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SAFETY CLIMATE IN HEALTH CARE ORGANIZATIONS: A MULTIDIMENSIONAL APPROACH

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Treatment errors are a major problem in the health care industry. This study explored four dimensions of safety climate and the interactions among them as predictors of treatment errors. A total of 632 participants in 46 hospital units assessed their units' safety climate. Results demonstrated a curvilinear relationship between the levels of the perceived detailing of safety procedures and the number of treatment errors. Also, the perceived priority of safety moderated the curvilinear relationship between safety procedures and treatment errors as well as the relationship between the way employees interpreted their managers' safety practices and treatment errors.

The critical issues of patient safety and medical treatment errors have received a great deal of attention lately (Davis, 2004; Kohn, Corrigan, & Donaldson, 1999). Policy makers, caregivers, health care administrators, and researchers have generally agreed that medical treatment errors in the health care industry pose a serious problem (Chassin, Galvin, & the National Roundtable on Healthcare Quality, 1998; Leape, 2002). This problem has gone relatively unexplored from the perspective of organizational behavior.

Safety in organizations, in general, is defined as freedom from accidental injury (Perrow, 1984; Roberts, 1990) and is related to the safety of employees and other organizational stakeholders such as the organization's customers. In the health care industry, patients are the customers, and patient safety refers to the avoidance, prevention, and amelioration of adverse outcomes or injuries stemming from the processes of health care. These adverse outcomes include errors and accidents caused by medical actions (in contrast to disease complications), events that result from equipment failure, failure to complete a planned action as intended (e.g., surgical events, events involving devices, patient protection, and care), or the use of the wrong plan to achieve an aim (Gaba, 2000; Leape, 2002).

Traditionally, to ensure safety performance organizations have responded with safety rules and procedures. The premise has been that, to ensure safety and avoid the costs of adverse events, organizations should invest in the implementation of formal safety programs and risk management systems (Brunsson Jacobsson et al., 2000; Roberts, 1990). Research findings have been unable to determine decisively the extent to which these formal organizational efforts have indeed led to safety improvement (Leape, 2002). Only recently have researchers suggested that informal aspects of the work environment may also be factors that affect safety in the health care industry (Kohn, Corrigan, & Donaldson, 1999).

One such informal aspect is safety climate, which is considered a key organizational variable for understanding an organization's safety performance (e.g., Hofmann & Stetzer, 1998; Zohar, 2000). Traditionally, safety climate has been studied in industries such as steel factories (Brown, Willis, & Prussia, 2000; Zohar, 2002), offshore environments (Mearns, Whitaker, & Flin, 2003), and highly regulated environments such as the nuclear industry (Harvey, Erdos, Bolman, Cox, Kennedy, & Gregory, 2002). However, the concept of safety climate in the health care industry requires further research, since the health care sector has several unique characteristics that differentiate it from the above industries. First, in health care, the results of a safe environment directly affect not only an organization's staff members but also its customers—that is, the patients. Studies on safety climate have concentrated mainly on employee safety. Indeed, Burke and Sarpy emphasized that "the conceptualization and measurement of safety climate should be expanded to include not only how characteristics of the work environment affect the personal well-being of workers, but also how characteristics of the work environment affect the well-being of other relevant stakeholder groups . . . [such] as clients" (2003: 81). Second, the health care environment is very complex in terms of task characteristics, since each patient is unique. In this context, strict adherence to safety polices and procedures can only partially ensure good safety performance, because uncertainty is high, and proper patient care necessitates flexibility and constant decision making. In uncertain situations, formal polices and procedures that should ensure safe employee behavior cannot encompass all possible daily work situations (Gittell, 2002). Third, in a health care setting, employee (safety) behavior is controlled not only by the organization but also by the health care professions (physicians and nurses). Professions define social reality by creating principles and guidelines for action (Scott & Backman, 1990).

The aim of the present study was to apply a multidimensional approach to safety climate to understand the safety performance of health care organizations, as expressed in the occurrence of treatment errors.

SAFETY CLIMATE DIMENSIONS AS PREDICTORS OF SAFETY PERFORMANCE

Climate is defined as "the shared perceptions of the employees concerning the practices, procedures, and the kind of behaviors that get rewarded, supported, and expected in a setting" (Schneider, 1990: 384). Given that multiple climates often exist simultaneously within a single organization, climate is best regarded as a specific construct having a referent—that is, a climate is a climate *for* something, such as a climate for service, for innovation, or for safety (Schneider, White, & Paul, 1998). In addition, different units within the organization may have different levels of a specific climate as a result of characteristics of their work, interactions, work conditions, or managerial behaviors (Zohar, 2002).

Dimensions of Safety Climate

Safety climate is a multidimensional construct that encompasses individual perceptions of a wide range of safety aspects in a work environment (Ashkanasy, Wilderom, & Peterson, 2000; James, James, & Ashe, 1990). Two dimensions of safety climate that are commonly identified in the literature are employees' perceptions of the safety practices of their immediate supervisor, and employees' perceptions of the general priority assigned within their organizational unit to the issue of safety (e.g., Hofmann & Stetzer, 1998; Zohar, 2002). We suggest two additional dimensions that are based on the way employees perceive two main initiatives that organizations commonly take in order to improve safety performance. These initiatives are the implementation of formal safety procedures and the dissemination of information about safety to employees (Naveh, Katz-Navon, & Stern, 2005; OHSAS 18001, 1999). We now elaborate each of these four dimensions and hypothesize about their relationships with safety performance.

Dimension 1: Safety procedures. Safety procedures as a dimension of safety climate refer to employees' shared perceptions of the level of detail in an organization's safety procedures. Procedures' level of detail refers to the extent to which employees perceive the volume and detail of procedures to be extensive, and whether procedures relate to all work issues. Formal safety procedures are explicit statements issued by an organization, but the shared perceptions of these formal procedures may vary across organizational units.

Formal safety procedures are one element of an organization's structure, and they define particular ways of conducting organizational functions (Argote & Ingram, 2000). Organizations rely heavily on formal procedures that strictly control the sequence of steps that should be taken for the safe completion of tasks (Brunsson et al., 2000). Studies have suggested a positive linear relationship between the use of formal procedures and an organization's performance (Hickson, Pugh, & Pheysey, 1969). Nevertheless, although organizations implement safety procedures, findings regarding the extent to which such implementation leads to safety improvement have been inconsistent (Leape, 2002).

Possible explanations for these inconsistent results rest, first, on the assumption that the relationship between safety procedures and safety performance is linear. Second, the above studies may have neglected the informal aspect of procedures. A common reaction of organizations to hazardous events is to add more formal safety procedures, assuming that these additions will guide employee behavior and thus improve safety performance. However, Sitkin and Roth (1993) and Cropanzano and Byrne claimed that many procedures could impair organizational performance because "[compliance] becomes more and more difficult even for a well-meaning firm" (2001: 38). This claim is consistent with Brown and Eisenhardt's (1997) suggestion of a curvilinear relationship between an organization's level of formal structure and its performance. They argued that organizations need to balance between too much and too little structure. Too much structure and a system will be too rigid to move; too little structure, and it "will fly chaotically apart" (Brown & Eisenhardt, 1997: 34). Extrapolating from this idea, we propose that the relationship between employees' perception of safety procedures and safety performance is also curvilinear.

The literature on the effect of safety procedures on safety performance rarely takes into account employees' perception of procedures. Adler and Borys (1996) suggested that employees perceive formal rules and procedures as either good or bad. Employees perceive formal safety procedures as good if these procedures are applicable on a daily basis, enabling them to master the task at hand. On the other hand, employees perceive procedures as bad if they perceive the procedures as too numerous or too few. Employees may perceive many or excessively detailed procedures as interfering with the daily flow of work, as a bureaucracy that complicates their jobs, and as a burden that demands investment of time and excessive human resources. Particularly in uncertain environments such as hospitals, very detailed or very numerous procedures may be perceived as inhibiting employee discretion in situations that require immediate adaptation to changing conditions (Cropanzano & Byrne, 2001). Too few or scantily detailed procedures may be perceived as insufficient, as not encompassing all possible work situations, and thus, as providing inadequate guidelines on how to behave or how to maintain safety.

Hence, we suggest a curvilinear relationship between perceived safety procedures and unit safety performance. Members of different units might perceive the same procedures as ranging between the two poles of few to many details, with an optimal intermediate level of detail. At this perceived optimal level, safety performance would peak, because employees can use the procedures daily and yet not resent a high degree of imposed structure (Adler & Boris, 1996). We thus hypothesize the following:

Hypothesis 1. The relationship between the perceived level of detail of safety procedures and a unit's safety performance is curvilinear (inverse U-shaped), with the best safety performance occurring at intermediate levels of perceived detail.

Dimension 2: Safety information flow. The second dimension of safety climate refers to how employees perceive the amount of information they receive through routine circulation of safety information and training. The formal flow of safety information within an organization deals with delivery of several types of information to the employees, such as information about unusual events and potential hazardous conditions, and safety training sessions (OHSAS 18001, 1999). The dissemination of safety information to employees constitutes an organization's planned effort to improve employees' current and future safety performance by increasing their capabilities for and redirecting their attention toward safety (Baldridge, 2003; Ford, Salas, Kozlowski, Kraiger, & Teachout, 1994).

The implicit assumption within organizations is that more safety information is needed and that the increase should lead to better safety performance (Baldridge, 2003; OHSAS 18001, 1999). Thus, customarily, to improve safety performance, organizations have sought to increase the flow of safety information. Recently, researchers (e.g., Marcus & Nichols, 1999) have even suggested that organizations should pay specific attention to safety warnings, since many accidents could have been avoided had they noticed the warnings.

Organizational units may vary in the degree to which they perceive the safety information flow to be available. On the one hand, units may perceive that they are exposed to a large amount of safety information, resulting in information overload (O'Reilly, 1980). A ceaseless barrage of information may be beyond a unit's capacity to process, causing stress and confusion, the upshot of which may be an inability to differentiate between what is and what is not critical for safety processes and results (O'Reilly, 1980). Information overload can affect safety performance negatively; however, the importance of this phenomenon has rarely been investigated. On the other hand, insufficient exposure to safety information, or information underload (O'Reilly, 1980), may also cause deficient safety performance, since employees are not aware of what is required of them in terms of safety. At the intermediate level of safety information flow, safety information is available and accessible to an optimal degree. Thus, we suggest a curvilinear relationship between the flow level of safety information and a unit's safety performance, as expressed by the following hypothesis:

Hypothesis 2. The relationship between the perceived level of safety information flow and a unit's safety performance is curvilinear (inverse U-shaped), with the best safety performance occurring at an intermediate level of safety information flow.

Dimension 3: Perceived managerial safety practices. The third dimension refers to employees' perception of their supervisors' safety-related activities and methods (Flin, Mearns, O'Connor, & Bryden, 2000; Zohar, 2002). Managerial practices express to employees the extent to which their supervisor is committed to safety. Supervisors set the tone and tempo for safety by, for example, emphasizing specific safety behaviors while overlooking others. In units where employees work for a supervisor who is committed to safety, this dimension of safety climate is high (Cheyne, Cox, Oliver, & Thomas, 1998; Hofmann & Stetzer, 1998). Several studies have pointed to the positive impact on safety performance of supervisor safety practices that emphasize safety (Barling, Loughlin, & Kelloway, 2002; Thompson, Hilton, & Witt, 1998; Zohar, 2002). Manager safety practices that promoted and emphasized the importance of safety-oriented behavior led to high safety performance. Conversely, managerial practices that were perceived by employees as undermining organizational safety policies or that sent a message that safety could be ignored without consequences led to low safety performance. Therefore, we assert the following:

Hypothesis 3. Perceived managerial safety practices and a unit's safety performance are positively associated.

Dimension 4: The priority of safety. The fourth dimension of safety climate is the degree of priority assigned to safety within an organizational unit. It refers to employee expectations and daily behaviors regarding the balance maintained among work pace, workload, and pressures for productivity and safety (Zohar, 2000). Working in a safe manner often entails working at a slower pace, investing extra effort, or operating under less comfortable conditions. Consequently, whenever work pressure increases, employees use a complex system of considerations to set the relative priorities for safety versus speed or productivity. Most employees first seek information concerning the type of activities their organization rewards. They may obtain this information directly from the organization's evaluation and reward systems or by determining whether safety is part of the goal-setting and feedback systems. Once the required behavior is clarified, employees aim to adjust their behavior so as to be rewarded. However, many reward systems mistakenly reward the behaviors that they try to discourage (Kerr, 1975). Many organizations intend to emphasize safety yet at the same time reward employees only for speed and productivity. In addition, particularly in health care, the profession of staff members (physicians and nurses) also guides their behaviors and helps them set their priorities. Their professional expertise and autonomy, their belief that their profession is regulated by its members, and their belief in the importance of the service their profession provides determine their safety priorities (Scott & Backman, 1990). For example, a physician may decide that a patient's medical situation demands an immediate medical operation and, thus, may not completely follow the patient identification procedure that has to take place before this operation.

The perceptions of the priority of safety may vary in different organizational units as a result of their diverse activities and group dynamics. A high safety priority within a unit means that safety is considered an important issue that must be given precedence regardless of other competing demands, such as work speed and productivity. A high priority of safety can potentially motivate employees to take greater ownership of, and responsibility for, safety. This, in turn, is likely to influence employees' tendency to behave safely. A low safety priority denotes that safety-related policies and procedures are perceived only as rhetoric or as a pretense and that they can be inadequately followed or even ignored without consequences (Falbruch & Wilpert, 1999).

Previous studies have indicated that the dimensions of safety climate have an additive effect on safety performance (Flin et al., 2000). Some studies have focused only on safety priority and its relationship with safety performance (Hofmann & Stetzer, 1998; Zohar & Luria, 2004). The relationships among the dimensions in their influence on safety performance have hardly been tested.

Several studies specifically on safety and leadership have pointed to the possibility that priority of safety could have a moderating role. For example, studying the relationships between leadership styles and safety performance, Zohar (2003) and Hofmann, Morgeson, and Gerras (2003) found that safety priority moderated this relationship in such a way that different leadership styles affected safety performance differently, depending on the extent to which safety was considered a priority. They argued that safety priority indicated the direction employee behavior would take. In ambiguous situations, the priorities signal to employees the expected safety behavior. Thus, in view of the moderating role the above mentioned research found for safety priority, we suggest that safety priority moderates the relationships between each of the other three climate dimensions and safety performance. In addition to the additive effect of the dimensions of safety climate on safety performance, we expect to find that safety priority functions as a variable that supports the full realization of the other three climate dimensions.

Priority of Safety as a Moderator

Safety procedures and safety priority. Baer and Frese (2003) found that climate could either encourage or discourage the implementation of new formal procedures representing change attempts. In particular, new procedures led to better organizational performance when an organization had a more supportive climate for change (as opposed to a less supportive climate). A supportive climate for change referred to the priority given to change within an organization in relation to other organizational activities. They explained that the implementation of new procedures requires an effort and potentially causes problems, and a climate supportive of change assists with coping with these difficulties. Similarly, we suggest that, in the context of safety, safety priority can encourage or discourage the use of safety procedures, whether they are perceived as insufficiently, optimally, or overly detailed. Specifically, we expect that the perceived optimal level of detailing of safety procedures, combined with a high priority of safety, will be associated with high safety performance.

Employees may perceive procedures as good or as optimally detailed; nevertheless, they may be less likely to follow these procedures if the safety priority is low in their unit. Moreover, to follow procedures, employees need resources such as time and additional human resources. When safety is a low priority within a unit, employees may also conclude that the use of (limited) resources for the purpose of following procedures is not one of the goals that the unit rewards. For example, hospitals have strict, formal procedures for blood transfusions. A unit's personnel may perceive this blood transfusion procedure to be a good procedure and thus be disposed to follow it. However, they may choose not to do so because following this procedure slows down the work pace and they perceive that meeting productivity goals has a higher priority within the unit than safety goals.

On the other hand, employees may perceive procedures as either overly or insufficiently detailed. Whichever is the case, the use of the procedures should be associated with better safety performance when safety is a high priority than when safety is a low priority. The supportive climate for safety that would help employees cope with the difficulties that bad procedures involve explains this association (Baer & Frese, 2003). Thus, we hypothesize that the curvilinear relationship between the level of detail of safety procedures and safety performance depends upon the level of priority of safety:

Hypothesis 4a. Safety priority moderates the curvilinear relationship between safety procedures and safety performance in such a way that an intermediate level of detail of safety procedures is associated with higher safety performance when the priority of safety is high rather than low.

Safety information flow and safety priority. Smith-Crowe, Burke, and Landis (2003) found that a climate for the transfer of safety training moderated the relationship between the knowledge and information about safety that employees received during training and their safety performance. The researchers defined a climate for the transfer of training as the perceived degree of prioritization of safety training and its value within an organization. The relationship between safety information and safety performance was stronger when training was perceived as having a high rather than low priority. Thus, in regard to our dimension of safety information flow, safety priority can encourage or discourage the application of safety information that employees receive. Specifically, regarding the curvilinear relationship we suggested between safety information flow and safety performance, the combination of an optimal level of perceived safety information and a high priority of safety should be associated with the highest safety performance. When safety is considered a high priority in a unit, individuals aim to do their jobs in a safe manner, by using the information they have received about safety. When safety is perceived as a low priority—that is, the unit rewards behavior other than safety behavior—employees will be less likely to apply the safety information they received, even if they perceive information flow as optimal.

When employees perceive the information flow in their unit as either insufficient or overloaded yet also see that safety is a high priority, their safety performance will be better than if safety were given a low priority. Assigning safety a high priority encourages employees to cope with problems of too little/too much safety information, because the additional coping efforts are rewarded within the unit (Baer & Frese, 2003). Coping with these problems means, for example, asking for more information when there is not enough or investing extra effort in coping with a large amount of information. Thus, we hypothesize that the curvilinear relationship between safety information flow and safety performance depends upon the priority of safety:

Hypothesis 4b. Safety priority moderates the curvilinear relationship between safety information flow and safety performance in such a way that an intermediate level of safety information flow is associated with higher safety *performance when the priority of safety is high rather than low.*

Managerial safety practices and safety priority. Role theory (Katz & Kahn, 1978) suggests that individuals in organizations accomplish tasks by engaging in the roles that others in their organizations expect them to fill. The relationship between a manager and a subordinate has a particularly important influence on employee role behavior (Katz & Kahn, 1978). Thus, the perception that managers use safety practices is expected to have a strong influence on employee safety behavior. In addition, the priority assigned to safety within a unit is yet another perceived expectation about the importance of safety. Katz and Kahn extended their argument to say that employees experience role conflict when there is a "simultaneous occurrence of two or more role expectations such that compliance with one would make compliance with the other more difficult" (1978: 204). Experienced role conflict, in turn, is negatively associated with employee performance. Thus, when safety is perceived as a high priority and managerial use of safety practices is high, employees should not experience role conflict, and the result should be high safety performance. However, when safety is assigned a high priority and at the same time a unit's manager does not practice safety, employees receive conflicting messages about the importance of safety within the unit, which leads to role conflict and, consequently, decreases safety performance. Similarly, employees are expected to experience role conflict when safety is a low priority and the manager practices safety. Thus, we hypothesize the following:

Hypothesis 4c. Safety priority moderates the relationship between managerial safety practices and safety performance in such a way that a high level of managerial safety practices is associated with high safety performance when the priority of safety is high rather than low.

METHODS

Participants

Forty-seven medical units (e.g., surgery, anesthesiology, cardiology, gastroenterology, orthopedics, OB/GYN, emergency medicine and pediatrics) in three general hospitals in Israel participated in the study. Each hospital treated more than 100,000 patients annually. All staff members received a questionnaire. A total of 632 hospital employees answered the questionnaire; this number of respondents represented a response rate of about 70 percent. The number of respondents in each unit ranged from 6 to 18, with an average of 13. Participants had different roles in the hospital; junior and senior physicians comprised about a third of the sample, with junior and senior nurses comprising the other two-thirds.

Measures

Independent variables. The Appendix lists our measures and scales. The dimension of *safety procedures* was assessed with four items adapted from the concept of procedures of Brunsson et al. (2000; α = .91). The dimension of *safety information flow* was assessed with four items adapted from Hofmann and Stetzer (1998) and O'Reilly (1980; α = .85). The dimension of *managerial safety practices* was measured with six items adapted from Zohar's expectations factor (2000) and Hofmann and Stetzer's (1998) safety climate measure. A physician and a chief nurse headed each hospital department. Physicians within a unit were asked to rank its head, and nurses were asked to rank their unit's chief nurse (α = .85). Finally, *priority of safety* was assessed with a seven-item scale that drew on Zohar (2000; α = .89). Originally, the four measures had an additional four items, but these were deleted in the refinement process because of low standardized factor loadings.

Dependent variable. We measured the safety performance variable, *patient safety,* by tallying each unit's annual number of treatment errors that resulted in accidents (as opposed to near-misses) to patients. We tallied this number using the hospitals' archival data, accumulated through their risk management systems, as the source of information on treatment errors. Reports of such safety events enable hospitals to manage risk and better prepare for possible malpractice suits. In the three hospitals, treatment errors were formally reported on similar forms. A treatment error was defined as any error in the performance of an operation, procedure, or test; or in the administration of treatment; or in the dosage or method of using a drug; and also as generally inappropriate care that resulted in an accident—that is, in harm to a patient (Leape, 2002; Kohn, Corrigan, & Donaldson, 1999). For example, hospital intensive care units are prone to several common types of safety mishaps. In these units, patients often simultaneously receive several different infusions with different solutions in them. When one infusion finishes, a nurse may accidentally connect the wrong solution. Another common mishap in units is patients falling from their beds because nurses do not pull up the bedside railing. Physicians who take blood from a patient might put the identification label of patient A on patient B's test tube. Such errors are reported to the hospital risk management system since they may cause significant harm to patients and in many cases are life-threatening. In the hospitals in which we conducted our research, the data were accumulated at the unit level only.

Control variables. We used three control variables. One was annual average bed occupancy, included as a control for the workload in each department. The second was the number of treatment errors reported in the year prior to the study. To the extent that the number of errors within units was stable across time, it was possible that respondents would rate the independent variables in the questionnaire with the previous year's safety record in mind. This might produce the expected relationships between the independent and the dependent variables, rather than, or in addition to, the effects of the ratings of the independent variables on the following year's safety records. Thus, the previous year's safety performance should help demonstrate that the four dimensions of safety climate and their interactions contribute to the explanation of this year's safety performance over and above the previous year's safety performance. Likewise, the number of treatment errors reported in the previous year increases the credibility of the dependent variable of safety performance, since the correlation between last year's and this year's safety performance rates (r = .69; see Table 1) can be used as a test-retest reliability coefficient.

Finally, a third control accounted for potential differences between the hospitals.

Procedures

First, prior to the administration of the survey, we obtained the number of treatment errors of the previous year. We then administered the questionnaire that measured the independent variables capturing the four dimensions of safety climate. The hospital staff received the questionnaire during working hours. Upon completing the measurement of the independent variables, we started to collect the data about the dependent variable, treatment errors. We accumulated data about the number of treatment errors in each unit for *a full year after* the completion of the questionnaire.

Level of Analysis

The analysis was conducted at the unit level, since the safety performance data were gathered only at the unit level. For the independent variables, individuals answered questions that referred to their unit, and we aggregated responses to the unit level (James, Demaree, & Wolf, 1984) by calculating for each unit the mean scores on each of the four safety climate dimensions. We tested for the homogeneity of responses at the unit level by calculating the r_{wg} coefficients (James et al., 1984) for each of the four dimensions for each of the 47 participating medical units. We based the calculations on a uniform expected variance distribution (James et al., 1984). The $r_{wg(j)}$'s for the safety procedures dimension were between .70 and .97, with a median of .88; for safety information flow they ranged between .70 and .97, with a median of .83; for priority of safety, between .72 and .99, with median of .89; and for managerial safety practices, between .77 and .98, with a median of .86. Homogeneity was also tested by interclass correlations (ICC1) and by the reliability of the mean (ICC2; Bliese, 2000). Results for ICC1 and ICC2 for safety procedures were 0.12 and 0.64, respectively; for safety information flow, 0.23 and 0.79, respectively; for managerial safety practices, 0.13 and 0.67,

TABLE 1
Means, Standard Deviations, and Correlations[a]

Variable	Mean	s.d.	1	2	3	4	5	6
1. Safety procedures	3.94	0.41	(.88)					
2. Safety information flow	3.56	0.47	.71**	(.85)				
3. Managerial safety practices	3.91	0.36	.56**	.41**	(.85)			
4. Priority of safety	3.90	0.45	.35*	.06	.31*	(.89)		
5. Safety performance[b]	15.13	14.40	.28	.30*	.29*	−.16		
6. Unit workload	102.57	18.60	.18	.09	.24	−.10	.30*	
7. Unit's previous year's safety performance[b]	11.45	11.08	.20	.32*	.34*	−.08	.69**	.30*

[a] These statistics are at the unit level of analysis. Cronbach alpha coefficients are on the diagonal in parentheses.
n = 47 unless otherwise indicated.
[b] n = 46.
* $p < .05$
** $p < .01$

respectively; and for priority of safety, 0.19 and 0.76, respectively. Between-groups variance was tested with one-way analysis of variance (ANOVA). We conducted this analysis with unaggregated data, using the work-unit affiliation of each respondent as the independent variable. Results indicated that all four safety climate dimensions exhibited significant between-group variance (safety procedures: $F[47, 582] = 2.81$, $p < .01$; safety information flow: $F[47, 583] = 4.85$, $p < .01$; managerial safety practices: $F[47, 556] = 3.05$, $p < .01$; and priority of safety: $F[47, 582] = 4.12$, $p < .01$). Together, the results suggested that within-group homogeneity and between-unit variance were sufficiently high to justify consideration of subscale aggregation (Bliese, 2000; Zohar, 2000).

RESULTS

First, to test the four safety climate factors structure, we conducted a confirmatory factor analysis (CFA) at the individual level, using the EQS program, version 6 (Bentler, 2002). The analyses were performed on variance-covariance matrices with pairwise deletion of missing values. Two additional, alternative methods of dealing with missing values were used: listwise deletion and imputation using the expectation-maximization (EM) method. All three methods yielded very similar results. The variables in the data were multivariately nonnormally distributed, with normalized multivariate kurtosis of 51.03 ($p < .01$). To overcome this violation of structural equation modeling (SEM) assumptions, we employed a maximum-likelihood estimation method with robust standard errors together with the Satorra-Bentler rescaled chi-square statistic (Satorra & Bentler, 1994) that compensates for nonnormality of variables. The CFA yielded an acceptable fit (Hu & Bentler, 1999) ($\chi^2[183, n = 631] = 445.40$, $p < .001$; NFI = .920, NNFI = .94, CFI = .95, SRMR = .05, RMSEA = .05). All the standardized factor loadings in the model were above .56 (the majority of the loadings were in the .70s and .80s). For safety procedures, the interfactor correlation with safety information flow was .68; with priority of safety, .20; and with managerial safety practices, .56.

Between safety information flow and priority of safety, the correlation was .19, and between safety information flow and managerial safety practices, it was .55; between priority of safety and managerial safety practices, the correlation was .34 (all $p < .05$).

To validate the four-factor structure, we also conducted a second CFA in which all items were allowed to load on one factor. The CFA yielded an unacceptable fit ($\chi^2[189, n = 631] = 2{,}750.40$, $p < .001$, NFI = .50, NNFI = .47, CFI = .52, SRMR = .16, and RMSEA = .15). The difference between the chi-square of this model and that of the four-factor model suggested that the four-factor model better fitted the data ($\chi^2[6, n = 631] = 2{,}305.02$, $p < .001$. Since safety procedures and safety information flow were relatively highly correlated, and since Zohar (2002) treated the two dimensions of managerial safety practices and priority of safety as one factor, we tried a third CFA. In this analysis, we tested a two-factor structure that included the dimensions of safety procedures and safety information flow as one factor, and managerial safety practices and priority of safety as another factor. This CFA also yielded unacceptable fit ($\chi^2[188, n = 631] = 1{,}749.33$, $p < .001$; NFI = .69, NNFI = .67, CFI = .71, SRMR = .16, RMSEA = .12). The difference between the chi-square statistics of this model and the four-factor model was significant ($\chi^2[5, n = 631] = 1{,}303.93$, $p < .001$).

Finally, a fourth CFA with a three-factor structure that included the dimensions of safety procedures and safety information flow as one factor, and managerial safety practices and the priority of safety as two others, also yielded an unacceptable fit ($\chi^2[186, n = 631] = 796.29$, $p < .001$; NFI = .86, NNFI = .87, CFI = .89, SRMR = .06, and RMSEA = .07; $\Delta\chi^2[3, n = 631] = 350.89$, $p < .001$). Thus, the four-factor model was the only model that exceeded acceptable measures of fit.

Table 1 summarizes the means, standard deviations, and correlations among the variables at the unit level of analysis. Note that there was a significant increase in the mean number of treatment errors from the previous year to the year in which data were collected (the "present year") ($t = 2.4$, $p < .05$; Cohen's $d = .26$). We compared the change in the mean number of previous year's treatment errors to the mean number of the present year's treatment errors for units in the upper quartile of the distribution of priority of safety (mean units' previous-year level of safety performance = 10.46, s.d. = 9.63, and mean units' present-year level of safety performance = 12.23, s.d. = 12.7). The difference in the numbers of treatment errors was not significant ($t[12] = 1.13$, $p = .28$). In contrast, the other units in the sample—that is, the lower three-quarters of the distribution of priority of safety—showed a significant increase in the level of treatment errors from the previous to the present year (mean units' previous-year level of safety performance = 11.84, s.d. = 11.72, and mean units' present-year level of safety performance = 16.27, s.d. = 15.05, $t[32] = 2.15$, $p < .05$). These results suggest that in units in which the priority of safety was relatively low, safety performance decreased over the year. However, in units with a relatively high priority of safety, safety performance was steady over time.

Because the dependent variable was a count of infrequently occurring events that had only nonnegative integer values, we used a Poisson regression with a correction for overdispersion (Gardner, Mulvey, & Shaw, 1995). To effectively "partial out" all hospital variance, thereby eliminating the potential lack of independence in the unit-level residual, we dummy-coded for hospital and used it as a control variable. In all models, we also included the two control variables of unit workload and the previous-year unit safety performance. Since the variable of unit workload was not significant in all the analyses, we reanalyzed the models without it.

First, we regressed safety performance on the four dimensions of safety climate and the three two-way interactions of safety priority with each of the other three climate dimensions (see model 1 in Table 2). In this model, we introduced safety procedures and safety information flow to assess their possible linear effects on safety performance. Results indicated significant main effects for safety procedures, safety information flow, and managerial safety practices. The three interactions of safety procedures, safety information flow, and managerial safety practices with priority of safety were also significant.

Second, we regressed safety performance on all the variables of model 1 as well as on safety procedures squared, safety information flow squared (in order to assess the possibility of nonlinear relationships between them and safety performance), and these two squared terms' interactions with priority of safety. Results demonstrated that only the interaction of managerial safety practices with priority of safety and their two main effects were significant. All other effects in this model were not significant. In this model, the interaction of safety information flow squared and priority of safety had a near-zero-magnitude, insignificant effect. Also, since theoretically a curvilinear relationship was the less parsimonious explanation, we regressed another model without this interaction of information flow squared with priority of safety (Cohen, 1988; see model 2, Table 2).

Results demonstrated that the main effects of safety procedures, safety procedures squared, managerial safety practices, and priority of safety were significant. Thus, Hypotheses 1 and 3 were confirmed. The interactions of priority of safety with safety procedures squared and with managerial safety practices were also significant. This pattern of findings confirmed Hypotheses 4a and 4c. To understand the nature of the interactions, we followed the graphing method outlined by Aiken and West (1991). Figure 1 shows that the curvilinear effect of safety procedures on safety performance depends on the level of a unit's priority of safety. The rises in the low-priority curve were steeper than those in the high-priority curve. At intermediate levels of safety procedures, there was no significant difference between the numbers of treatment errors for high and low safety priority (t = 0.72, n.s.).

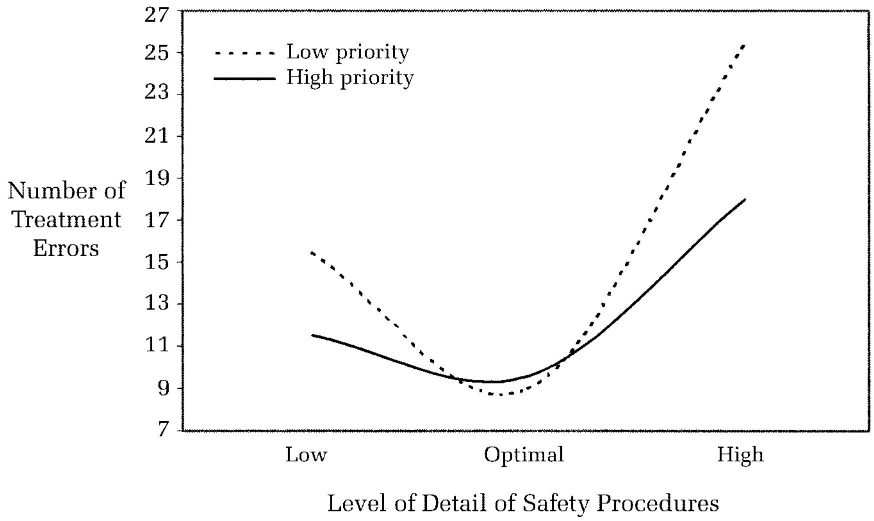
Figure 2 plots the interaction of managerial safety practices with safety priority. When priority of safety was low, there were more treatment errors when managerial safety practices were high than when managerial safety practices were low. When safety was a high priority, there was no significant

TABLE 2
Results of Poisson Regression Analysis of Safety Performance on the Four Climate Dimensions[a]

Variable	Model 1	Model 2
Intercept	7.63 (9.40)	290.17* (140.62)
Safety procedures	13.21** (4.80)	−130.09* (68.95)
Safety procedures squared		18.34* (8.76)
Safety information flow	−10.07** (3.10)	−3.07 (5.80)
Safety information flow squared		−1.05 (0.70)
Managerial safety practices	−5.60* (2.89)	−9.91** (3.41)
Priority of safety	−2.29 (2.45)	−72.65* (35.70)
Safety procedures × priority of safety	−3.32** (1.23)	30.70 (17.09)
Safety procedures squared × priority of safety		−4.33* (2.16)
Safety information flow × priority of safety	2.49** (0.76)	2.67** (0.73)
Managerial safety practices × priority of safety	1.63* (0.75)	2.57** (0.85)
Unit's previous year's safety performance	0.04** (0.01)	0.05** (0.01)
Hospital	0.28 (0.16)	0.15 (0.16)

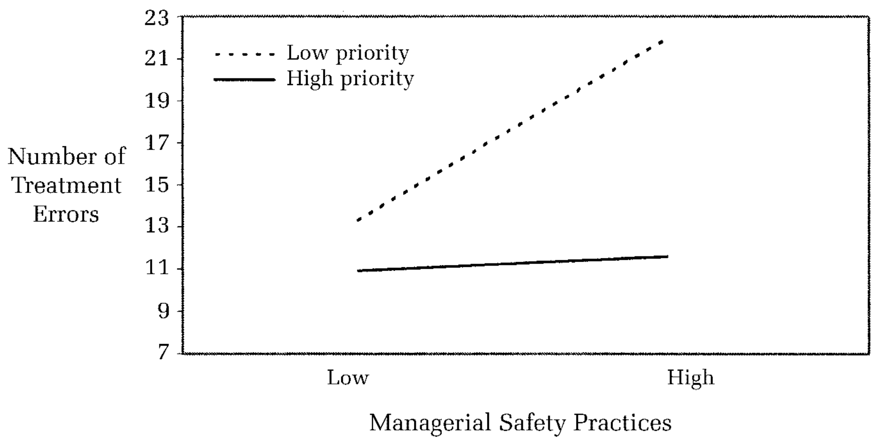
[a] Unstandardized regression coefficients are shown, with standard errors, in parentheses.
* $p < .05$
** $p < .01$

FIGURE 1
Number of Treatment Errors as a Function of the Level of Detail of Safety Procedures and Priority of Safety[a]



[a] Higher safety performance is shown by lower numbers of treatment errors.

FIGURE 2
Number of Treatment Errors as a Function of Managerial Safety Practices and Priority of Safety[a]



[a] Higher safety performance is shown by lower numbers of treatment errors.

difference between the numbers of treatment errors for high and low managerial safety practices (t = 1.56, n.s).

DISCUSSION

Although hospitals try to ensure patient safety, they are not completely successful, and treatment errors are still a major problem in the health care industry. The present study adds theoretical and empirical tiers to understanding of the origin of treatment errors. Theoretically, by taking a multidimensional approach, this study captures the importance of safety climate as a key factor in explaining patient safety. Authors of other recent studies have tended to conceptualize safety climate as unidimensional. For example, Zohar and Luria (2004) and Hofmann, Morgeson, and Gerras (2003) grouped the dimensions of managerial safety practices and safety priority in conceptualizing safety climate. Our study brings some evidence regarding the difference between these variables and their different relationships with safety performance. In addition, our study takes the safety climate literature beyond its emphasis on the safety of employees to an examination of the safety of an organization's customers. We used safety climate theory, which traditionally has been used to explain how employees guard their own safety, to explain the extent to which employees preserve the safety of others. Our focus in this area is important, since keeping others safe is not necessarily the same as keeping oneself safe.

Specifically, while studies on safety have tended to concentrate on the degree to which formal procedures exist and on a linear relationship between safety procedures and safety performance (Perrow, 1984), we have demonstrated a curvilinear relationship between perceived procedures and unit safety performance. Organizations invest time and money in development and implementation of safety rules and procedures. Moreover, a common reaction of organizations to hazardous events is to add more safety requirements that are, in turn, translated into additional formal procedures. The results of the present study demonstrated that this "linear approach" of organizations to safety assurance was not necessarily associated with good safety performance. To reduce the number of treatment errors, adding formal procedures is not enough. How employees perceive and interpret formal safety procedures also plays an important role. Although it has been clear that a lack of procedures is detrimental to safety performance (Perrow, 1984), our results demonstrate that too many or overly detailed procedures are also associated with lower safety performance. Safety rules and procedures can not cover all possible contingencies except when work is highly routine. In most hospital situations, the work is not highly routine, and in many other types of organizations as well, nonroutine tasks and room for personal discretion are common.

Our second hypothesis, about a curvilinear relationship between safety information flow and safety performance, was not supported. The results suggested some evidence for a linear relationship between the two. Therefore, in the case of information about safety, it seems possible that more is better, as earlier studies have suggested (e.g., Marcus & Nichols, 1999). Another possible reason for the lack of support for curvilinearity is that the information about safety delivered in the hospitals in this study had not reached the level that was perceived as overload.

Our results replicated earlier studies' findings about the direct influence of perceived managerial safety practices on safety performance (Zohar, 2002)—this time, in a health care setting. Nonetheless, in contrast to previous studies in which managerial safety practices and safety priority have been treated as one dimension, this study differentiated and stressed the difference between the dimensions of managerial safety practices and safety priority.

We demonstrated that the priority of safety moderated the curvilinear relationship between safety procedures and the number of a unit's treatment errors, and the linear relationship between managerial safety practices and the number of a unit's treatment errors. When safety was a high rather than low priority, there were fewer treatment errors when procedures were perceived as either insufficient or overly detailed. Thus, when there were few procedures, safety priority may have compensated for the lack of guidelines on how to behave, substituting general guidelines for safety behavior for specific safety guidelines. Safety priority might also have compensated for a rigid structure resulting from overly numerous procedures, by differentiating the more important activities. When the level of safety procedures was perceived as optimal, there was no difference between units with high and low safety priority. Thus, if the procedures are perceived as good and as enabling daily work, additional signaling or guidelines on how to behave are superfluous. Previous research on safety climate (e.g., Zohar, 2002) did not control for the way employees perceived safety procedures. Our results suggest that giving safety a high priority, when coupled with a perceived high level of detail of safety procedures, can hinder safety performance. Thus, the claim that giving priority to safety is always important needs further clarification.

The relationships between high and low managerial use of safety practices and safety performance were approximately the same when the priority assigned to safety was high. In other words, when safety was given high priority, the influence of managerial safety practices was nullified. Apparently, employees received enough cues regarding the importance of safety within their unit via their understanding of the safety priority; the understanding that their manager also emphasized safety had no additional influence on their behavior. Interestingly, our results revealed that when the priority assigned to safety was low, there were more treatment errors in units with high rather than low managerial emphasis on safety practices. This result suggests that employees might have experienced role conflict, which was detrimental to their safety performance. The role conflict that resulted from the high priority of safety and low managerial safety practice use did not have such a detrimental effect, which suggests that the high safety priority might have had the stronger influence.

Measurement Issues

A major advantage of this study is that we varied the sources of the data. The study used questionnaires for the independent variables of the safety climate dimensions and an objective criterion variable of treatment errors for safety performance.

The collection of safety data in organizations in general, and in hospitals specifically, can be subject to problems of willingness to report. Employees may tend to underreport errors (Leape, 2002). Nevertheless, we believe that this limitation might not be acute in this study, since the data about treatment errors were about errors that resulted in accidents (harm to patients) and not about near-misses. Actual errors are apparent and usually cannot be hidden, and thus are reported to the risk management system. Indeed, many near-misses occurring in hospitals do not result in accidents, and thus, they are not reported. The problem of underreporting can be more serious with near-misses that remain unknown and can be concealed by staff. This tendency may also explain the relatively low number of treatment errors reported.

A relationship between safety climate and the tendency to report treatment errors may exist. Possibly, heightened sensitivity to safety concerns makes individuals report treatment errors more fully. Thus, one would expect that units with a high level of safety climate would tend to report more treatment errors. Our results demonstrated that units that had a a high level of safety climate had *fewer* treatment errors. This finding suggested that our measure did not reflect the tendency to report but was a picture of the "real" occurrence of treatment errors. Alternatively, when sensitivity to safety concerns is heightened, individuals may refrain from reporting treatment errors, because they may be afraid of the consequences. However, in a recent issue of the *New England Journal of Medicine,* Studdert, Mello, and Brennan (2004) argued that transparency has become the leitmotif of the patient safety movement (for example, Sage, 2003; Berwick & Leape, 1999). To learn from errors, hospitals must first identify them; to identify them, they must foster an atmosphere that is conducive to openness about mistakes. Hospitals and physicians are urged to be honest with patients about medical errors, and to report such events to one another and to regulators.

Limitations and Future Research

This article is concerned specifically with patient safety. Equating employee safety and patient safety suggests that a climate emphasizing safety would also be expected to reduce the number of work errors in general, regardless of the specific work context. Hence, future research should address the question of whether the results articulated here hold for all types of work, all service work, or just medical work.

All questionnaire data were collected from the same respondents and, therefore, were susceptible to same-source–same-method bias. Future research should replicate and develop other sources of data for climate assessment. Another methodological issue is that the research was conducted over a relatively short period. A longitudinal design would strengthen the ability to infer causality. Also, a longitudinal design would enable better understanding of other potential factors that might have caused the overall increase in treatment errors over the course of a year seen in the present study.

Finally, our study was limited to four dimensions of safety climate. Although the four dimensions are important and by themselves explained treatment errors, safety climate is a complex construct, and further studies should seek to identify other safety climate dimensions.

Implications for Management

Health care policy makers try to improve patient safety using medical science solutions (Leape, 2002), yet the present study demonstrated that organizational behavior theory can help explain variance in treatment errors in hospitals. Health care management can also benefit from using the means and methods offered by organizational behavior theory.

Managers have been offered rather simplistic structural prescriptions for safety assurance. However, the evidence from this study provides tentative support for the argument that they also need to use the informal aspects of safety climate to ensure safety. Managers should realize that there is safety climate variance between different units. Hence, the use of the same procedures or information may have different effects on safety performance in different units.

Specifically, to ensure safety, organizations should design interventions that target all four safety climate dimensions. Interventions that aim to improve only part of the four dimensions are unlikely to be as effective, since the dimensions are interrelated and together influence the occurrence of treatment errors. In addition, organizations develop safety evaluation methods that use criteria such as the existence of procedures or employee familiarity with them. We suggest that organizations should also include criteria for safety climate dimensions in their evaluation system.

The priority placed upon safety is a key component in ensuring good safety performance. Managers should be made aware that the level of priority they give safety in their units enables or disables the benefits of other safety assurance interventions. If the priority of safety in a unit is low, managers should be cautious in their safety practices, since a conflict between low priority placed on safety and a high level of managerial use of safety practices is detrimental to safety performance. Nonetheless, it seems that developing procedures that are perceived as optimally detailed might deemphasize safety priority.

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APPENDIX

Measurement Scales

Safety Procedures

Responses ranged from 1, “not at all or to a very slight extent,” to 5, “to a very large extent.”

“In your unit, to what extent. . .”
are there many written procedures?
do the safety procedures relate to all work-related issues?
are the safety procedures detailed?
are the safety procedures extensive?

Safety Information Flow

Responses again ranged from 1, “not at all or to a very slight extent,” to 5,“to a very large extent.”

“In your unit, to what extent. . .”
are employees informed about many new updates of the safety rules and regulations?
are the employees informed about potential hazards?
are there many safety training programs?
is information about safety distributed regularly?

Managerial Safety Practices

Responses ranged from 1, “not at all true in my unit,” to 5, “very true in my unit.”

“In your unit, the unit head. . .”
approaches team members during work to bring safety issues to their attention.
monitors us more closely when a team member vio lates a safety rule.
considers safety performance in performance evalua tions and in promotion reviews.
gets annoyed with workers who ignore safety rules.
ensures there are no hazards in the unit.
creates an atmosphere in which people can say what ever they think about safety.

Priority of Safety

Responses ranged from 1, “not at all true in my unit,” to 5, “very true in my unit.” All the priority items were reverse-scored.

“In my unit. . .”
in order to get the work done, one must ignore some safety aspects.
whenever pressure builds up, the preference is to do the job as fast as possible, even if that means com promising on safety.
human resource shortage undermines safety standards.
safety rules and procedures are ignored.
safety rules and procedures are nothing more than a cover-up for lawsuits.
ignoring safety is acceptable.
it doesn’t matter how the work is done as long as there are no accidents.

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