Speaking up constructively: Managerial practices that elicit solutions from front-line employees

Julia Adler-Milstein
Sara J. Singer
Michael W. Toffel

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Ideas that could enable organizations to improve their operating processes often come from front-line workers who voice concerns and share ideas about how to solve problems. Our study is among the first to develop and empirically test theory about how specific management practices can encourage employees to speak up about problems and to offer suggestions for solving them. We hypothesize that employees are more likely to speak up and offer solutions when organizations launch information campaigns to promote process improvement and when managers engage in process-improvement activities themselves. We test our hypotheses in the health-care context, in which problems are frequent and many organizations use incident-reporting systems to encourage employees to communicate about the operational problems they witness. Using data on nearly 7,500 reported incidents, we find that information campaigns encouraging process improvement promote both speaking up and offering solutions, while managerial engagement in process improvement promotes the latter. Our findings suggest that particular management practices can influence front-line workers’ decisions about whether to speak up and that direct managerial engagement can result in their doing so constructively.

INTRODUCTION

Many ideas for improving an organization’s operating processes come from front-line workers who possess firsthand knowledge of problems and how they can be resolved. Employee reports of accidents, near misses, and other operational problems can provide managers with information unavailable elsewhere about opportunities to improve work systems (Cannon and Edmondson 2005, Hogan et al. 2008, Sitkin 1992). Because organizations can learn particularly effectively from failures (Madsen and Desai 2010), managers can use the information from these reports to promote remedial and preventive measures (Madsen 2009). Employee suggestions have brought about meaningful
organizational improvements, including fewer errors (Stern et al. 2008), improved work systems (Tucker et al. 2008), and higher employee morale (Sobo and Sadler 2002). Organizational silence, which results when employees do not speak up, can “shut down creativity and undermine productivity” (Perlow and Williams 2003: 3) and even imperil employees and customers (Detert and Treviño 2010). Many organizations, industries, and government agencies have therefore implemented confidential reporting systems (Short and Toffel 2008, Billings and Reynard 1984, Farley et al. 2008), but these can only succeed if employees are willing to speak up when problems arise.

It is well known that employees often fail to speak up because they are not convinced of the value of doing so (Detert and Treviño 2010, Kish Gephart et al. 2009, Milliken, Morrison, and Hewlin 2003, Morrison and Milliken 2000, Subrahmaniam and Ramanujam 2008a, Van Dyne, Ang, and Botero 2003). Employees may be dissuaded by fear of interpersonal risk (Ryan and Oestreich 1998) and potential repercussions (Blatt et al. 2006, Kish Gephart et al. 2009), such as appearing incompetent by admitting an error or asking for help and suffering lack of promotions, raises, or project assignments as a result. Even without such fears, employees may not feel motivated to carve out time to invest the discretionary effort to speak up, particularly if they do not trust that managers will respond productively to their concerns or if they suspect that management’s solutions will be no better than their own workarounds (Blatt et al. 2006, Tucker and Edmondson 2003, Tucker 2007).

The prior literature has identified a number of ways to overcome these obstacles. For example, managers can create a psychologically safe environment by behaving in ways that reduce perceptions of power and status differences and thus lead employees to perceive managers as non-threatening (Detert and Burris 2007, Edmondson 1999, 2003, Nembhard and Edmondson 2006). Managers can motivate speaking up by conveying openness to suggestions and a willingness to listen and by responding to reported problems in a fair and supportive rather than blaming manner (Ashford 1998, Detert and Burris 2007, Dutton and Ashford 1993, Morrison and Phelps 1999, Tangirala and Ramanujam 2008a, Tucker 2007). Managers can also reward employee contributions and offer coaching to motivate employees to speak up (Edmondson 1999, 2003, Nembhard and Edmondson 2006).
This literature has largely focused on behavioral changes, by individual managers or employees, which effect speaking up within teams. Far less is known about the efficacy of organization-wide efforts, which can be less expensive, can require less training, and can be implemented more consistently and with less dependence on the level of support offered by any particular line manager. This paper focuses on an organization-wide information campaign to encourage speaking up: a hospital’s annual safety awareness campaign. Such campaigns seek to change employee behavior by disseminating information rather than by other mechanisms, such as attempts to change organizational culture. We argue that, just as public information campaigns can spur citizens to take particular actions, such as wearing seat belts or quitting smoking, organizational information campaigns that encourage process improvement can lead employees to speak up to report problems and propose solutions.

Scant research has focused on employees offering solutions when speaking up or on the managerial practices that encourage them to do so. We focus on employees’ willingness to offer solutions because it constitutes a particularly constructive form of speaking up, often much more valuable to managers than merely receiving reports or complaints about problems. In addition, soliciting front-line workers’ proposed solutions to operating problems is a fundamental objective of incident-reporting systems. The literature has suggested, for example, that managerial engagement in process improvement can promote speaking up (e.g., Edmondson 1999, Milliken, Morrison, and Hewlin 2003, Tucker 2007), but has not explored how that engagement affects employees’ willingness to speak up constructively by offering solutions to the problems they report. We argue that managers who demonstrate their openness and responsiveness to ideas for improvement by routinely engaging in process improvement themselves will thereby encourage their employees not only to speak up but also to offer solutions.

Finally, little is known about how managers can effectively deploy the array of approaches available to them to encourage employees to speak up and offer solutions, which can be especially important because different approaches can enhance or diminish each other’s effectiveness. To address this, we examine how information campaigns and managerial engagement interact and whether they operate as complements or substitutes.
We test our hypotheses in the U.S. health-care industry, a setting in which problems occur often and with consequences that can range from minor inconveniences to serious patient harm. Operational problems in the health-care industry result in tens of thousands of patient deaths and cost billions of dollars per year (Kohn et al. 2000). Many hospitals, the specific focus of our empirical analysis, have implemented incident-reporting systems to encourage employees to speak up (Farley et al. 2008). While several studies have focused on the limited use of incident-reporting systems (e.g., Leape 2002, Logio and Ramanujam 2010), little research has explored how these systems are actually being used to achieve their objective of surfacing and resolving problems (Benn et al. 2009). Ours is among the first studies to begin addressing this important issue.

In our empirical analysis, we find that information campaigns and managerial engagement in process improvement are associated with higher levels of employees speaking up and offering solutions. We also find that these managerial strategies operate as substitutes, as information campaigns are most effective in departments with less managerial engagement in process improvement.

Our results are particularly robust for several reasons. First, we avoid concerns about measurement error associated with perceptual and survey-based measures commonly employed in the literature on speaking up (e.g., Detert and Burris 2007, Zhou and McGeorge 2001, LePine and Van Dyne 1998) because we rely on more objective incident-report data collected over several years. These data were not created for an academic study, but rather as part of the organization’s ongoing efforts to have employees surface operational problems and improvement opportunities. Second, our panel dataset enables us to use lagged independent variables to overcome concerns about reverse causality and to use fixed effects to control for unobservable time-invariant factors within hospital units. Third, our results are robust to several alternative specifications.

We contribute to the literature on speaking up by (a) distinguishing a particularly constructive form of speaking up that promotes problem solving and process improvement and (b) identifying two management strategies that can elicit this form of speaking up. By applying insights from the literature on successful public information campaigns, we introduce information campaigns as a management strategy
that can encourage employees to speak up.

We also examine how employee willingness to offer solutions is influenced by managerial engagement in process improvement. We are among the first to rely on an objective rather than a perceptual measure of such engagement. Our study is also among the first to explore potential trade-offs and synergies between alternative strategies managers can use to encourage employees to speak up and offer solutions. Our findings reveal that such strategies can be substitutes for each other in encouraging employees to offer solutions. Finally, our paper contributes to the process-improvement literature by highlighting strategies that managers can use to cultivate front-line recommendations for problem-solving.

THEORY AND HYPOTHESES

The discretionary effort by employees to constructively address and resolve problems by engaging supervisors and managers has been referred to as improvement-oriented voice (Detert and Burris 2007) and pro-social voice (Van Dyne et al. 2003).\(^1\) Such efforts often alert management to operational problems and process-improvement opportunities (Detert and Treviño 2010). Beyond merely surfacing problems, employees can speak up constructively by also taking steps to mitigate the consequences and prevent the recurrence of those problems by (a) taking action to address the problems and informing managers of these solutions and (b) offering suggestions to managers about how the problems could be solved. These additional activities, which we also refer to as offering solutions, can carry more interpersonal and professional risk because management might reject the ideas or might view the offers as usurping authority from those with higher status (Argyris 1985). However, demonstrating or proposing solutions can also be particularly gratifying and rewarding to employees whose managers value employee engagement in solving problems and in improving operational performance. In addition, offering solutions has greater potential to improve operational performance because front-line workers’ firsthand

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\(^1\) This construct differs from Hirschman’s original use of voice, which referred to “any attempt at all to change, rather than to escape from, an objectionable state of affairs” (Hirschman 1970: 30), in that we emphasize the constructive role that employees can play in resolving problems. Voice is one of a number of constructs related to speaking up to individuals in positions of higher authority; other constructs include issue-selling, dissent, whistle-blowing, taking charge, breaking silence, help-seeking, and others (Ashford et al. 2007).
knowledge enables them to understand the root causes of problems and offer particularly well-informed ideas about how to solve them (Tucker 2007).

We hypothesize how two managerial strategies—organization-wide information campaigns and unit-level managerial engagement in process improvement—can encourage employees to speak up and to offer solutions; that is, to speak up constructively. Focusing on these two strategies allows us to compare the effects of organization-wide and unit-level approaches to encourage both speaking up and doing so constructively. In addition, both are practical, low-cost, non-punitive approaches that can motivate employees to speak up constructively by countering their “lack of conviction that their input is explicitly needed and desired by others [because without] a clear and compelling reason to offer one’s views, the effort and risk involved in speaking up make it unlikely” (Edmondson 2003: 1424). Both of these approaches seek to overcome the challenge of encouraging employees to discount perceptions of risk and anxiety that impede their “willingness to speak up openly with questions and concerns” (Edmondson 2003: 1423).

**Information Campaigns**

Information campaigns provide information intended to influence targeted individuals’ thinking and actions (Weiss and Tschirhart 1994). They seek “to generate specific outcomes or effects in a relatively large number of individuals, usually within a specified period of time, and through an organized set of communication activities” (Rogers and Storey 1987: 821). Public information campaigns, which address social and political issues and often target particular segments of the citizenry, can both inform their target audiences and influence personal behaviors. For example, public information campaigns have sought to change household consumption patterns (Ettema, Brown, and Luepker 1983, Schultz et al. 2007, Vedung 1999) and commuting choices (Henry and Gordon 2003), encourage seat-belt usage, promote condom use to prevent sexually transmitted diseases (de Walque 2007, Fröligh and Vazquez-Alverez 2009, Singer et al. 1991), and discourage littering and recreational drug use (Schmeling and Wotring 1980). Assessments of information campaigns have often yielded ambiguous results (Weiss and Tschirhart 1994). For example, after reviewing evaluations of public information campaigns to promote
healthy behavior, Aitkin and Salmon (2010: 419) conclude that “the preponderance of the evidence shows that conventional campaigns typically have only limited direct and immediate effects.”

Managers of many organizations have also deployed information campaigns to encourage employees to engage in specific behaviors, including working more safely, exercising and eating healthily, and making charitable contributions. Like public information campaigns, organizational information campaigns can use persuasive communication to foster employees’ adoption of desired behaviors (Falbe and Yukl 1992). Organizational information campaigns seek to command employees’ attention, to change the way front-line workers interact with their managers, and to encourage behavior that improves organizational performance (Zohar 2002, Naveh et al. 2005).

Organizational information campaigns have been the subject of far less scholarly attention than public information campaigns. However, the following four insights from studies that evaluated the effectiveness of public information campaigns lead us to believe that organizational information campaigns can be particularly effective in changing behavior.

First, public information campaigns are most successful at changing behaviors when the targeted individuals are interested in the subject area (Mendelsohn 1973) and when the campaigns offer specific suggestions (Vedung 1999). There are two reasons why a company-based information campaign can be more customized to the target audience, more specific about the desired change, and presumably more persuasive. Employees within an organization are typically less diverse than the general public. In addition, managers likely know the preferences, attitudes, and points of resistance among their employees better than a public entity and its advertising council know these attributes of the general population.

Second, public information campaigns are particularly influential when the targeted individuals are motivated by a campaign’s message to behave in the desired way (Ettema et al. 1983). Organizational information campaigns that encourage employees to exert discretionary effort toward corporate-level initiatives often provide opportunities for employees to gain favorable visibility with senior management. Compared to the citizenry targeted by public information campaigns, employees often have stronger incentives to respond to organizational information campaigns because such campaigns convey
organizational priorities, adherence to which can influence employees’ wages, job assignments, and career advancement prospects (Leavitt 2005). Further, emphasizing that particular issues are of current interest to management can lead employees to perceive management as being particularly willing to respond to suggestions on those issues, which encourages employee engagement (Ashford et al. 1998).

Third, public information campaigns are effective when the targeted individuals have control over the behaviors being promoted, perceive specific opportunities to take action, and believe that their actions will produce benefits (Mendelsohn 1973, Vedung 1999). This suggests that information campaigns can inspire behavioral change by creating conditions that make responding easy and fulfilling. Organizational information campaigns are typically designed to enable employees to translate the campaign’s message directly into their work practices. In our context, an organizational information campaign that sought to promote safety awareness among employees included specific encouragement for employees to submit a report to the organization’s incident-reporting system that would notify management of a safety concern.

Fourth, public information campaigns have been found to be particularly influential when they include feedback about results, which motivates continued change (Vedung 1999). It is easier to communicate feedback within an organization than to the general public.

For all these reasons, we hypothesize:

HYPOTHESIS 1 (H1). Organizational information campaigns that promote process improvement will increase the frequency of employees’ speaking up.

Information campaigns promoting process improvement can lead employees to go beyond merely voicing their concerns about problems. Campaigns can encourage employees who speak up to do so constructively; that is, to also share suggestions or describe problem-solving activities in the hope of avoiding future problems. There are three potential mechanisms through which information campaigns may promote employees to offer solutions. First, an information campaign can encourage employees to internalize and personally adopt the campaign’s underlying message that process improvement is important to the organization. Chatman and Cha (2003: 23) argue that “relying on formal rules, policies, and procedures will not result in outstanding anything, be it customer service, innovation, or quality,” all
of which instead requires leaders to instill a strong culture “that empowers employees to think and act on their own in pursuit of strategic objectives, increasing their commitment to those goals.” Information campaigns that emphasize process improvement can help to inculcate such a culture and foster voluntary efforts among employees to enhance process improvement. By signaling that the organization expects employees to participate in problem solving and process improvement, information campaigns might prompt employees not only to speak up, but also to speak up more constructively.

Second, information campaigns can increase the salience of process improvement and the potential for speaking up constructively to aid in process improvement efforts by highlighting examples of how employees’ providing solutions have led to problems being solved and processes being improved (Denning 2004). We argue that these campaigns will increase employees’ willingness to speak up constructively when reporting incidents because they enhance the belief that offering solutions may promote problem solving and process improvement.

Third, information campaigns may reduce perceived risks associated with offering constructive feedback. By explicitly inviting and appreciating employees’ contributions to process improvement, managers increase employees’ perception that the environment is safe for speaking up and taking initiative (Nembhard and Edmondson 2006). Information campaigns that promote process improvement can convey a similar message, which may likewise encourage employees to offer solutions while speaking up.

We thus hypothesize:

HYPOTHESIS 2 (H2). Organizational information campaigns that promote process improvement will increase the frequency of employees’ offering solutions.

Managerial Engagement

Managers communicate organizational priorities to subordinates through their words and actions. Leading by example or role-modeling behavior is a widely advocated managerial technique (House 1977, Trice and Beyer 1991) and has proven particularly effective in encouraging employees to engage in discretionary behaviors such as speaking up (Yukl and Lepsinger 2005, Potters, Sefton, and Vesterlund
In contrast, the failure of managers to lead by example has been identified as a key contributing factor to major accidents (e.g., U.S. Chemical Safety and Hazard Investigation Board 2007).

Managers who engage in activities such as coaching and boundary spanning can bolster front-line employees’ perception that their managers support their efforts to highlight problems (Edmondson 2003). To encourage employees to feel comfortable speaking up, managers can act in ways that foster an open and trusting environment (Tangirala and Ramanujam 2008a) and that encourage teamwork (Edmondson 2003). Similarly, managers can be highly responsive to concerns raised by their subordinates (Tucker 2007). By engaging in such discretionary behavior, managers signal the importance, appropriateness, and value of speaking up. By actively responding to employees who speak up, managers can mitigate its perceived risk and increase the perception that employees’ voices will be heard. As a result, such managerial engagement enhances the value to employees of speaking up (Dutton et al. 2002, Tucker and Edmondson 2003, Tucker 2007).

Managerial engagement can also encourage employees to speak up in ways that may more directly prevent or mitigate future problems. Engaged managers make it worthwhile for employees to offer solutions once they decide to speak up because they anticipate responsiveness to their recommendations. Engaged managers also demonstrate by example that they value constructive engagement in process improvement, mitigating fears associated with the appearance of usurping authority from those with higher status. Thus, rather than speaking up for the sake of complaining, whistle-blowing, or simply describing the problem, employees of engaged managers are more likely to speak up constructively. Thus, we hypothesize:

**HYPOTHESIS 3 (H3).** Greater managerial engagement in process improvement will increase the frequency of employees’ offering solutions.

**EMPIRICAL SETTING AND DATA**

We test our hypotheses using data from a large Massachusetts hospital’s electronic incident-reporting system, a type of dataset which few prior studies have investigated because access is restricted to protect the confidentiality of patients and health-care providers. Incident-reporting systems capture
information about medical errors, near-misses, and safety concerns, which might or might not result in patient harm. The hospital’s incident-reporting system, a commercial database customized by the hospital, was implemented in June 2004. The hospital employs a dedicated patient-safety team of four employees, whose responsibilities include managing the incident-reporting system and facilitating incident follow-up. Reporting is strictly voluntary and confidential (but not anonymous). Any hospital employee can file an incident report, which involves responding to a set of structured, semi-structured, and free-text questions to gather basic information about the incident (e.g., type, date, and time), the individuals involved (e.g., the names of the patient, staff, and doctors), the outcome of the incident (e.g., the degree of patient harm that resulted), contributing factors, and actions taken in response to the incident. After a report is filed, it is automatically routed to a designated unit manager, process manager, risk manager, and patient-safety manager. While any of these managers can enter additional information about the incident, unit managers are primarily responsible for follow-up. Managers have the opportunity to populate a set of fields in the system pertaining to follow-up and resolution, visible to and modifiable by only them.

We examined incidents that were reported by all 201 work units, which are physically defined areas within the hospital in which different types of health care and related services are delivered (e.g., pediatric, intensive care unit, chemotherapy). Our sample includes incidents reported between January 1, 2005 and May 31, 2008, a period that begins six months after the system was installed (to avoid potentially inaccurate data entered during this start-up period) and extends through the most recent reports we could obtain.

We further restricted our analytic sample to the following four incident types: (1) surgery/procedure incidents, which are related to the ordering, preparation, or performance of a surgical procedure or anesthesia; (2) blood/blood product incidents, which are related to the prescribing, processing, dispensing, or administration of blood or blood products; (3) lab specimen/test incidents,
which are related to the ordering, preparation, performance, or results of a lab specimen/test; and (4) identification/documentation/consent incidents, which are related to patient identification procedures and documentation of consent in the patient chart but are not a contributing factor to an incident of another type. We focus on these four incident types because a detailed preliminary review of a randomly selected subset of incident reports led us to discover that reports for the nine other incident types included recording errors that risked confounding our measure of employees offering solutions (described below). Specifically, we created our measure of employees offering solutions using data on suggestions and follow-up actions contained in the two fields in the incident report in which these were supposed to be reported. The other incident types beyond our focal four types often featured follow-up actions being erroneously recorded in another free-text field meant for the incident’s description. Our four focal incident types comprise 62% of all incidents.

The hospital that provided our dataset is quite similar to other hospitals in Massachusetts. To assess this, we examined the number of serious reportable events that hospitals were legally required to report to the state regulator. According to a 2008 assessment (Massachusetts Department of Public Health 2009), the number of serious reportable events reported by our focal hospital was within one standard deviation (1.37) of the average rate of 1.06 serious reportable events per 10,000 patient-days for all hospitals in Massachusetts. Comparing the three most common types of serious reportable event, our focal hospital had a slightly lower proportion of events associated with the hospital environment (e.g., electrical shocks, burns, falls) than the average hospital in Massachusetts, a higher proportion of care-management events (e.g., medication errors), and about the average proportion of surgical events (e.g., incorrect surgical procedures). This offers some indication that our setting includes a range of work-related problems similar to that of other hospitals across Massachusetts and supports the generalizability of our analysis.

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3 These recording errors affected one of our dependent variables, offering solutions, but not our other dependent variable, speaking up. In a robustness test described below, we re-estimated our models that predicted speaking up based on samples that included incidents of all types, which yielded results consistent with our primary results.

4 To preserve anonymity, we cannot disclose the number of serious reportable events our focal hospital reported.
Measures

**Speaking Up.** Speaking up reflects employees’ decisions, when encountering problems, to bring their concerns to the attention of management. Because the focal hospital operates an incident-reporting system, we operationalize speaking up based on incident reports, as others have done (e.g., Garbutt et al. 2008). Specifically, we measured *speaking up* as the number of incident reports filed by employees within each hospital unit per month.

**Offering Solutions.** Offering solutions refers to an employee’s effort, once he or she has decided to file an incident report, to help his or her organization by providing managers with information about actions employees have already taken to resolve the problem or with suggestions for resolving it, either of which could be applied to solve future problems. Incident reports that offer solutions can be particularly valuable because, rather than simply highlighting a problem, they identify remedies that can be acted upon. For example, patient-safety team members at the focal hospital reported that, in response to a recommendation from one incident report, they implemented automatic notification of abnormal test results to prompt more rapid follow-up. In contrast, an incident report without a specific recommendation led to the initiation of a task force to investigate ways to improve communication of patient allergies and sensitivities to medications. Ultimately, this task force implemented a new policy and changed a computerized order-entry screen to make documentation easier, but these changes took considerable time and effort. We measured *offering solutions* as the monthly number of incident reports that documented any actions taken by staff in response to the incident or any suggestions for avoiding similar incidents. As with speaking up, we calculate this monthly metric for each hospital unit.

**Information Campaign.** The hospital runs an annual patient-safety awareness week in early March as an information campaign designed to improve patient safety throughout the hospital. The hospital schedules this campaign to occur during the National Patient Safety Foundation’s annual Patient Safety Awareness Week. The hospital’s campaign focuses on explaining to employees when they should file incident reports, the process for doing so, and the resulting benefits. During the campaign, the hospital promotes patient-safety practices via the hospital bulletin, a table with patient-safety materials, and a
patient-safety knowledge contest (e.g., a crossword puzzle or quiz). The campaign highlights prior incident reports that resulted in specific improvements and promotes increased incident reporting by entering staff in a lottery for gift certificates or awarding credit in the hospital cafeteria for each report filed during the campaign week. According to patient-safety team members, these annual campaigns result in heightened safety awareness throughout March and April. We created a dichotomous variable, information campaign, coded “1” for reports filed for incidents that occurred in March or April and “0” otherwise.

Managerial Engagement in Process Improvement. The difficulty of obtaining objective measures of managerial engagement in problem solving and process improvement has led most researchers to rely on perceptual measures based on employee surveys (e.g., Detert and Burriss 2007, Zhou and McGeorge 2001, LePine and Van Dyne 1998), despite concerns that such measures might be biased (Detert and Burriss 2007). Instead of a perceptual measure, we rely on an objective indicator which we believe is a valid proxy for managerial engagement. After a front-line worker files an incident report at the focal hospital, his or her unit manager is the primary individual tasked with responding. The unit manager receives an automatic e-mail for each incident report filed in her unit, which also provides her with the opportunity to enter information into a structured field to record the actions taken as a result of her involvement. Examples include “communication process enhanced” and “leadership/responsibility defined.” Front-line employees observe the resulting changes and those who report incidents also receive a monthly e-mail that highlights the latest actions taken in response to incident reports. We created a variable that captures the overall level of managerial engagement in process improvement within each unit, measured as the proportion of a unit’s annual number of incident reports in which managers recorded actions taken. When a unit had no incidents in the calendar year, we recoded managerial engagement in process improvement from missing to zero and created a dichotomous variable managerial engagement undetermined coded “1” to denote such instances and “0” otherwise. In the models, we lag these variables one year to overcome concerns about reverse causality.
EMPIRICAL APPROACH AND RESULTS

Summary statistics and correlations are reported in Table 1. In our sample, on average, 1.4 incident reports per month were filed by employees from each hospital unit.

Empirical Models

To assess how information campaigns and managerial engagement affect speaking up and offering solutions, we estimated the following model:

\[ Y_{jt} = F(\text{InfoCamp}_{t}, \text{MgrEng}_{jt-1}, \text{Year}_{t}, \text{Unit}_{j}) \]

where \( F(\cdot) \) is the Poisson function. This model estimates for hospital unit \( j \) in month \( t \) either (a) the overall number of incident reports (speaking up) or (b) the number of incident reports that feature actions taken or suggestions made (offering solutions). In both cases, these outcomes are modeled as a function of whether they occurred during or immediately after the month of a hospital-wide information campaign (\( \text{InfoCamp}_{t} \)) and also of the level of managerial engagement in process improvement within the hospital unit in the previous year (\( \text{MgrEng}_{jt-1} \)). We include a full set of year dummies (\( \text{Year}_{t} \)) to account for the possibility that reporting levels might be affected by changes in annual budgets and strategic priorities, whether or not the hospital was subjected to a biannual visit by the Joint Commission to reevaluate its accreditation status, and other differences between years. We also include (conditional) fixed effects at the hospital-unit-level, which controls for unit-specific time-invariant factors that could affect the unit’s monthly number of incident reports, such as the types of activities conducted in the unit, the number of beds, and the unit’s profitability (Horwitz 2005).

Results

Because our models predict count variables, we use conditional fixed-effects quasi-maximum likelihood Poisson regression with robust standard errors (Wooldridge 1999). Results are reported in Table 2, where we also provide incident-rate ratios (IRRs) to facilitate interpretation.

Information Campaigns. The results of our primary model that predicts the frequency of speaking up indicate that information campaigns increased the number of incident reports (Table 2, Model 1: \( \beta=0.12, p<0.01, \text{IRR}=1.1 \)), which supports Hypothesis 1. The average marginal effect (partial
effect) of 0.08 reflects an increase from 1.44 incident reports per month per hospital unit to 1.52 during the month in which the information campaign occurs and the following month. To put this additional 0.08 reports per unit-month in perspective, it is equivalent to 32 additional reports being filed across the hospital’s 201 units during the month in which the information campaign occurred and the following month.

The results of our primary model that predicts the frequency of offering solutions indicate that information campaigns are also associated with more incident reports that offer solutions (Model 2: $\beta=0.30$, $p<0.01$, IRR=1.4), which supports Hypothesis 2. The average marginal effect (partial effect) of 0.54 reflects an increase from 0.31 incident reports offering solutions per month per hospital unit to 0.85 during the month in which the information campaign occurs and the following month. This represents a 174% increase above (nearly tripling) the 0.31 average. To put in perspective this additional 0.54 solutions per unit-month, it amounts to 217 additional solutions offered across the hospital’s 201 units in the two-month period.

**Managerial Engagement.** The results of Model 2 also indicate that higher levels of managerial engagement are associated with more incident reports that offer solutions ($\beta=0.48$, $p=0.07$, IRR=1.6), which supports Hypothesis 3. Based on the average marginal effect of 0.86, a hospital unit with a level of managerial engagement one standard deviation (SD=0.28) above the mean has 0.24 more solutions offered per month, or nearly two per year. This monthly increase represents a 77% increase above the 0.31 average number of monthly solutions offered per hospital unit. If all 201 units were to exhibit this one-standard-deviation increase, this would amount to 581 more solutions offered per year across the entire hospital. These results suggest that employees who work for more engaged managers file particularly constructive incident reports compared to those who work for less engaged managers.

**Robustness Tests**

We estimated our primary models using conditional fixed-effects quasi-maximum likelihood Poisson regression with robust standard errors rather than a conditional fixed-effects negative binomial specification because the Poisson model is consistent under a weaker set of assumptions and is robust to
arbitrary forms of heteroskedasticity (Simcoe et al. 2009). Our results were nearly identical when we re-estimated our models using conditional fixed-effects negative binomial regression.

Earlier, we explained that, to minimize error associated with our measure of offering solutions, we restricted our sample to the four incident types for which employee solutions were most often correctly coded. Whereas such errors could confound our models that predict offering solutions, it cannot bias our models that predict speaking up because these models estimate the total count of incident reports irrespective of their content. Our results were nearly identical when, as a robustness test, we re-estimated our speaking up models to predict the total incident reports per hospital-unit-month based on all 13 types of incident. In addition to the four incident types considered in our main analysis, the nine additional types were airway management, coordination of care, diagnosis/treatment, diagnostic test, environment, fall, line/tube (related to intravenous therapy), maternal/childbirth, and skin/tissue.

Perhaps the most significant threat to the validity of our conclusions derives from our measuring solutions offered as a count of incident reports featuring suggestions and actions taken, which is a subset of the count of all incident reports (our measure of speaking up). It is possible that we might observe increases in the number of solutions offered simply as an artifact of increases in the overall number of incident reports. For example, our results indicate that information campaigns increased the number of incident reports filed (speaking up) by a factor of 1.11 and increased the number of incident reports featuring suggestions and actions taken (offering solutions) by a factor of 1.35. While the latter factor being larger than former suggests that information campaigns also appear to be associated with a greater proportion of incident reports offering solutions, the fact that each of these odds ratios is statistically significant does not necessarily mean that this increased proportion is statistically significant.

To investigate this, we estimated an alternative model that assesses how information campaigns and managerial engagement affect the likelihood that employees who speak up by filing an incident report also offer solutions. We estimate this model using the individual incident report as the unit of analysis, which also enables us to control for a host of incident-specific factors that may be associated with the likelihood of offering solutions. These include actual or potential patient harm as a result of the incident,
the magnitude of patient harm when it occurs, legal liability risk, and whether equipment was involved. We include (a) fixed effects to control for differences between our four focal incident types and for the month and year the report was filed and (b) conditional fixed effects to control for differences across hospital units. The measures, model, and estimation approach of this conditional fixed-effects logistic regression model are described in detail in the Appendix, with summary statistics and correlations reported in Table A-1.

The results, reported in Table A-2 in the Appendix, indicate that information campaigns and managerial engagement in process improvement were each associated with statistically significant increases in the likelihood of employees offering solutions as part of their incident reports (OR = 1.7 and 2.5, respectively; p < 0.01 in both cases). This reinforces support for Hypotheses 2 and 3. Combined with our primary results, our findings indicate that both tactics increase the number of solutions offered (Model 2) as well as the likelihood that solutions are offered when employees choose to speak up (Table A-2).

EXTENSION: ARE INFORMATION CAMPAIGNS AND MANAGERIAL ENGAGEMENT COMPLEMENTS OR SUBSTITUTES?

Our main results treat information campaigns and managerial engagement as independent approaches that managers can deploy to encourage employees to speak up and to offer solutions. As an extension, we explore whether these two approaches might serve as complements or substitutes. Because front-line workers’ commitment and willingness to cooperate depends on managerial consistency in action and communication (Kopelman, Brief, and Guzzo 1990, Rogg et al. 2001), information campaigns and managerial engagement in process improvement could be mutually reinforcing if they convey a consistent message. Similarly, since both tactics emphasize process quality as an organizational priority, the combination might be especially likely to persuade employees that management is open to learning from problems, which can attenuate employees’ perceived risks of speaking up and offering solutions (Detert and Burris 2007, Morrison and Phelps 1999). These factors suggest that managerial engagement and information campaigns would operate as complements, so that employees in units with managers who are highly engaged in problem solving would be especially likely to respond to an organizational
information campaign. In such units, organizational information campaigns would inform employees that speaking up is valued not only within their unit but also by the organization as a whole. In contrast, employees whose managers are unresponsive to their concerns and suggestions would likely view organizational information campaigns as merely symbolic activities, undeserving of a response (Weiss and Tschirhart 1994).

On the other hand, information campaigns and managerial engagement might operate as substitutes. In units whose managers are highly responsive to employees, employees might be relatively unaffected by an organization-wide information campaign reminding them of the importance of speaking up and offering solutions. Because these employees already have a responsive outlet, they would gain little from such a campaign and might even view it as counterproductive to file more incident reports, since that might divert their manager’s attention from the most critical issues already being reported. In units with low managerial engagement, however, such information campaigns might be essential to promote speaking up and offering solutions. For employees in these circumstances, such campaigns would provide a rare opportunity to share concerns. Information campaigns could thus overcome these employees’ reluctance to speak up and offer solutions by indicating that, despite their immediate managers’ lack of responsiveness, senior management and other higher-level managers will welcome and act on their feedback (Detert and Treviño 2010).

To assess whether the two managerial tactics operate as complements or substitutes, we included in each of our models a term that interacted managerial engagement with information campaigns. The interaction term yielded a coefficient in Model 3 that was near zero and non-significant, which provided no evidence that these strategies operated as either complements or substitutes in encouraging employees to speak up. In Model 4, which predicted the number of incident reports offering solutions, we found evidence of a substitution effect. Specifically, managerial engagement increased the number of incident reports offering solutions outside of information campaign periods (Model 4: ß=0.58, p<0.01, IRR=1.8) but had little impact during campaigns (ß=0.07, p=0.77, IRR=1.1), with the latter values calculated as the linear combination of the coefficients on managerial engagement (0.58) and the interaction term (-0.51).
The differential effect is statistically significant, as indicated by the interaction term ($\beta=-0.51$, $p<0.05$). Because the average marginal effect of managerial engagement outside of information campaign periods is 1.06, a one-standard-deviation increase in managerial engagement (SD for this estimation sample=0.24) is associated with a predicted monthly increase in each hospital unit of 0.25 incident reports offering solutions, a 59% increase beyond the sample mean of 0.43.

This substitution effect is depicted in Figure 1, which graphs the average predicted number of incident reports offering solutions across various levels of managerial engagement, both during and outside of information campaign periods. The upward-sloping line reflects a positive relationship between managerial engagement and the number of incident reports offering solutions outside of information campaign periods. The horizontal line indicates that, during information campaigns, the monthly number of incident reports offering solutions was consistent irrespective of the level of managerial engagement. In a sense, campaigns served as an equalizer, closing the gap (of nearly 0.6 incident reports offering solutions per month) outside of campaign periods between hospital units with minimum and maximum levels of managerial engagement. This clearly shows that information campaigns had a greater impact on encouraging employees to speak up constructively in units with low managerial engagement in problem solving.

**DISCUSSION**

Addressing and preventing operational problems, as opposed to working around them, creates the opportunity to improve organizational performance (Tucker 2004) by institutionalizing solutions (Madsen 2009). Ideas that could enable such improvements in operating processes often come from front-line workers. However, little is known about how specific management practices can promote the kind of employee communication that facilitates problem-solving. We examined this question in the health-care setting, in which operational problems are common and have potentially severe consequences and in which many organizations have implemented confidential incident-reporting systems to encourage employees to provide feedback in an effort to improve work processes.

Our research demonstrates that information campaigns were associated with more frequent
speaking up and that campaigns and higher managerial engagement in process improvement were associated with more solutions offered. This suggests that managers’ actions can prompt employees to invest the additional effort to speak up and to do so more constructively by documenting actions taken and suggestions to improve work processes.

While finding that information campaigns and managerial engagement are each capable of encouraging employees to offer solutions, Figure 1 reveals that information campaigns were particularly effective in units with less managerial engagement. Specifically, employees in units with low managerial engagement were just as likely to offer solutions during information campaigns as were employees in units with high managerial engagement outside of campaigns. This suggests that organization-wide information campaigns can compensate for low unit-level managerial engagement.

**Contributions**

Our study extends the literature on the benefits of employee communication that supports process improvement. We distinguish offering solutions from other forms of speaking up that, while informative, do not recommend specific solutions to help managers improve work processes. Offering solutions is one of several types of information-sharing that involve alerting managers to front-line problems and previous research has tended to consider these behaviors jointly (e.g., Detert and Treviño 2010). However, compared to merely informing managers of problems, offering solutions is both more risky to employees and more beneficial to managers and to the organization. Researchers and managers should consider distinct strategies to encourage this particular behavior.

Our research identifies two strategies that increase employees’ speaking up and doing so constructively. In particular, the organizational information campaign is a management strategy that has garnered little attention in the management literature. While information campaigns are commonly used to activate particular behaviors among citizens in the public sphere, our research highlights their potential contribution as a management tool that can spur particular behaviors among employees.

Our finding that managers’ active engagement in problem solving makes it more likely that employees filing reports take the time to offer solutions is aligned with research on group efficacy
(Tucker 2007, Gibson 1999). For example, in her study of hospital work units, Tucker (2007) found that nurses and their managers reported that more problem-solving behavior occurred in those units where nurses believed it was worthwhile to bring problems to their manager’s attention. We build on this work by using an objective measure of managerial engagement to demonstrate that such activity can lead front-line workers to offer solutions. By drawing on objective data, our paper makes an important methodological contribution to the speaking up literature by overcoming concerns of bias associated with perceptual survey-based measures more commonly used in this literature (e.g., Detert and Burris 2007, Zhou and McGeorge 2001, LePine and Van Dyne 1998).

Our study is among the first to report the relative effectiveness of alternative managerial approaches to encouraging employees to speak up and reveals important interactions between these approaches. Specifically, we found that information campaigns provoked more solutions being offered by front-line workers whose managers were less routinely engaged in problem solving, whereas information campaigns appeared to have little impact on workers whose managers were already highly engaged in problem solving. This suggests that efforts at the organizational level can compensate for managers who cannot or do not create an environment that inspires front-line workers to speak up. Our research thus highlights substitution effects between the two managerial approaches. These findings complement prior studies that have identified important interactions among employee characteristics and their perceptions of their work climate (Detert and Burris 2007, Tangirala and Ramanujam 2008a, 2008b).

Our research also contributes to the literature that examines how managers at multiple levels can influence speaking up. Our results suggest that organizational-level information campaigns sponsored by senior management can leverage the influence of these skip-level leaders and offset the limited enthusiasm or prioritization of direct supervisors, creating conditions more favorable for employees to speak up. This finding contrasts with prior research highlighting ways in which the actions of skip-level leaders deterred speaking up (Detert and Treviño 2010) and complements the finding that positive leadership by direct supervisors offsets the negative effects of senior managers (Zohar and Luria 2005). In addition, our finding is consistent with prior research that shows that senior managers can encourage or
impede speaking up among employees (Dutten et al. 2002).

Our paper also extends the literature on process improvement by highlighting specific managerial strategies to cultivate front-line recommendations for solving problems and improving work processes. Much of this literature recognizes how valuable front-line workers can be as a resource for prioritizing problems and identifying feasible and effective ways to resolve them (e.g., MacDuffie 1997, Tucker and Edmondson 2003). This literature also suggests, however, that learning from front-line workers is difficult because information is local and groups often fail to reflect on their work (Edmondson 2002). Process-improvement strategies emanating from Japan have highlighted the need for managers to observe problems on the front lines (Imai 1996) and have recommended specific strategies, such as Toyota’s andon cord, which enable workers to signal problems and stop production until countermeasures can be applied (Spear and Bowen 1999). However, such strategies have met resistance outside of Japan due to the way they shift power from managers to workers and to the cultural change this requires (Young 1992). In contrast, information campaigns and managerial engagement leverage front-line worker knowledge to improve processes without disrupting traditional hierarchical status relationships.

**Limitations and Further Research**

We acknowledge a number of limitations to our study. Many scholars have described how organizational culture affects incident reporting (Waring 2005), dedication to quality improvement (Carman et al. 1996), and safety outcomes (McFadden, Henagan, and Gowen 2009, Singer et al. 2009, Vogus and Sutcliffe 2007). Similarly, others have found that an employee’s willingness to speak up can be influenced by individual characteristics such as his or her level of job satisfaction (Rusbult et al. 1988) and by the interactions between individual traits and such team characteristics as group size and self-management (Blatt et al. 2006, LePine and Van Dyne 1998, Tangirala and Ramanujam 2008a, 2008b). Prior research on the effectiveness of public information campaigns also suggests that individuals who have incentives, who have the ability to change their behavior, and who are motivated by the message of the campaign are especially likely to respond (e.g., Mendelsohn 1973, Vedung 1999). While our single hospital context enabled us to control for organization-level culture and our measure of managerial
engagement and fixed effects enabled us to control for some cultural aspects at the hospital-unit level, we acknowledge that other time-variant unit-level factors, as well as individual employee characteristics, could also influence the frequency with which individuals report incidents and offer solutions (Edmondson 2004, Naveh et al. 2005) or engage in process improvement (Tucker, Nembhard, and Edmondson 2007). While confidentiality restrictions prevented us from accessing other measures of unit-level culture, future research could examine how organizational culture affects problem solving in response to reported incidents across several organizations as well as within different units of the same organization.

Another potential limitation of our study is our exclusive reliance on the organization’s incident-reporting system to measure both managerial engagement in process improvement and the likelihood of employees to offer solutions to problems they confront. We acknowledge that some employees and managers in our focal organization might also work together to improve work processes through informal discussions (Frankel et al. 2008, Tucker and Singer 2009, Zohar 2002), although this potential threat to validity would be attenuated by the extent to which these alternative mechanisms are positively correlated with those we observe in our dataset. We encourage future researchers to examine both formal processes such as incident-reporting systems and informal interactions among employees and managers in order to construct a more comprehensive understanding of effective managerial approaches to improving work practices. Future research could also examine potential interactions between our two management approaches—managerial engagement and information campaigns—and other approaches that have been shown to encourage employee suggestions, including strong social pressure, mandatory quotas of suggestions, and rewards (Young 1992).

Another potential limitation derives from the fact that our focal hospital does not track, nor could we obtain in any other way, the number of incidents that actually occurred. We could only analyze the incidents that were reported. This discrepancy could affect the interpretation of our count models (Table 2), which implicitly rely on the assumption that the hospital did not experience heightened rates of unreported incidents during information campaigns or within units exhibiting higher levels of managerial
engagement in process improvement. While neither we nor the focal hospital’s patient-safety team see
any theoretical or practical reason to question this assumption, we nonetheless highlight that it underpins
our interpretations.

While our analysis lags managerial engagement to overcome concerns of reverse causality, we
nonetheless acknowledge that the level of engagement a manager exhibits is a choice about which we do
not hypothesize or model. Future research could develop simultaneous models to explore whether—and,
if so, how—employee behaviors and managerial engagement simultaneously affect one another. Future
research could also leverage relatively exogenous personnel changes (e.g., when a manager takes
maternity leave) to more clearly identify the effects of changes in managerial engagement on speaking up,
an approach we were unable to pursue due to anonymity requirements associated with our data. In
addition, the information campaigns in our context not only increased awareness of the importance of
patient safety but also provided small incentives (e.g., cafeteria credit) to staff who filed incident reports.
As such, it is possible that staff were motivated to speak up by these incentives offered during the one-
week campaign. In our regressions that predict the number of incident reports, we were unable to tease
apart these motivations, but we encourage future research to do so, perhaps through field experiments that
vary such characteristics of information campaigns. There is, however, no reason to believe that these
incentives confounded our results on solutions offered because the incentives targeted the frequency but
not the content of incident reports.

While our findings suggest that a limited, episodic, but organization-wide information campaign
can effectively encourage speaking up and offering solutions, our empirical context did not enable us to
determine the most effective frequency and duration for an organizational information campaign. Prior
research suggests that public information campaigns benefit from novelty, saturation, and endurance (Flay
1987). If novelty drives salience and, therefore, action, effectiveness might diminish if organizational
information campaigns are run too long or repeated too often. Further research is required to understand
how campaign length and frequency affect salience as well as the conditions under which campaigns
promote temporary versus enduring increases in speaking up and in doing so constructively.
Our research sheds light on how two key managerial approaches affect speaking up within the health-care industry, one of the largest and fastest-growing industries (U.S. Bureau of Labor Statistics 2010) and one that faces serious process-improvement challenges (Kohn et al. 2000). However, while major hospitals and academic medical centers, being highly complex institutions, are often compared to industries such as aviation that also demand highly reliable results from very complex activities (Gaba 2000, Singer et al. 2010), it remains unclear to what extent our findings, based on a nonprofit organization in the health-care industry, are generalizable to for-profit companies in other sectors. We suspect that the substitution effect between managerial approaches is particularly relevant to environments facing high production pressure in which employees would be challenged to make time to speak up and offer solutions.

Future research could integrate our focus on the determinants of offering solutions through incident-reporting systems with the literature that explores underreporting in such systems. Among the many reasons why employees report only a subset of incidents is a perception that little would come of such reports (Gandhi et al. 2005). Similarly, front-line workers have stated that more evidence linking incident reports to system changes would increase their likelihood of reporting incidents (Taylor et al. 2004, Evans et al. 2006). Future research could examine whether more transparency in the managerial actions following incident reports would encourage employees to engage in more incident reporting.

Although we explored two strategies associated with increasing employees’ willingness to offer solutions, we did not determine whether the organization we studied actually learned from the concerns and suggestions shared by employees and we did not assess the effectiveness of the organization’s responses. Future research should assess the extent to which the solutions employees offer actually result in reductions in operational problems and, if so, the precise mechanisms through which this occurs. A better understanding of the determinants and outcomes of incident reporting would be relevant well beyond the health-care sector, given that “schemes for reporting near misses, ‘close calls,’ or sentinel (‘warning’) events have [also] been institutionalised in aviation, nuclear power technology, petrochemical processing, steel production, military operations, and air transportation” (Barach and Small 2000: 759).
CONCLUSION

This study is among the first to develop and empirically test theory about how specific management practices can encourage employees to speak up about operational problems they witness. Our findings provide evidence that (a) employees speak up more often and offer more solutions when managers promote this behavior through information campaigns and through their own engagement in problem-solving activities and (b) these managerial behaviors may be considered substitutes. By identifying specific managerial behaviors, this study empowers managers to adjust their approaches to engaging workers in problem solving, which in turn can provide them with new sources of information about opportunities to improve work systems. In organizations that can learn from mistakes, this information can spark a virtuous cycle of performance improvement.
REFERENCES


Nembhard, I. M., A. C. Edmondson. 2006. Making it safe: The effects of leader inclusiveness and


Vogus, T. J., K. M. Sutcliffe. 2007. The impact of safety organizing, trusted leadership, and care pathways on reported medication errors in hospital nursing units. Medical Care 45(10) 997–1002.


Figure 1.
Average Predicted Number of Incident Reports with Solutions Offered, Per Hospital-Unit-Month

This figure displays the average predicted monthly number of incident reports offering solutions within each hospital unit in our sample, based on results of a fixed effects Poisson estimation of Model 4 in Table 2.
Table 1.
Sample Description

Panel A. Summary statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of incident reports per hospital-unit-month</td>
<td>1.44</td>
<td>4.38</td>
<td>0</td>
<td>78</td>
</tr>
<tr>
<td>Number of incident reports that offered a solution per hospital-unit-month</td>
<td>0.31</td>
<td>1.32</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td>Information campaign (dummy)</td>
<td>0.17</td>
<td>0.38</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Managerial engagement in process improvement</td>
<td>0.19</td>
<td>0.28</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Panel B. Correlations

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.59</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.01</td>
<td>0.03</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.01</td>
<td>-0.02</td>
<td>-0.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Note: N=7,379 hospital-unit-month observations (from 157 hospital units over 47 months), except for managerial engagement in process improvement, for which N=4,488 due to missing values.
Table 2.
Regression Results Predicting the Prevalence of Employees’ Speaking Up and Offering Solutions

<table>
<thead>
<tr>
<th>Model</th>
<th>Speaking Up</th>
<th>Offering Solutions</th>
<th>Speaking Up</th>
<th>Offering Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of incident reports</td>
<td>Number of incident reports with solutions</td>
<td>Number of incident reports</td>
<td>Number of incident reports with solutions</td>
</tr>
<tr>
<td></td>
<td>Coefficient</td>
<td>IRR</td>
<td>Coefficient</td>
<td>IRR</td>
</tr>
<tr>
<td>Information campaign</td>
<td>0.120***</td>
<td>1.13</td>
<td>0.301***</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td>[0.031]</td>
<td></td>
<td>[0.056]</td>
<td></td>
</tr>
<tr>
<td>Managerial engagement in process improvement</td>
<td>-0.099</td>
<td>0.91</td>
<td>0.482*</td>
<td>1.62</td>
</tr>
<tr>
<td></td>
<td>[0.187]</td>
<td></td>
<td>[0.272]</td>
<td></td>
</tr>
<tr>
<td>Managerial engagement in process improvement X Information campaign</td>
<td>0.139</td>
<td>1.03</td>
<td>0.139</td>
<td>1.03</td>
</tr>
<tr>
<td></td>
<td>[0.126]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations (hospital-unit-months)</td>
<td>7,379</td>
<td>5,311</td>
<td>7,379</td>
<td>5,311</td>
</tr>
<tr>
<td>Hospital units</td>
<td>157</td>
<td>113</td>
<td>157</td>
<td>113</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-7,075</td>
<td>-2,909</td>
<td>-7,074</td>
<td>-2,907</td>
</tr>
<tr>
<td>Model Wald Chi-squared</td>
<td>43.28***</td>
<td>557.9***</td>
<td>53.44***</td>
<td>573.1***</td>
</tr>
</tbody>
</table>

This table reports coefficients and incident rate ratios (IRR) from conditional fixed-effects quasi-maximum likelihood Poisson regressions. Brackets contain robust standard errors; *** p<0.01, ** p<0.05, * p<0.10. The unit of analysis is the hospital-unit-month. All models include a dummy variable (managerial engagement undetermined) designating hospital units with no reported incidents in the previous year and therefore no opportunity for managerial engagement in process improvement to be assessed. The estimates in Models 2 and 4 are based on fewer observations because the conditional fixed-effects Poisson model drops hospital units (groups) that lacked variation in the number of incident reports with solutions.
APPENDIX

This Appendix describes an alternative model that serves as a robustness test for our primary model that estimated the frequency of solutions offered (Table 2, Model 2). This model estimates the likelihood that solutions are offered conditional on an incident report being filed.

Empirical Model

We are interested in exploring whether information campaigns and managerial engagement in process improvement increase the likelihood of employees offering solutions as part of their incident reports. We estimated the following model with the individual incident report as the unit of analysis:

$$Offering\ Solutions_{ijt} = F(InfoCamp_t, MgrEng_{jt-1}, Harm_i, Equipment_i, Type_i, Month_t, Year_t, Unit_j)$$

where $F(\cdot)$ is the logit function. This model estimates the likelihood of an employee offering a solution when reporting incident $i$ in hospital unit $j$ on date $t$ as a function of (a) whether or not the incident occurred during a hospital-wide information campaign ($InfoCamp_t$) and (b) the level of managerial engagement in process improvement in the previous year in the hospital unit in which the incident occurred ($MgrEng_{jt-1}$). These independent variables are identical to those in the primary analysis.

Because this model is at the incident-report level, we can control for additional factors that can influence the likelihood of employees offering solutions in their incident reports. We control for actual or potential patient harm as a result of the incident ($Harm_i$) by including dummy variables denoting (a) liability risk due to a patient being involved in the incident, (b) whether the incident involved obstetrics, and (c) whether the incident occurred in a patient or clinical area. We also include a series of dummies indicating whether the incident caused no patient harm, temporary patient harm, permanent patient harm, or patient death. We also include a dummy indicating whether equipment was involved ($Equipment_i$) and a full series of dummies indicating whether the incident type ($Type_i$) was related to blood or blood products; identification, documentation, or consent; lab specimen or test; or a surgery or procedure. The “Measures” section below provides more detail on these measures.

We also control for the month in which the incident occurred by including a full set of month
dummies ($Month_t$) because discussions with our hospital contacts revealed that responses to incidents varied by month. For example, our contacts perceived lower levels of responsiveness during holiday months in the summer (July and August) and winter (December), when many employees take their vacation time. We control for the year in which the incident occurred by including a full set of year dummies ($Year_t$) for reasons described above. Finally, we include (conditional) fixed effects at the hospital-unit level ($Unit_j$) to control for unit-specific time-invariant factors, such as the unit’s activities and profitability (Horwitz 2005), that might affect the propensity for offering solutions in an incident report.

**Measures**

**Solution Offered in Incident Report.** We created *solution offered in incident report* as a dichotomous variable, coded “1” when an incident report documented any actions taken by staff recorded in the structured list within the incident report or any suggestions for avoiding similar incidents and “0” otherwise. Our preliminary review of the free-text field intended for suggestions identified several instances where it contained other information (e.g., incident descriptions) but not suggestions. To avoid miscoding those reports as containing suggestions, one author reviewed every report’s suggestion field to identify those instances in which the employee suggestion was clear.

**Patient Harm.** Not all incident reports involve harm or potential harm to patients and some describe concerns rather than actual incidents. For example, some reported incidents involve wheelchair transportation taking so long that nurses have to make several calls, or procedural errors such as excess blood units being wasted because they were not returned promptly to the blood bank. However, incidents that either did or could have resulted in patient harm carry the risk of malpractice lawsuits (Kessler and McClellan 1996). Not only do incidents that directly involve patients run a greater risk of legal liability, but they are also particularly likely to conflict with a hospital’s mission of providing high-quality patient care. We created several measures to identify incidents that either harmed or could have harmed patients because these types of incidents might lead employees to be especially willing to offer solutions. We created *patient involved* as a dichotomous variable, coded “1” if the incident reporter populated the
“patient age” field, noted in the “severity” field that patient harm had occurred, noted that the incident involved a fall, or reported that the patient was in pain; and “0” otherwise. We also created patient or clinical area as a dichotomous variable, coded “1” when an incident occurred in a unit, patient room, or treatment area, and “0” when it occurred elsewhere (e.g., in a public area such as a hallway or cafeteria).

To capture varying levels of patient harm, we created four dichotomous variables pulled directly from fields in the incident report: patient death, permanent patient harm, temporary patient harm, and low severity, the latter referring to near misses and incidents that did not result in patient harm. Finally, we identified incidents associated with obstetrics because malpractice claims are especially likely in this practice area (Kim 2007, Rodwin et al. 2008, Studdert et al. 2006). We created obstetrics as a dichotomous variable, coded “1” for incidents that took place in the obstetrics ward, the nursery, or a neonatal intensive care unit (NICU); incidents for which the patient was admitted for newborn, newborn specialty, or obstetrics care; incidents involving a patient less than one month old; and incidents classified as maternal/childbirth; and “0” otherwise.

Equipment. Incidents involving equipment may influence the extent to which employees offer solutions because they may not be in a position to repair or replace the equipment. We created equipment as a dichotomous variable, coded “1” when the incident reporter indicated that equipment was involved and “0” otherwise.

Summary statistics and correlations of these variables are provided in Table A-1.

Results

We used conditional fixed-effects logistic regression to estimate this model that predicts the likelihood that a particular incident report will offer solutions, a dichotomous variable.\textsuperscript{5} Results are reported as coefficients and odds ratios (OR) in Table A-2. The results indicate that incident reports filed during and shortly after an information campaign were significantly more likely to include solutions than incident reports filed at other times (\( \hat{\beta}=0.55, p<0.01, \text{OR}=1.7 \)), which bolsters support for Hypothesis 2.

\textsuperscript{5} This conditional fixed-effects logistic regression model failed to converge until we reassigned a random half of the observations in the most populous location code to a new location code. To ensure this particular reassignment was not driving our results, we replicated this process 100 times for each model; the results were nearly identical.
The average marginal effect reveals that information campaigns increase the probability that an incident report would offer solutions by 7.4 percentage points, a substantial increase beyond the average probability of 30.6% within the sample. Together, these results and our main results indicate that information campaigns increased speaking up (the number of incident reports), the number of solutions offered, and the likelihood of particular incident reports offering solutions.

Incident reports filed by employees in hospital units with greater managerial engagement were significantly more likely to offer solutions (β=0.92, p<0.01, OR=2.5), which bolsters support for Hypothesis 3. Based on the average marginal effect (0.12), a one-standard-deviation increase in managerial engagement (SD=0.26) is associated with a 3.1-percentage-point increase in the likelihood that an incident report will offer solutions, a 10% increase beyond the mean likelihood of 30.6%. These results suggest that employees who work for more engaged managers file particularly constructive incident reports compared to those who work for less engaged managers.
Table A-1.
Sample Description for Incident Report Level Analysis

Panel A. Summary statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution offered in incident report</td>
<td>0.31</td>
<td>0.46</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Information campaign</td>
<td>0.22</td>
<td>0.41</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Managerial engagement in process improvement</td>
<td>0.21</td>
<td>0.26</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Harm – patient present</td>
<td>0.89</td>
<td>0.31</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Harm – patient or clinical area</td>
<td>0.11</td>
<td>0.31</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Harm – temporary</td>
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</tr>
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Panel B. Correlations

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Panel C. Frequency of Incident Types in Sample

<table>
<thead>
<tr>
<th>Incident type</th>
<th>Percent of incidents of this type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood/blood product</td>
<td>46%</td>
</tr>
<tr>
<td>ID/documentation/consent</td>
<td>11%</td>
</tr>
<tr>
<td>Lab specimen/test</td>
<td>28%</td>
</tr>
<tr>
<td>Surgery/procedure</td>
<td>14%</td>
</tr>
</tbody>
</table>

Notes: N=7,407 incident reports (all Panels). All except managerial engagement in process improvement are dummy variables.
Table A-2.
Regression Results Predicting the Likelihood of Employees to Offer Solutions within Incident Reports

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Solution offered in incident report</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
</tr>
<tr>
<td>Information campaign</td>
<td>0.546***</td>
</tr>
<tr>
<td></td>
<td>[0.154]</td>
</tr>
<tr>
<td>Managerial engagement in process improvement</td>
<td>0.915***</td>
</tr>
<tr>
<td></td>
<td>[0.301]</td>
</tr>
<tr>
<td>Harm - patient present</td>
<td>0.288***</td>
</tr>
<tr>
<td></td>
<td>[0.112]</td>
</tr>
<tr>
<td>Harm - patient or clinical area</td>
<td>0.497**</td>
</tr>
<tr>
<td></td>
<td>[0.243]</td>
</tr>
<tr>
<td>Harm – temporary</td>
<td>1.264***</td>
</tr>
<tr>
<td></td>
<td>[0.175]</td>
</tr>
<tr>
<td>Harm – permanent</td>
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<td>Harm – death</td>
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<td>[1.243]</td>
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<td>Harm – obstetrics</td>
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<td>[0.321]</td>
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<td>0.519***</td>
</tr>
<tr>
<td></td>
<td>[0.170]</td>
</tr>
<tr>
<td>Conditional fixed effects for hospital units</td>
<td>Included</td>
</tr>
<tr>
<td>Incident-type fixed effects</td>
<td>Included</td>
</tr>
<tr>
<td>Month fixed effects</td>
<td>Included</td>
</tr>
<tr>
<td>Observations (incident reports)</td>
<td>7,341</td>
</tr>
<tr>
<td>Hospital units</td>
<td>101</td>
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<tr>
<td>Log likelihood</td>
<td>-2,619</td>
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<tr>
<td>Model Wald Chi-squared</td>
<td>3,122***</td>
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<tr>
<td>McFadden’s R-squared</td>
<td>0.37</td>
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</tbody>
</table>

This table displays results of a conditional fixed-effects logistic regression model. Brackets contain standard errors; *** p<0.01, ** p<0.05, * p<0.10. The unit of analysis is the incident report. This model also includes a dummy variable (managerial engagement undetermined) designating incidents that took place in units with no reported incidents in the previous year and therefore no opportunities for managerial engagement in process improvement to be assessed. The model also includes a dummy variable (area unreported) designating incident reports that did not indicate where the incident occurred. This conditional fixed-effects logistic model dropped 32 hospital units (groups), representing 66 incident reports (observations), because these units lacked outcome variation (e.g., no reports offered solutions during our sample period).