate safety information and provide a model of safe behavior (6) improve safety climate. In addition, related leader behaviors, including attempts to change language [e.g., investigations of errors becomes the analysis of accidents (31)] and be more inclusive of others (105), enhance employee engagement in creating a safety culture (155). An empowering leadership style (179) that includes coaching (32), dynamic delegation to junior members of a team (71), and candid conversation among team members (135) also positively affects safety culture.

Other specific interventions that feature leader behaviors include interactions with frontline caregivers regarding patient safety issues, frontline safety forums (159), Leadership WalkRounds™ (38), patient safety rounding (87), and adopt-a-work unit (122). Zohar & Luria (184) experimented with a direct approach for changing leader behavior and strengthening safety climate. Specifically, frontline managers received weekly feedback concerning their safety-oriented interactions with subordinates, and upper-level managers

received similar feedback as well as data on the frequency of employees' safety behaviors. Safety-oriented interaction increased both manager and employee ratings of safety climate. Safety climate is also improved by integrated bundles of safety practices (e.g., the comprehensive unit safety program), including active measurement of safety climate, safety education, mechanisms for identifying and addressing staff concerns, and extensive senior executive involvement (e.g., adopt-a-work unit programs) (121).

Human resource practices. Human resource (HR) practices create the conditions under which a skilled workforce is developed (e.g., through careful selection, extensive and ongoing training, and adequate staffing) to reduce hospital errors and sufficiently empowered to capitalize on these skills. Such work practices were shown to improve the quality of information shared and to reduce medication errors (117). A similar set of practices was associated with reductions in mortality from errors (172). Additional research has focused on the impact of a single HR practice (e.g., staffing/workload or training) on safety climate and hospital errors. Studies of nurse-to-patient ratios find that adequate staffing is associated with fewer adverse events (2, 102). In contrast, less adequate staffing levels (indicated by workload, overtime, or increased nonregistered nurse hours of care) resulted in unexpected deaths (28) and medication errors (132).

Technology. Research has identified information technology as an important mechanism for enabling safety culture, but at the same time, its efficacy in reducing hospital errors is heavily dependent upon the organization's cultural readiness to make use of it. Two of the most researched technologies are computerized physician order entry (CPOE) and electronic medical records. Some large-scale studies, simulations, and systematic reviews suggest that implementation of such technologies remains slow, fatal orders are inconsistently de-

tected (93), and new errors are introduced by CPOE (75). However, there is also suggestive evidence that these systems can substantially reduce medication errors (67). Although a recent review concluded that the effect of CPOE on adverse drug events is mixed (175), others show that CPOE is an improvement over educational interventions (44). Electronic medical records have been shown to have a small positive effect on patient safety (113), whereas other information systems, including electronic medication reconciliation systems (1) and bar code verification technology (116), have demonstrated stronger effects, albeit on a more limited scale. The efficacy of such initiatives importantly depends upon the organization's readiness to adopt the technology (147) and the implementation process (77).

SAFETY CLIMATE

We treat safety climate as the key mechanism through which enabling promotes enacting and, in turn, safety. Specifically, we suggest that frontline provider interpretations of safety-relevant leader and organizational practices constitute safety climate, and their perceptions of safety climate influence their safety behaviors.

Safety climate perceptions are commonly tied to a local leader's commitment to safety (e.g., through safety practices, procedures, and other resources committed to safety), priority placed on safety (i.e., the extent to which safety is subordinated to other goals), and dissemination of safety information (66). For example, a supervisor who disregards safety procedures whenever production falls behind schedule or who punishes people for mistakes signals a low commitment to safety (14). More recent research has expanded the dimensions of safety climate to include management/supervisors, safety systems, risk perception, job demands, encouragement of reporting/speaking up, safety attitudes/behaviors, communication/feedback, teamwork, personal resources (e.g., stress), and other organizational factors (36).

Frontline staff perceptions of safety climate have been found to predict fewer treatment errors, fewer infections (63), fewer readmissions for heart failure and acute myocardial infarction patients (57), lower incidences of preventable complications (141), and a better patient safety grade (33).

The effects of a leader's personal safety practices on treatment errors are amplified when they are paired with an organization-wide priority on safety (66). Safety climate, as indicated by suitable safety procedures and clear information flow, reduced treatment errors only when leaders emphasized safety and gave it a high priority (100). Perception of a strong safety climate results in improved safety performance because it increases safety motivation (i.e., willingness to exert effort), participation in voluntary safety activities (e.g., helping coworkers with safety-related issues and attending safety meetings) (101), adherence to safety protocols, employee reporting of errors and incidents (99), and creative problem solving (63, 141).

However, perceptions of safety climate are rarely shared across an organization. In fact, numerous studies find that the perception of safety climate varies based on one's position in the organizational hierarchy [i.e., administrators tend to see higher levels of safety climate than frontline caregivers (137)], professional affiliation [i.e., doctors perceive higher levels of safety climate than do nurses on dimensions such as teamwork and support/recognition of safety efforts (58)], and medical specialty or unit [e.g., emergency department personnel perceive a weaker safety climate (138)]. Importantly, the discrepancies in perceptions of safety climate are also consequential for safety outcomes. For example, frontline staff's perceptions of safety climate have been associated with patient safety indicators, whereas those of senior managers were not (127, 141).

ENACTING

Enacting a safety culture that reduces hospital errors means frontline health care providers consistently translate safety policies and guide-

lines into routine practice. Enacting safety culture requires identifying and reducing latent and manifest threats to safety. To accomplish this, organizations must confront communication failures, including the failure to transmit information about vulnerabilities and mistakes. Research suggests that enacting a safety culture reduces errors when enacting consists of deliberate efforts such as engaging caregivers and patients in effective interpersonal processes (i.e., teamwork, mindful organizing, and relational coordination), promoting regular reporting and voicing concerns, and deploying checklists and standardized protocols to coordinate care when transitions occur.

Interpersonal Processes

Teamwork. Teamwork among health care providers is considered both an important component of a culture of safety and an essential ingredient for reducing medical errors. Definitions and frameworks for thinking about teamwork are plentiful, as are measures of teamwork (160). Qualitative research has highlighted the consequences of poor teamwork on hospital errors (151). Qualitative studies have also identified conditions (129) and practices (41) that inhibit or promote effective teamwork. In addition, the literature describes a variety of interventions to improve teamwork. The most prevalent of these are education-based team training initiatives, such as crew resource management (68) and TeamSTEPPS (166). They have been found to positively impact the quantity and quality of communication and teamwork behaviors as well as safety and teamwork climates. These team training programs, which aim to cultivate enhanced communication and coordination within teams, use a variety of intervention modalities, including simulation-based training (23). Training programs may have a single focus (64) or have a multidisciplinary focus. Many programs include teamwork training as an essential component of a multipronged program, combining it with checklists (17), patient communication (10), leadership (109), and policy initiatives (5).

Mindful organizing. According to Weick & Sutcliffe (167), mindful organizing consists of five interrelated organizational processes: preoccupation with failure, reluctance to simplify interpretations, sensitivity to operations, commitment to resilience, and deference to expertise. High-reliability organizations, which operate technically complex systems in a nearly error-free manner over long periods, enact these processes (72). Case studies of organizational disasters suggest that the absence of mindful organizing was a major contributing factor (168). Consequently, developing mindfulness among frontline workers to prevent errors becomes a priority (125). There have been efforts to build mindful organizing in hospital units (87) and to measure and improve it using surveys (162). Evaluations have demonstrated that increased mindful organizing results in fewer errors and patient falls (162), especially when paired with trusted leaders and structured protocols, e.g., care pathways (163).

Relational coordination. Relational coordination is a term broadly encompassing strategies focused on improving communication and relationships among individuals whose roles require them to work together to integrate tasks (48). Studies have associated relational climate with adherence to recommended practices (7). Adherence to protocols is associated with operational reliability that makes error-free performance more likely. Some efforts have sought to improve relational coordination (88) and to describe conditions (e.g., use of HR practices) that make relational coordination more likely (49). Additional research suggests that relational coordination may be more important when task and cognitive loads are greater (35).

Patient involvement. Long-standing research suggests that patients can play an important role in reducing medical errors by helping to more quickly detect and correct errors, but only if the organization is open to and supportive of their involvement. Researchers have identified and assessed strategies for effectively engaging patients that range from

having patients ask questions about their health and treatment to actively managing and coordinating their own care (62, 170). They also have identified conditions that enhance the likelihood of successful patient involvement; these include self-efficacy, preventability of incidents, and effective actions (131). Several studies have explored the potential for information technologies to promote more effective patient-provider communication, suggesting the use of technology as a means to strengthen data gathering, diagnosis verification, and patient follow-up and monitoring among adults (142), particularly for vulnerable populations (106). Studies exploring the potential for patient involvement also have examined the accuracy of patient-reported events with mixed results (146, 180).

Reporting and Voicing Concerns

The extensive literature on incident reporting suggests that policy makers and practitioners believe this strategy has the potential for reducing medical errors. In fact, reporting and a reporting culture are seen as building blocks for patient safety (74) and safety culture (124). Research in hospitals has examined the accuracy, comprehensiveness, and sufficiency of reporting; the information derived from reporting; the conditions under which it occurs; and its effect on errors. Several scholars have proposed frameworks or typologies for detecting and reporting errors (128, 145). Various studies document substantial underreporting of incidents among clinicians (108) and explore reasons for failing to report (61). Research comparing information obtained through different reporting systems (80) has found that the information obtained may be redundant (52). In the majority of instances, however, different perspectives provide complementary insights about organizational safety, thus warranting a portfolio of reporting systems. For example, communication problems were common from patient complaints, whereas WalkRounds tended to identify issues with equipment and supplies. A few papers look beyond incident reporting by describing strategies for analyzing,

addressing (43), and learning from (150) reported incidents. These papers highlight the need for responsiveness and closure to reap benefits from and cultivate continued reporting. Additional studies have treated a clinician's willingness to voice concerns as an independent variable, correlating higher levels of voiced concerns with reduced hospital errors and other outcomes (99).

Coordinating at Care Transitions and Across Interdependent Functions

Checklists. Among lessons the health care sector has learned from aviation is that checklists have the potential to improve the consistency of safe practices as well as communication and teamwork, thereby promoting error-free results (45). Effective checklist use, however, requires the perception that the organization embraces them (120). A growing body of evidence suggests that checklists can improve patient safety (73). Although commonly applied in intensive care units (12) and surgery (25, 59), studies also describe checklist use in emergency departments, acute care settings, medication administration (44), and as part of multipronged programs (174). In practice, however, checklist use varies once adopted, presenting an obstacle to deriving benefits (98). A few studies explore barriers to checklist use (37) and characteristics of implementation processes that promote it, including the ability of leaders to persuasively explain why and how to use the checklist (20). Other reports provide suggestions for developing medical checklists (56) and describe surveys that measure the factors associated with effective checklist implementation (16).

Hand overs. The transition of patients between care settings and the sequential exchange of information between clinicians caring for the same patients both present opportunities for error and require effective management to avoid them. Evidence demonstrates that poor hand overs result in errors both within (97) and between (76) specialties. Interventions have

shown promise in improving hand overs by reducing information omissions, technical errors, and preventable adverse events include an education curriculum (11), checklists (15), and structured interdisciplinary rounds (110).

Others. Myriad additional opportunities exist for enacting a safety culture to reduce hospital errors (133). Research has shown that physician participation is positively associated with improvement in hospital patient safety indicators, but involvement by multiple hospital units in the improvement effort is associated with worse values on this and other quality measures (169). Efforts specifically focused on standardizing aspects of health care delivery also have been shown to reduce errors (177). In addition, studies have demonstrated potential benefits for patient safety from time management (3), risk management (13), and remediation, i.e., disclosure (40) and apology (60). The literature also highlights common conditions that contribute to the inability of hospitals to reduce errors, such as health care worker stress and burnout (173) and the practice of work-arounds (55).

ELABORATING

Elaborating a safety culture is the systematic process of reflecting and translating prior experience to spread and refine manager and frontline employee safety-oriented behaviors and practices that have been previously enabled and enacted. Elaboration refers to the evolutionary expansion of these behaviors and practices, preferably characterized by increasing tolerance for them and growing capabilities for addressing complications that may accompany them. Interventions that promote the elaboration of a safety culture include those that promote learning, education, operational improvement, and system monitoring.

Learning-Oriented Interventions

Learning from small failures through experimentation presents health care organizations with the opportunity to prevent problems that

have the potential to cause patient deaths (144). Learning also has been credited with the successful transfer and retention of best practices (8). Considerable attention has been given to identifying the facilitators of learning from errors, and most notable among them is psychological safety—a belief that the group environment is safe for taking interpersonal risks (29). Studies also have identified barriers to learning (153) and conditions under which learning is less likely, such as when a problem is ambiguous (30). Organizations may learn from frontline workers' complaints about operational problems (157), briefings and debriefings (161), incident reporting systems (86, 150), and mortality and morbidity (M&M) conferences (111). Survey measures also provide organizations with opportunities to assess the extent to which they are learning organizations (139) and learn from reported events (46).

Education

Education is a popular feature of many interventions designed to reduce hospital errors. Several interventions have used educational initiatives to promote safety culture, some with positive effects (47). Education is frequently a component of multipronged interventions and has been used in combination with teamwork, leadership, frontline system improvement, technology, incident reporting, patient partnership, checklists, and measurement and feedback programs to improve safety culture (5, 118). More specifically, simulation is becoming an increasingly popular mode for introducing practices and processes for shaping safety culture and reducing hospital errors, but current evidence of its effects is mixed (22, 23, 81). Studies have identified how safety and team-based training for medical students (70), frontline caregivers (125), and leaders (140) changes behavior (e.g., more learning oriented) and reinforces safety culture. They also have demonstrated that, in the context of academic medicine, faculty and students must manage a trade-off between education and patient safety (95).

Operational Improvements

Industrial techniques. Recognizing that operational failures can contribute not only to excess costs but also to safety problems, experts recommend applying principles from industrial production for clarifying and streamlining operations and reducing controllable variations to enhance reliability and reduce hospital errors (82). Such techniques, including the Toyota Production System and lean manufacturing principles, have been successfully implemented across organizations, notably at the Virginia Mason Medical Center in Seattle (69) and ThedaCare Appleton Medical Center in Appleton, Wisconsin (154). Evidence suggests these programs have improved problem resolution (39) and the timeliness and reliability of care processes (178).

Frontline system improvement. Given the unique and expert perspective of frontline workers on safety hazards in hospitals (159), scholars and policy makers advocate training, trusting, and supporting them to identify and resolve safety problems (9). Studies present models for understanding frontline problem-solving behavior (157) and programs for identifying and monitoring problems to improve problem solving and patient safety (149). They also describe how improvement efforts can reduce work-arounds (54) and improve policy compliance (89). Frontline system improvement often plays a prominent role in multipronged approaches, such as the comprehensive unit safety program, which has been credited with improvements in safety culture (118). However, substantial research also suggests frontline system improvement must be fostered because frontline workers tend to compensate for failures rather than treat them as learning opportunities (156). Leadership turnover can also undermine improvement initiatives (115).

Improvement infrastructure. Research also highlights the importance of maintaining the infrastructure to support safety initiatives

because it is necessary to catalyze, execute, and sustain efforts to reduce hospital errors. Internally focused, safety-oriented committees provide a systematic approach to identifying and supporting efforts to improve and maintain safety and safety culture (115). Similarly, externally driven improvement collaboratives provide participants with a forum, motivation, and social support as well as project management and process-improvement skills to execute improvement activities in their organizations (103). Collaborative approaches also have been recommended for the prioritization and resolution of safety hazards that lend themselves to industry-wide solutions (119). Research shows that performance improvement increases with the use of both internal and external learning activities (104).

System Monitoring

The literature describes a variety of strategies—prospective, retrospective, and concurrent—for enriching our understanding of delivery systems and promoting a safety climate and safe practices throughout an organization.

Prospective review. Prospective strategies include failure mode and effects analysis (FMEA), prospective hazard analysis, and human factors engineering. FMEA and other forms of prospective hazard analysis ask practitioners to identify potential hazards and rate their severity and likelihood to design processes that prevent them. These techniques have been applied to a broad range of care processes alone (26) and as part of multipronged programs (136), used to prioritize interventions (65), and credited with reducing medical errors (94). Human factors engineering applies an understanding of the cognitive and behavioral limitations of human beings to system design. Studies have demonstrated the ability of this discipline to develop safe, comfortable, and effective equipment and systems through iterative tests and refinements (51).

Retrospective review. Retrospective analysis in hospitals usually takes the form of root cause analysis, a structured approach to identifying the factors that resulted in a harmful outcome. Predicated on the belief that addressing the causes of past problems may prevent future problems, studies have demonstrated the importance of conducting these analyses to identify multiple approaches and shape clinician workflow in the name of reducing hospital errors (42). These are often combined with stories of dramatic events that can engage clinicians to consider the system problems that cause them, thus reinforcing a safety culture. For example, the long-standing *Annals of Medicine* case-based series, the Agency for Healthcare Research and Quality-sponsored “WebM&M,” and M&M rounds have engaged caregivers in disclosing and collective learning from specific events (165). M&M conferences are also widespread among teaching hospitals (112). However, many clinicians are reluctant to openly discuss errors in a conference setting (114). Research has offered suggestions for promoting enhanced learning from M&M conferences (111, 112), including making the organization’s stance toward errors explicit, selecting cases that present learning opportunities, using skilled moderators to facilitate discussion, encouraging broad attendance, and focusing on generalizable lessons. Implementing such programs has been associated with improvement in safety climate (152).

Concurrent review. Compliance monitoring is a form of concurrent analysis involving the collection and analysis of information on the performance of programs or protocols following initial implementation. Studies have demonstrated methods for compliance monitoring (e.g., real-time, clandestine observation) and their value for continuous improvement of care processes and protocols (85).

DISCUSSION

In this review, we distilled research on interventions to reduce hospital errors into a framework

that captures the varied ways in which they operate through processes of enabling, enacting, or elaborating a safety culture. Although the assembled evidence suggests support for the effects of interventions on safety climate and safety culture, evidence is weaker for reducing hospital errors. As identified in earlier reviews (176), this is undoubtedly, in part, a function of the organizational and systemic nature of hospital errors, which makes it difficult to conceptualize and measure them and erects numerous barriers to implementing interventions.

At the same time, the modest effects of varied interventions on reducing hospital errors suggest a key contribution of our review: recognizing that the systematic pursuit of enabling, enacting, and elaborating—not isolated interventions—offers the greatest potential for reducing hospital errors. In addition, as our adapted conceptual model implies, a hospital can never be fully error free. However, ongoing and iterative processes of enabling, enacting, and elaborating a safety culture can reduce and minimize hospital errors.

Implications for Research and Practice

The main implication of our adapted conceptual model is that the starting point for considering future interventions should resemble what we have identified as multipronged approaches. These would intentionally address the organization's ability to enable, enact, and elaborate a safety culture rather than focus on just one of these areas. For example, if an organization or unit was going to intervene to increase teamwork (which we have identified as a form of enacting), it would mean considering how teamwork could be enabled through leader support and organizational practices (e.g., adequate staffing to allow for training and other exercises during work hours) and how it could be elaborated by disseminating the plan to other groups and refining the intervention over time. Once initiated, teamwork interventions might be further enabled by policies that reward team-based care. This interpretation of our model also suggests a more holistic approach to asking

research questions and the means of answering them.

Another important implication of our adapted model is that interventions will be more successful when implemented in a culturally sensitive manner. Not all interventions will be useful and appropriate in all settings (a potentially important explanation for the mixed findings observed for many interventions). The ability to discover interventions that can work within an organization's existing culture relies on, and is an underappreciated aspect of, leadership. It requires understanding the fundamental mechanisms through which the intervention is expected to achieve change and reconciling these to the basic shared beliefs and assumptions held by organizational members. This implication is consistent with studies that have explained previous failures to spread improvement interventions (e.g., total quality management) as a result of leaders' failures to fundamentally change the motivational structure of the work (53).

Above, we have described the large and growing literature on safety climate as bridging the enabling and enacting of a safety culture. One persistent finding in this literature is that an organization-level safety climate is elusive. Instead, there is considerable evidence that climate is fragmented across professions, organizational levels, and organizational subunits. This raises the important question of when (if ever) a hospital-level safety climate (and culture) emerges. Are climate perceptions more likely to be shared when many, if not all, of the enabling conditions we identified are present? Or are some factors (e.g., leader practices) especially important?

Lastly, **Table 1** suggests a number of important research questions, the answers to which will further refine the proposed model and better establish the linkages among interventions, culture, and hospital errors. For example, we need more systematic research on external motivators. What external actors or policies motivate hospitals to pursue efforts that have demonstrated impacts on reducing hospital errors? Future research should also more

carefully and consistently operationalize a number of the concepts we identified in our model, including safety climate, HR practices, and teamwork.

In addition, as previously established (34, 176), our review finds that a rigorous, quantitative demonstration of the relationship between an intervention and outcomes remains rare. Although one could easily dismiss research designs other than randomized clinical trials as less rigorous and call for stronger analytical methods for evaluation, our investigation suggests some caveats to this typical conclusion. Our model suggests that intervening in ways that are sensitive to the existing culture and that attempt to shape the culture through systematically enabling, enacting, and elaborating will be most effective. Holding organizational interventions to a “gold standard” could result in the application of validated interventions that neither fit a particular organization nor span the full enabling, enacting, and elaborating cycle. Quantitative studies of the relationships between interventions and outcomes, especially when controlling for prior performance through structural equation modeling or other rigorous approaches, should constitute

evidence for diffusing an intervention under appropriate conditions. Combining these studies with those that directly assess the contextual conditions under which interventions—from voice to leadership behaviors to education and learning—are most effective for reducing hospital errors (i.e., moderators that enhance the relationship) is also needed. Finally, we need additional longitudinal, mixed methods and qualitative investigations—including ethnography and case comparisons—that identify the mechanisms through which an intervention leads to fewer hospital errors.

CONCLUSION

Faced with the persistent challenge of hospital errors, policy makers and practitioners need guidance regarding how to achieve improvement. We have argued that piecemeal initiatives are inadequate and that strengthening safety culture necessitates interventions that simultaneously enable, enact, and elaborate it in a way that is attuned to the existing culture. This approach may hold the key to demonstrably reducing hospital errors and ultimately saving lives.

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