

The Association of Patient Safety Culture with Hospital Safety Performance: A Cross-sectional Survey

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Abstract

Introduction: The theme of patient safety has been extensively studied since the publication of two landmark reports “To Err is Human” and “Crossing the Quality Chasm” in which advocated creating a culture of safety could avoid the adverse events and medical errors. Patient safety culture (PSC) and staff safety behavior may have an impact on hospital safety performance. To date, evidence in establishing the association of PSC and safety performance remains unclear and inconsistency in developing countries. The aim of this study is to evaluate the association of PSC, staff safety behavior and hospital safety performance.

Methods: A convenient sample of five tertiary general hospitals in Harbin, China, with more than 1000 beds respectively, were evolved in this onsite cross-sectional survey. We measured 10 dimensions of Hospital Survey on Patient Safety Culture, 2 dimensions of staff safety behavior and 4 dimensions of hospital safety performance among 507 doctors and nurses using a previously validated self-evaluation questionnaire. Descriptive statistics and logistic regression were utilized.

Results: The internal consistency of this study was evaluated by Cronbach's alpha=0.94, with a survey positive response rate 60%. In our final logistic regression models, after controlling for the physician/nurse factors, we found the number of physician/nurses reported medical errors were significantly associated with Hospital Handoffs and Transitions OR=0.19, 95% CI (0.07-0.53). Staff safety behavior were protective factors for hospital safety management.

Conclusion: This multicenter cross-sectional study found that PSC and staff safety behavior were associated with hospital safety performance. Staff safety behavior exerts positive effects on safety performance

Keywords: Patient safety; Safety culture; Medical errors; Performance measures

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Introduction

The theme of patient safety has been extensively studied since the publication of two landmark reports “To Err is Human” and “Crossing the Quality Chasm” in which the authors advocated creating a culture of safety could substantially avoid the adverse events and medical errors in health care system [1,2]. In 2009, World Health Organization (WHO) ranked patient safety culture as the as the third most popular topic of fifty global top-priority research topics. The concept of safety culture refers to “the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine

the commitment to, and the style and proficiency of, an organization's health and safety management” [3]. Although hospitals strive in pursuing high quality and safety of health services, evidence suggests the urgency of enhancing a culture of safety. The measure of patient safety culture is the first necessary step to improve the culture of safety within a clinical setting. A successful initiative conducted by AHRQ in measuring patient safety culture is the development of Hospital Survey on Patient Safety Culture (HSOPSC), this led the measurement of safety culture literature and has been widely applied due to its high reliability and validity [4]. The survey questionnaire contains ten dimensions of safety culture and two dimensions

of patient safety outcome [3]. Leveraging this measurement, Hansen LO and colleagues' research indicated hospitals with a higher overall safety culture score associated with a decrease of hospital readmission rate [5]. The education background and work environment of health workers were positively associated with patient safety outcomes [6]. The impact of staff safety behaviour on patient safety outcomes was considered in Neal and Griffin's study in 2002 [7]. They categorized safety behavior into two types: compliance and participation behavior. Their results indicated that a culture of safety can promote safety behavior among health workers. Studies revealed patient safety culture was associated with patient outcomes. However, the current literature of exploring the association of patient safety culture and hospital safety performance was limited in one specific department [8,9] or one specific group of population [10,11]. The safety behavior might be an important knot between patient safety culture and hospital safety performance. Published researchers' definition of safety performance is limited to negative indicators (e.g., readmission rate, adverse events, medical error) [12,13], positive indicators are barely used in previous studies. Literature evidence in assessing the association of patient safety culture and safety performance remains unclear and inconsistent in developing countries. To address this literature gap, we conducted this study with an aim of establishing the association of patient safety culture and hospital safety performance in five tertiary hospitals in northern China. We proposed the following research theoretical model and hypothesis (Figure 1).

Hypothesis 1: Patient safety dimensions positively associated with the safety performance.

Hypothesis 2: Staff safety behavior exerts positive effects on safety performance.

Methods

Development of survey questionnaire

Two translators translated the original HSOPSC into Chinese. Staff safety behavior was categorized as compliance behavior and participation behavior. We defined hospital safety performance as all measurable results that acquired from health care delivery. It includes four dimensions: safety management: the organizations and principles developed in purpose of safety management; safety facility: the facilities used to avoid harm to patients and staff; safety training: training that hospital provided for staff and patients to ensure care safety; and safety events: the number of errors reported and the disposal procedure when error occurs. Discrepancies in the development of questionnaire were solved through group discussion involved senior health service researchers, doctors, nurses and translators. The finalized survey questionnaire has 16 dimensions (Table 1) and the answers followed the 5-point Likert scale of agreement/frequency (Strongly Disagree/Never =1; Strongly Agree/Always=5). We conducted a pilot study to test the reliability and validity of this questionnaire and the results indicated a good performance. This on-site cross-sectional study recruited a convenience sample of five tertiary hospitals with over 1000 beds respectively in Harbin, China. Purposive sampling was applied during the hospital unit selection in order to cover all important clinical departments in hospital. Under the agreement of the research team and participated hospitals, a group of trained investigators distributed the questionnaires in each department during the morning meeting. The attending staff voluntarily and anonymously participated in this survey. A small gift was distributed to participants when the questionnaire

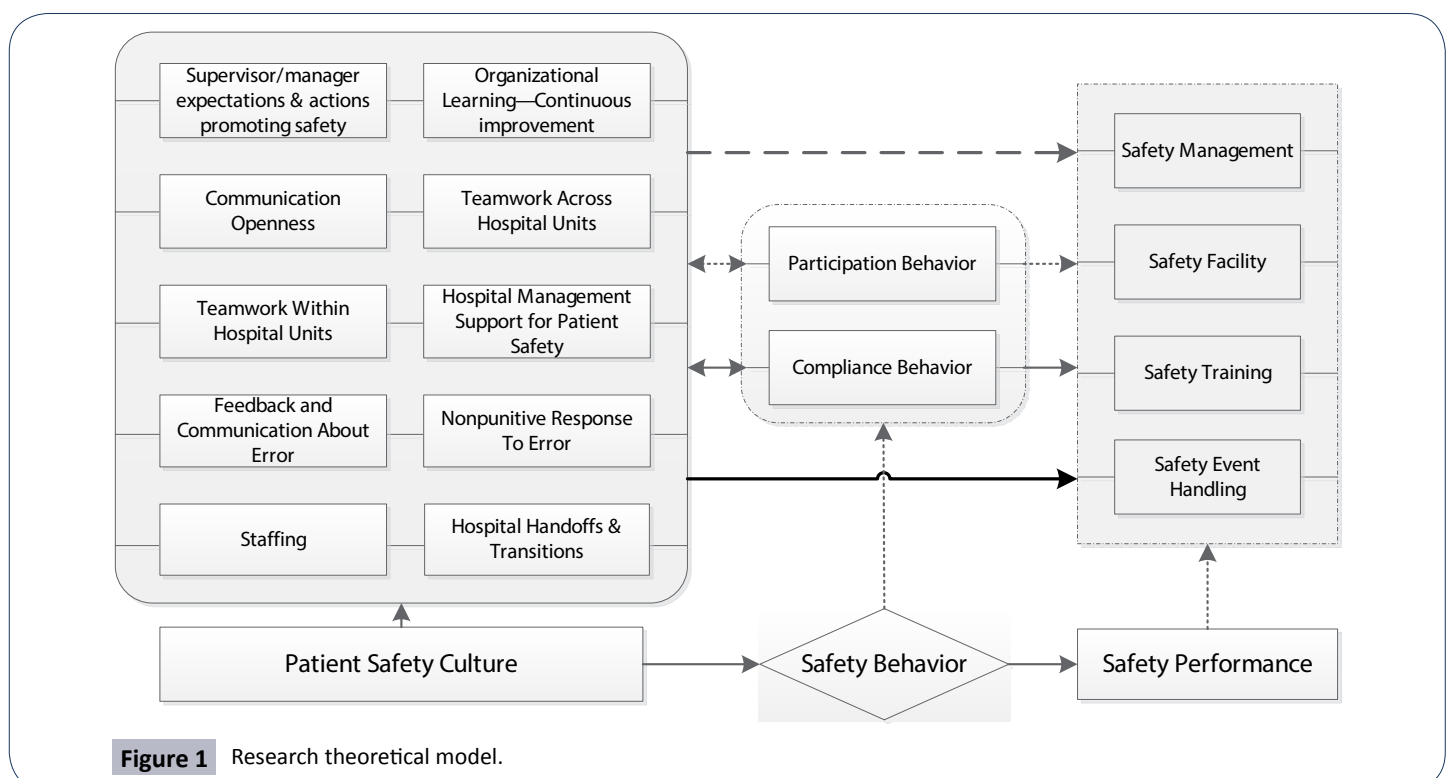


Figure 1 Research theoretical model.

Table 1 Survey questionnaire dimensions.

Patient safety culture	Supervisor/Manager Expectations and Actions Promoting Safety	4 items
	Organizational Learning—Continuous improvement	3 items
	Teamwork Within Hospital Units	4 items
	Communication Openness	3 items
	Feedback and Communication about Error	3 items
	Nonpunitive Response to Error	3 items
	Staffing	4 items
	Hospital Management Support for Patient Safety	3 items
	Teamwork Across Hospital Units	4 items
	Hospital Handoffs and Transitions	4 items
Safety behavior	Participation Behavior	5 items
	Compliance Behavior	5 items
Safety performance	Safety Management	7 items
	Safety Facility	5 items
	Safety Training	6 items
	Safety Event Report	6 items

was returned to ensure the questionnaire answer quality and maximize response rates.

Statistical Analysis

Descriptive statistics (proportions, medians and interquartile range or means and standard deviations as appropriate) were employed to describe the participants' characteristics. Cronbach's alpha was calculated to describe the reliability of survey questionnaire. Logistic regression was used to establish the association of patient safety culture and hospital safety performance adjusted for the staff age, gender, education background, title, work hours per week and health professional years. Stepwise regression was used to refine the logistic model (Alpha-to-Enter=0.1, Alpha-to-Remove=0.2). Odds ratios (OR) and 95% confidence intervals (CI) was employed to summarize measures of association. P value of 0.05 was considered as significant level. Statistical analysis was performed using Stata SE 13.1 (Stata Corp. LP, College Station, TX, USA).

Ethical approval

Local ethics board approved this study and all hospitals were informed prior to the survey. All participated staff was informed of the research purpose through a cover letter of the questionnaire and voluntarily joined the investigation. We are unable to disseminate research results to any participants due to our anonymous procedure.

Results

Sample and response statistics

Five tertiary hospitals with over 1000 beds respectively agreed to participated in this survey. We distributed 600 questionnaires and 507 of them were returned and analyzed. Overall response rate was 84.5%. Demographic characteristics of survey participants were summarized in **Table 2**. The participants were physicians and nurses from Internal Medicine/non-surgical (147, 29%), Surgery Department (138, 27%), Psychiatry/mental health (91, 18%), Intensive care unit (70, 14%), Obstetrics (20, 4%) and

others (41, 8%). There were 115 physicians and 382 nurses, and among them, 81% was female. About 60% of the participants were around 30 years old. They had about 3 to 9 years of health professional experience (42.5%). Specifically, most of them (45.2%) had 3 to 9 years of experience in their hospital unit or work area. About 80% of them have bachelor's degrees and master's degrees. Workload is critical: 57% of the participants worked more than 40 hours per week. Stratify analysis indicated that 83.5% doctors and 49.7% nurses worked more than 40 hours a week.

Positive response rate

We calculated the positive response rate for each dimension. The numerator is defined as the number of positive responses ("Strongly agree/Agree," or "Always/Most of the time) to the items in the dimension, and the denominator is the total number of responses to the items (positive, neutral, and negative) in the dimension. The positive response rate of patient safety culture part in this study was compared with the response rate of the AHRQ 2016 report. The internal validity was assessed with Cronbaha Alpha. Most dimensions of this survey showed a good validity with a Cronbaha Alpha over 0.6. And overall, the survey questionnaire reached an internal validity of 0.94. A comparison of our validity test results with HSOPSC were listed in **Table 3**.

Analysis of the association

Logistic regression was utilized to analysis the association of patient safety culture, staff safety behavior and hospital safety performance. Multivariable-adjusted analyses of hospital safety performance were summarized in **Table 4**. In our final logistic regression models, after controlling for the physician/nurse factors (age, gender, education background, professional, work hours per week and healthcare working experience in years), we found patient safety culture dimensions were associated with hospital safety performance. The team work within/ across hospital units were significantly associated with safety management, with odds ratio of 0.3, 95% CI (0.15-0.61) and 0.53, 95% CI (0.34-0.84), respectively. Staff safety participation and compliance behavior were protective factors for hospital

Table 2 Demographic characteristics of participants.

	Overall (n/%)	Physician (n/%)	Nurse (n/%)
Hospital Type			
Teaching	334 (65.88)	87 (26.05)	247 (73.95)
Nonteaching	173 (34.12)	28 (16.18)	145 (83.82)
Gender			
Male	96 (18.93)	64 (55.65)	32 (8.16)
Female	411 (81.07)	51 (44.35)	360 (91.84)
Age			
18-25	65 (12.82)	4 (3.48)	61 (15.56)
25-35	303 (59.77)	58 (50.43)	245 (59.76)
35-45	107 (21.1)	39 (33.91)	68 (21.1)
≥45	32 (6.31)	14 (12.17)	18 (6.31)
Title			
Assistant	275 (54.24)	32 (27.83)	243 (61.99)
Associate	163 (32.15)	39 (33.91)	124 (31.63)
Vice professor	44 (8.68)	29 (25.22)	15 (3.83)
Professor	13 (2.57)	9 (7.83)	4 (1.02)
Else	12 (2.36)	6 (5.22)	6 (1.53)
Education			
Undergraduate	100 (19.72)	0	100 (25.51)
Graduate	407 (80.28)	115 (100)	292 (74.49)
Work Hours Per Week			
≤40	216 (42.6)	19 (16.52)	197 (50.26)
> 40	291 (57.4)	96 (83.48)	195 (49.74)
Current Area/Unit work experience (year)			
≤2	133 (26.28)	37 (32.17)	96 (24.55)
3-10	224 (44.27)	41 (35.65)	183 (46.8)
10-20	100 (19.76)	24 (20.87)	76 (19.44)
≥20	49 (9.68)	13 (11.3)	36 (9.21)
Current Hospital work experience (year)			
≤2	107 (21.23)	27 (23.48)	80 (20.57)
3-10	228 (45.24)	44 (38.26)	184 (47.3)
10-20	109 (21.63)	27 (23.48)	82 (21.08)
≥20	60 (11.9)	17 (14.78)	43 (11.05)
Healthcare work experience (year)			
≤2	95 (18.89)	24 (20.87)	71 (18.3)
3-10	214 (42.54)	39 (33.91)	175 (45.1)
10-20	127 (25.25)	29 (25.22)	98 (25.26)
≥20	67 (13.32)	23 (20)	44 (11.34)

Table 3 Positive response rates (PPR) and Cronbaha Alpha for survey questionnaire. *Pearson's chi-squared test *p* value NA, Not associated.

Dimensions	PPR			Cronbaha Alpha		
	China (507)	US (128479)	<i>p</i> *	China (507)	US (128479)	<i>p</i> *
Supervisor/Manager Expectations and Actions Promoting Safety	78%	77%	0.783	0.72	0.75	0.12
Organizational Learning-Continuous Improvement	86%	72%	0.000	0.72	0.76	0.04
Teamwork Within Units	88%	80%	0.000	0.88	0.83	0.00
Communication Openness	36%	62%	0.000	0.58	0.72	0.00
Feedback and Communication About Error	73%	67%	0.008	0.77	0.78	0.55
Nonpunitive Response to Error	29%	42%	0.000	0.51	0.79	0.00
Staffing	46%	49%	0.234	0.38	0.63	0.00
Management Support for Patient Safety	36%	68%	0.000	0.51	0.83	0.00
Teamwork Across Units	66%	58%	0.000	0.61	0.80	0.00
Handoffs and Transitions	51%	44%	0.003	0.73	0.80	0.00
Participation Behavior	78%	NA	NA	0.83	NA	NA
Compliance Behavior	71%	NA	NA	0.74	NA	NA
Safety Management	64%	NA	NA	0.85	NA	NA
Safety Facility	70%	NA	NA	0.70	NA	NA
Safety Training	69%	NA	NA	0.82	NA	NA
Safety Event Handling	66%	NA	NA	0.65	NA	NA
Over ALL GRADE	60%	NA	NA	0.94	NA	NA

Table 4 Multivariable analysis of hospital safety performance. OR: Odds Ratio, CI: Confidence interval.

Variable	Adjusted OR (95% CI)	P
Safety management		
Gender	2.59 (1.38-4.88)	0.003
Professional	0.50 (0.27-0.93)	0.027
Work hours per week	1.61 (1.04-2.47)	0.031
Teamwork Within Hospital Units	0.30 (0.15-0.61)	<0.001
Teamwork Across Hospital Units	0.53 (0.34-0.84)	0.006
Hospital Handoffs and Transitions	0.54 (0.33-0.87)	0.012
Participation Behavior	0.23 (0.13-0.40)	<0.001
Compliance Behavior	0.51 (0.29-0.87)	0.013
Safety facility		
Gender	7.51 (3.07-18.38)	<0.001
Title	0.30 (0.13-0.67)	0.003
Feedback and Communication about Error	0.47 (0.23-0.96)	0.039
Hospital Handoffs and Transitions	2.52 (1.02-6.26)	0.046
Compliance Behavior	0.13 (0.07-0.26)	<0.001
Safety training		
Age	0.57 (0.37-0.9)	0.015
Gender	1.75 (1.11-2.76)	<0.001
Professional	0.32 (0.16-0.65)	<0.001
Education	1.86 (1.08-3.21)	0.025
Teamwork Across Hospital Units	0.58 (0.37-0.90)	0.014
Participation Behavior	0.21 (0.11-0.38)	<0.001
Compliance Behavior	0.30 (0.17-0.51)	<0.001
Patient safety event handling		
Gender	2.67 (1.40-5.10)	0.003
Professional	0.31 (0.16-0.61)	<0.001
Work hours per week	1.87 (1.22-2.86)	0.004
Supervisor/Manager Expectations and Actions Promoting Safety	1.80 (1.06-3.05)	0.029
Organizational Learning-Continuous improvement	0.51 (0.27-0.96)	0.037
Teamwork Across Hospital Units	0.47 (0.28-0.80)	0.006
Participation Behavior	0.42 (0.42-0.73)	0.002
Compliance Behavior	0.48 (0.27-0.83)	0.009
Title	0.4 (0.18-0.91)	0.03
Hospital Handoffs and Transitions	5.36 (1.87-15.33)	<0.001

safety management, OR=0.23, 95% CI (0.13-0.40) and OR=0.51, 95% CI (0.29-0.87). Safety facility was associated with Feedback and Communication about Error OR=0.47, 95% CI (0.23-0.96) and Hospital Handoffs and Transitions OR=2.52, 95% CI (1.02-6.26). Patient safety training was significantly associated with Teamwork Across Hospital Units. Staff safety behavior exerts positive impacts on hospital safety performance. The participation behavior was positively associated with safety management OR=0.23, 95% CI (0.13-0.40) and patient safety training OR=0.21, 95% CI (0.11-0.38). The compliance behavior was associated with safety management OR=0.51, 95% CI (0.29-0.87), safety facility OR=0.13, 95% CI (0.07-0.26) and patient safety training OR=0.30, 95% CI (0.17-0.51). Patient safety event handling was associated with Supervisor/manager expectations and actions promoting safety OR=1.80, 95% CI (1.06-3.05), Organizational Learning OR=0.51, 95% CI (0.27-0.96), Teamwork Across Hospital Units OR=0.47, 95% CI (0.28-0.80), participation behavior OR=0.42, 95% CI (0.42-0.73) and compliance behavior OR=0.48, 95% CI (0.27-0.83). Patient safety event report was

significantly associated with Hospital Handoffs and Transitions OR=5.36, 95% CI (1.87-15.33).

Discussion

This multicenter cross-sectional study found that patient safety culture was associated with safety performance. Staff safety behavior exerts positive effects on safety performance. The Teamwork Within and Across Hospital Units, Hospital Handoffs and Transitions should be used as a target for future quality and safety improvement initiatives to reduce medical errors. The sample of this study covered most of the hospital departments (e.g., Internal Medicine, Surgery, Pharmacy, Psychiatry, ER, ICU, Gynecology, Anesthesiology, etc.). The investigated physicians and nurses contributed a high response rate of 84.5%. Our survey tool was validated prior to this investigation. Our survey questionnaire showed a similar validity compare to the HSOPSC user guide. Our results indicated patient safety culture dimensions had a positive impact on hospital safety performance. For example, good teamwork within/across

hospital units lead to a better safety performance. The results are consistent with current literature. Previous studies found that improve the communication between members could decrease the mortality within a critical care unit [10]. A systematic review work also suggested that patient safety culture was associated with patient outcomes in nursing environment [14]. However, those studies were limited to single department/population. The findings in our study closed the knowledge gap and provided comprehensive evidences in establishing the association between patient safety culture and outcomes. The staff safety behavior was introduced in this particular study to measure its impact on safety performance. It demonstrated in our results as a significant protective factor for safety performance. The staff safety behavior includes compliance behavior and participation behavior. Neal and Griffin indicated that safety culture could promote staff safety behavior [7]. Our results showed, staff safety behavior is significantly associated with hospital safety performance, which means, staff safety behavior is the media of patient safety culture and hospital safety performance. Improving staff safety behavior may lead to both positive changes in safety culture and hospital safety performance. This might be an efficient route for future quality improvement initiatives. The definition of hospital safety performance in this study not

only included the hospital/patient safety outcomes, but also the hospital management of safety, facilities and trainings for safety, which we believe is a better way of understanding the essentials of hospital performance. Following factors should be considered when interpreting our results. First, the accuracy of health professionals' self-reported data is a known issue. The sampling bias may occur due to our convenient sampling method. Second, this study measured the association of patient safety culture and hospital safety performance with a cross-sectional design, therefore, causal inference is not applicable. Third, the external validity of this study was slightly impacted since the healthcare policy and resource allocation may different in other jurisdictions.

Conclusions

This study indicated that patient safety culture was associated with safety performance and staff safety behavior exerts positive effects on safety performance. The Teamwork Within and Across Hospital Units, Hospital Handoffs and Transitions could be targeted as a prioritization for future quality and safety improvement initiatives to optimal hospital safety performance.

Competing Interests

No competing interests reported.

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