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Underlying influence of perception of management leadership on patient safety climate in healthcare organizations – A mediation analysis approach

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Abstract

Objective: We aim to draw insights on how medical staff's perception of management leadership affects safety climate with key safety related dimensions—teamwork climate, job satisfaction and working conditions.

Design/Setting: A cross-sectional survey using Safety Attitude Questionnaire (SAQ) was performed in a medical center in Taichung City, Taiwan. The relationships among the dimensions in SAQ were then analyzed by structural equation modeling with a mediation analysis.

Participants: 2205 physicians and nurses of the medical center participated in the survey. Because not all questions in the survey are suitable for entire hospital staff, only the valid responses ($n = 1596$, response rate of 72%) were extracted for analysis.

Main Outcome Measure(s): Key measures are the direct and indirect effects of teamwork climate, job satisfaction, perception of management leadership, and working conditions on safety climate.

Results: Outcomes show that effect of perception of management leadership on safety climate is significant (standardized indirect effect of 0.892 with P-value 0.002) and fully mediated by other dimensions, where 66.9% is mediated through teamwork climate, 24.1% through working conditions and 9.0% through job satisfaction.

Conclusions: Our findings point to the importance of management leadership and the mechanism of its influence on safety climate. To improve safety climate, the implication is that commitment by management on leading safety improvement needs to be demonstrated when it implements daily supportive actions for other safety dimensions. For future improvement, development of a management system that can facilitate two-way trust between management and staff over the long term is recommended.

Key words: patient safety, management leadership, quality improvement, mediation effect

Introduction

In healthcare organizations, errors, failures and accidents in their processes can be extremely costly for both them and their patients [1, 2]. Improving patient safety has become a critical issue in the healthcare industry [3–8] and it is no coincidence that Patient Safety Culture (PSC) has received strong attention from healthcare organizations, including international organizations like the Institute of Medicine and The Joint Commission, and recently they have been pressuring hospitals to address patient safety issues through PSC surveys and appropriate quality interventions [3, 9].

One of the main theoretical sources healthcare organizations have been relying on for PSC research is High Reliability Theory (HRT), which was developed at the University of California Berkeley. It is based on a study of how High Reliability Organizations (HROs) manage to maintain such high reliability in their operations [10]. HROs are a type of organizations that require near error-free operations. Such organizations include those in the nuclear power industry and aviation industry. The main idea of HRT is that errors can be prevented through 'management leadership' and it emphasizes the trust of employees in the leadership and the quality of relationships between leaders and employees [11]. Another important element of the HRT is that HROs promote 'safety culture', which was first employed by the International Nuclear Safety Advisory Group after the Chernobyl disaster in 1986 [12]. Safety culture was defined by the IAEA (International Atomic Energy Agency) as "…the assembly of characteristics and attitudes in organizations and individuals which establish that, as an overriding priority, safety issues receive the attention warranted by their significance" [12]. A number of studies suggest the role of management leadership is critical for achieving high levels of safety within organizations [13–20]. Also it has been reported that organizations with strong safety cultures strive to make it their number one priority [21].

One of the instruments that have played an influential role in PSC research is the self-administered Safety Attitude Questionnaire (SAQ) which was developed by the University of Texas [22] and has been validated and widely used in the healthcare industry [23, 24]. The survey uses six safety dimensions—safety climate, perception of management, teamwork climate, job satisfaction, working conditions, and stress recognition [22]. Safety climate assesses the strength of the perception of a strong and proactive organizational commitment to safety. Perception of management is based on the degree to which staffs approve of managerial actions. Teamwork climate is defined as the perceived quality of collaboration among personnel. Job satisfaction is the degree to which people feel positively about their work experience. Working conditions are based on the perceived quality of the work environment and logistical support, such as staffing and equipment. Finally, stress recognition measures how performance is influenced by stressors.

In this research, we leverage two key elements of HRT, 'management leadership' and 'safety culture', to draw insights on how the influence of medical staff's perception of management leadership affects PSC of healthcare organizations by employing a SAQ-based instrument with a mediation analysis. Even though the impact of management leadership on safety culture has been well studied in the discipline of human resource management [13, 15–20, 25], this is not the case in PSC research where most works just analyze factors that affect PSC without putting the focus on the impact of management leadership, or just recognize the importance of management leadership on PSC without investigating the mechanisms behind it [26–28].

Methods

Hospital setting

This study was conducted at Taichung Veterans General Hospital in Taichung City, Taiwan. It began offering medical services on 16 September 1982. Since 1991 it has been accredited as a 'Medical Center and First-Class Teaching Hospital' by the Department of Health, Taiwan. Taichung Veterans General Hospital is a 1500-bed hospital with around 3000 employees. It is able to take care of 6000 outpatients, 130 inpatients and 180 patients in the emergency room daily.

Data collection

The hospital management implements a SAQ-based survey every year. Physicians, nurses and other employees in the hospital are required to do the survey in the e-learning system of the hospital. In hospitals, the core staff generally consists of physicians and registered nurses [29], with nurses being the biggest workforce in healthcare organizations, which possess enough power to move the underlying organizational culture toward a greater PSC [30]. Also not all questions in the survey were suitable for all staff members and therefore we only considered the responses from physicians and nurses. The responses were received in October 2013 and 1596 out of 2205 responses were valid, which represents a 72% response rate. The demographic information of the respondents in the data set is summarized in Table 1. The participants rated each question based on a five-point Likert scale ranging from strongly agree to strongly disagree, or a frequency such as never, rarely, sometimes, most of the time and always [22]. Ethical approval for this study was obtained from the Institutional Review Board of Taichung Veterans General Hospital in Taiwan (IRB TCVGH No: CW15250A).

Both physicians and nurses used 30 items to evaluate PSC. In addition, Items 2 and 11 were reversed questions such that each respondent's answer was adjusted. For instance, the original answer of strongly agree in Item 2 (In this clinical area, it is difficult to speak up if I perceive a problem with patient care) indicates poor performance of patient safety. The adjustment is thus to use a numerical value of one if the original answer is strongly agree instead of the numerical value of five. By the same token, the answer from Item 11 is also adjusted.

Measures

The key constructs in our research are management leadership and safety culture. To measure management leadership, we selected questions from the 'hospital management support' scale developed by a new Chinese version of SAQ [31] and the dimension of 'perception of management' in the original SAQ. These items were entitled as 'perception of management leadership' dimension. This dimension measures the perception of medical staff on how well the managers or leaders lead and support the medical staff in terms of commitment to safety [32–36]. Then to measure the construct of safety culture, items in 'safety climate' dimension of SAQ were used in this study. Guldenmund [37] states the 'culture' of an organization expresses itself through its organizational 'climate' and therefore measuring climate is commonly used in surveys for measuring organizational culture. Safety climate is considered an effective variable for measuring an organization's safety culture because of its ease and effectiveness [25, 38, 39].

The other safety dimensions of SAQ were measured by the original questions of SAQ, with the 'stress recognition' dimension excluded from the study. Taylor and Pandian [40] investigated the works of Speroff *et al.* [41] and Taylor *et al.* [42] to demonstrate that stress recognition does not fit into the overall safety climate

construct and consequently recommended stress recognition be removed in SAQ. Also Sexton *et al.* [22] and Lee *et al.* [29] reported that stress recognition is the only factor in SAQ whose correlation with safety climate is not significant. Based on the aforementioned studies, stress recognition was removed from the analysis.

The hypothesized model

Sexton *et al.* [22] and Lee *et al.* [29] both show that staff perceptions of management affect safety climate, teamwork climate, working conditions, and job satisfaction. Further, Salas *et al.* [43] propose the 'big 5' components that affect teamwork and put management leadership as the first component. They suggest that leaders will influence the effectiveness of teamwork by performance monitoring and backup behaviors. This is meaningful in the context of healthcare since medical staffs will expect the leader to monitor how members commit to safety as well as expect the leaders to back it up with their own behaviors. Leonard *et al.* [44] investigated the importance of teamwork and communication of the members for safe patient care and pointed out that management leadership is a critical in changing safety culture through improving teamwork and

**Table 1** Demographic information of the respondents in the data set

Category	Frequency	Percentage
Gender		
Male	378	16.6
Female	1899	83.4
Age		
<30 years old	839	36.8
31–40 years old	617	27.1
41–50 years old	533	23.4
51–60 years old	262	11.5
61 years old and above	26	1.1
Types of job		
Physicians	244	10.7
Nurses	1352	59.4
Medical technicians	205	9.0
Pharmacy staff	63	2.8
Administrative staff	304	13.4
Rehabilitation staff	12	0.5
Others	97	4.3
Working experience in hospital		
Under 6 months	110	4.8
6–11 months	84	3.7
1–2 years	383	16.8
3–4 years	314	13.8
5–10 years	456	20.0
11–20 years	496	21.8
Above 21 years	434	19.1
Working experience in department		
Under 6 months	170	7.5
6–11 months	120	5.3
1–2 years	460	20.2
3–4 years	395	17.3
5–10 years	507	22.3
11–20 years	376	16.5
Above 21 years	249	10.9
Education		
Under junior	17	0.7
High school	67	2.9
College	1826	80.2
Master's degree or above	367	16.1

communication. For job satisfaction, there are prior studies that claim the leadership style of management directly affects the job satisfaction of employees [45–49]. Regarding working conditions, there has been research on transformational leadership that suggests leaders can develop a collective mindset within the group and affect the perceptions of member's working conditions by the exertion of transformational leadership behaviors [50–52]. Drawing upon the aforementioned studies, we assume that perception of management leadership affects teamwork climate, job satisfaction' and working conditions and we posit the following hypothesized model in Fig. 1.

Our main research objective is the mechanism of *how* staff perceptions of management leadership influences the safety climate of the organization—what we try to test in Fig. 1 is: (i) Perception of management leadership affects safety climate directly; or (ii) the effects of perceptions of management leadership on safety climate go through other dimensions; or (iii) both 1 and 2 hold true at the same time. We employ mediation analysis in this study to investigate these possibilities. Mediation analysis is the procedure to see if there are variables acting as intermediary vessels, which are called 'mediators' or 'mediating variables', when we analyze the relationship between an independent variable and a dependent variable [53]. With respect to the three cases mentioned above, the first case is 'no mediation', the second is 'full mediation' and the last is 'partial mediation'. To perform mediation analysis, we formulate the research model using structural equation modeling (SEM) on AMOS ver. 21.0. SEM provides a state-of-the-art approach for analyzing mediated relationships among variables, particularly when multiple measures are required to capture the focal variables [54].

Results

The validity and reliability of the model is checked by confirmatory factor analysis since SAQ has been already validated and widely used in the healthcare industry [23, 24]. The results are illustrated in Table 2. First, the questions with low factor loadings were dropped from the analysis. The scale reliabilities of all dimensions (which is indicated by Cronbach's alpha) exceeded the recommended cutoff of 0.70 for established scales [55], and all questions in the model loaded significantly on their corresponding dimensions ($P < 0.001$). The model fit statistics indicate the measurement model exhibited a reasonable fit [56] [χ^2 (160, $N = 1596$) = 1507.88; $P = 0.000$; goodness-of-fit index = 0.909; adjusted goodness-of fit index = 0.880; Tucker–Lewis index (TLI) = 0.935; comparative fit index (CFI) = 0.945; root mean square error of approximation (RMSEA) = 0.073; standardized root mean square residual (SRMR) = 0.037]. The composite reliability (CR) values of the dimensions, which were all above 0.8, and average variance extracted (AVE) values, which were all above 0.5, indicate the good construct validity of the measurement model [56].
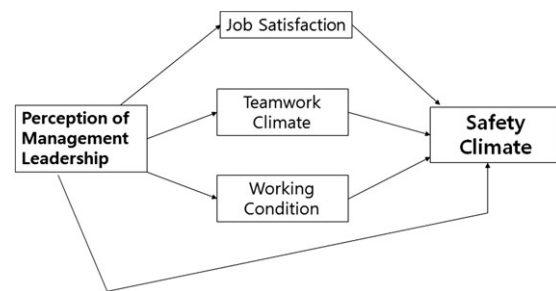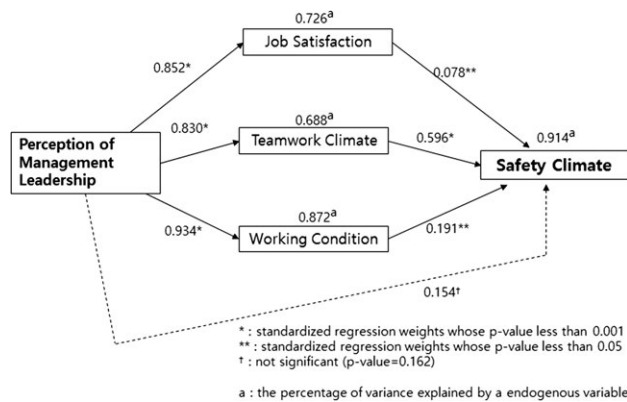

Figure 1 Hypothesized model in this study.

Table 2 Results of confirmatory factor analysis

Dimension	Cronbach's Alpha	CR	AVE	Question	Factor loading	P-value
Perception of management leadership	0.793	0.820	0.606	pm23	0.788	
				pm24	0.848	<0.001
				pm25	0.657	<0.001
Teamwork climate	0.837	0.844	0.575	tc3	0.728	
				tc4	0.790	<0.001
				tc5	0.755	<0.001
				tc6	0.751	<0.001
Job satisfaction	0.936	0.939	0.755	js14	0.746	
				js15	0.863	<0.001
				js16	0.930	<0.001
				js17	0.931	<0.001
				js18	0.856	<0.001
Working conditions	0.861	0.876	0.639	wc27	0.764	
				wc28	0.779	<0.001
				wc29	0.746	<0.001
				wc30	0.852	<0.001
Safety climate	0.857	0.870	0.625	sc7	0.781	
				sc8	0.759	<0.001
				sc9	0.789	<0.001
				sc10	0.778	<0.001

CR, Composite Reliability; AVE, Average Extracted Variance.

Figure 2 Resulting model from the analysis.

Table 3 Decomposition of standardized effects

Dimension	Perception of management	Teamwork climate	Job satisfaction	Working conditions
Safety climate				
Direct	n.s.	0.596*	0.078**	0.191**
Indirect	0.739*	–	–	–
Total	0.739*	0.596*	0.078**	0.191**
Teamwork climate				
Direct	0.830*	–	–	–
Total	0.830*	–	–	–
Job satisfaction				
Direct	0.852*	–	–	–
Total	0.852*	–	–	–
Working conditions				
Direct	0.934*	–	–	–
Total	0.934*	–	–	–

*$P < 0.01$.
**$P < 0.05$.
n.s., not significant ($P = 0.154$).

Normality check of the sample, that is required in an SEM analysis which typically uses maximum likelihood (ML) estimation, shows that all the observed variables have absolute values of skewness <2 and absolute values of kurtosis <7, which means the sample data show sufficient univariate normality for ML estimation [57].

The summarized results of the research model in Fig. 1 are presented in Fig. 2. The structural model in Fig. 2 shows a reasonable fit [56] [χ^2 (161, $N = 1596$) = 1396.368; $P = 0.000$; TLI = 0.941; CFI = 0.950; RMSEA = 0.069; SRMR = 0.037]. The percentages of variance explained by endogenous variables for all dimensions (which is the same as R-squared in regression analysis) are high (safety climate = 0.914; job satisfaction = 0.726; working conditions = 0.872; teamwork climate = 0.688), indicating all the dimensions in the analysis are well explained by the model. In particular, our dependent variable, safety climate, has a very high value for the percentage of variance explained (0.914), which means that the safety climate of the participants is explained very well by the dimensions selected in this study. Moreover, all the standardized regression weights are statistically significant, except for the one

from perception of management leadership to safety climate (standardized regression weight of 0.154 with $P = 0.162$).

Table 3 decomposes the standardized effects of the four safety culture dimensions tested in our model. All the effects are statistically significant, except for the direct effect of perception of management leadership on safety climate. The statistical significance of the standardized indirect effect of perception of management leadership on safety climate is produced by the bias-corrected percentile bootstrapping method (sample size of 1000, bootstrap 95% confidence interval lower limit of 0.496 and upper limit of 0.956, and P-value of 0.002).

In terms of total effects, perception of management leadership shows the largest effect on safety climate. Teamwork climate has the highest direct effect on safety climate (standardized effect of 0.596,

Table 4 Fit statistics for partial and full mediation models

Model	χ^2	df	P-value	CFI	TLI	RMSEA	SRMR
Partial mediation	1396.368	161	0.000	0.950	0.941	0.069	0.037
Full mediation	1398.506	162	0.000	0.950	0.941	0.069	0.037

$P < 0.001$). Table 3 also shows that there is a large, significant indirect effect of the perception of management leadership on safety climate (standardized indirect effect of 0.739, $P = 0.002$), which indicates that strong mediation effects exist between the perception of management leadership and safety climate. If we break down the indirect effects of perception of management leadership on safety climate, 66.9% (0.830*0.596) is mediated through teamwork climate, 24.1% (0.934*0.191) through working conditions and 9.0% (0.852*0.078) through job satisfaction.

To confirm the way management leadership affects safety climate, we compare two alternative structural models of partial mediation and full mediation using the approach in Holmbeck [58]. The structural model in Fig. 2 is the partial mediation model, since perception of management leadership not only affects safety climate directly, but indirectly through other dimensions. In the full mediation model, there is no direct path from perception of management leadership to safety climate. We thus need to check if adding a path from perception of management leadership to safety climate (partial mediation model) improves the fit of the full mediation model statistically by employing the chi-square difference test proposed by Bentler and Bonett [59], and we also have to examine if the added path in the partial mediation model is statistically significant. Table 4 compares the fits of these two models.

It can be found that the difference between the partial and full mediation models is not statistically significant [χ^2 (1, N = 1596) = 2.138, $P = 0.144$], and the other fit index values are almost identical. In addition, the added path in the partial mediation model is not statistically significant (Fig. 2). It has thus been shown that teamwork climate, working conditions and job satisfaction 'fully mediate' the effect of perception of management leadership on safety climate.

Discussion

In this study, we investigate the impact of management leadership on safety climate based on the theoretical background of HRT and show that the influence of management leadership on safety climate is critical and fully mediated by other safety dimensions, which means the effect is 'underlying' and not easy to see but important for the improvement of PSC.

Based on the analysis at the focal hospital, several managerial implications can be suggested. First, management should be aware that it may be less effective if it tries to improve PSC by carrying out some plans to directly improve staff perceptions of their leadership. Instead, it should focus on investing resources to improve other mediator dimensions—the key is to show their sincere attitude of commitment on leading safety improvement when it carries out daily supportive actions concerning those safety dimensions. Griffin and Neal [60] and Hofmann et al. [61] suggest that managers should demonstrate their commitment through their behaviors and the firm management practices, so that workers can readily perceive it. Therefore, it would be helpful if management itself works to educate the staff so that it understands the importance of showing its commitment to safety with their 'backup behaviors' when implementing such efforts [43]. Also, management efforts may begin from teamwork climate improvement since

the majority of the effect perception of management leadership has on safety climate is mediated through teamwork climate (67% in our experimentation). Lee et al. [29] also claim managers should pay more attention to teamwork climate in order to improve PSC.

For further improvement, we may recommend developing a management system that can facilitate two-way trust between management and staff over the long term. For example, management may build a cloud-based quality center to enable full and timely information access, as well as the sharing of reports from both management and staff, as this can provide a more trusting culture in which staff can trust management when reporting safety issues and management can trust the information they get from the staff and thus use it to make further improvements [13].

This study has several limitations to be addressed by further research. First, even though the sample size was not small, all respondents were from one city in Taiwan, which can limit the generalizability of our results. Future research should leverage various sources of regions for a more general assessment. Second, it would be interesting to further evaluate other staff's (e.g. technicians, pharmacists and others) opinions regarding PSC by using an instrument that can be applied to all staffers. A more insightful conclusion could then be drawn using multigroup comparisons. In addition, since our research was performed as a cross-sectional study, in the future a longitudinal design may give a deeper understanding of the causality among the dimensions considered in the present work. Another limitation is the fact that this study was based on SAQ, and therefore was limited to four dimensions—and thus the outcomes may be interpreted only within the context of SAQ. Safety climate of an organization is not a simple construct, and further research might be done based on either other validated safety dimensions or newly constructed surveys. Lastly, future research may consider more hospitals so that reliability of experiment results can be better. However, there is an intense competition between hospitals in Taiwan and there may be a need to conquer data collection issues at multiple sites.

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