Establishing a Culture of Patient Safety: Further Psychometric Validation of the Revised Safety Attitudes Questionnaire in Taiwan

Yung-Tai Tang, Hsin-Hung Wu, Yii-Ching Lee, and Chih-Hsuan Huang

***Abstract*—The increasing number of healthcare-related adverse events around the world confirms the importance of improving patient safety culture in healthcare organizations around the world. Physicians and nurses play a pivotal role in promoting patient safety due to the nature of their work. This study re-validates the Chinese version of the safety attitudes questionnaire (SAQ) to increase its accuracy and concision in estimating health professionals' safety attitudes in Taiwan. Two stages of data evaluation were employed. A survey was conducted with 384 healthcare workers in a regional teaching hospital, and its results were assessed using exploratory factor analysis (EFA) to extract potential dimensions. Then, survey data from 742 samples obtained from a medical center were examined using confirmatory factor analysis to estimate the stability of the measurement variables derived from the EFA results. Two correlated first-order factors were found, including 10 items identified as measures of collaborative commitment and stress recognition. To improve the quality of medical care delivered to patients, it is necessary to periodically assess patient safety culture and identify how medical staff perceive it. The revised SAQ will assist further practice in assessing patient safety in Chinese healthcare setting.**

***Index Terms*—Chinese version of safety attitudes questionnaire; patient safety culture; exploratory factor analysis; confirmatory factor analysis; scale adaptation**

I. Introduction

Patient safety is being increasingly recognized as a worldwide health concern and it is a key pillar in medical quality and safety. The US Institute of Medicine defined patient safety as "the prevention of harm to patients from the care that is intended to help them" [1]. Several studies have identified an abundance of patients who have suffered from preventable medical malpractice, which calls for more attention to be paid for patient safety. According to the annual report of the World Health Organization, 1 in 10 hospitalized patients experience medication-related harm due to adverse events and avoidable medication errors [2]. In addition, a report conducted by the Australian Institute of Health and Welfare found that 10.1% of overnight hospitalizations in Australia result in adverse events [3]. In Portugal, approximately 11.1% of medical errors happen in acute care hospitals, 53.2% of which are considered preventable [4]. Although the concept of patient-centered safety is widely promoted in hospitals, there is still room for improvement in the quality of patient care and safety.

Research has provided ample evidence that a staggering number of healthcare-related injuries and deaths could be prevented if patient safety were given first priority in hospitals [5,6]. A recent review of the literature on healthcare management identified that positive patient safety culture allows medical staff to reduce medical errors, work cooperatively across units, and commit to safer care [7,8]. To ensure patient safety and prevent adverse events, it is necessary to establish a stronger patient safety culture in healthcare organizations. Patient safety culture has been defined by the European Network for Patient Safety as "an integrated pattern of individual and organizational behavior, based upon shared beliefs and values that continuously seeks to minimize patient harm, which may result from the processes of care delivery" [9]. In recent years, the evaluation of patent safety culture has notably increased in many medical institutions. Patient safety culture assessments in Taiwan are conducted in healthcare organizations on a yearly basis to identify the shortcomings and inadequacies of the implications with regard to patient safety [5, 10].

Safety culture measurements have been conducted to evaluate the perceptions of medical staff concerning patient safety culture, such as the Hospital Survey on Patient Safety Culture, Safety Attitudes Questionnaire (SAQ), and Patient Safety Climate in Healthcare Organizations. The SAQ is the most commonly used safety culture assessment instrument in healthcare organizations, and it shows good psychometric properties and internal consistency [11,12]. In recent years, the SAQ has been cross-culturally verified and translated into different languages, including English, Swedish, Arabic, Italian, and Chinese [13–17]. Furthermore, previous studies have indicated the importance of the SAQ assessment in contributing to the identification of medication errors, the patient–physician relationship, length of hospital stay, and medical care [18–20].

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The original SAQ developed by Sexton et al. [13] has a six-factor assessment of patient safety culture, including the teamwork climate, safety climate, perceptions of management, job satisfaction, stress recognition, and working conditions. In 2007, the Joint Commission of Taiwan developed the Chinese version of the SAQ using forward and backward translation of the SAQ to ascertain the status of patient safety culture in healthcare organizations in Taiwan [21]. Since then, the Chinese version of the SAQ has become the official survey for healthcare organizations in Taiwan to yearly monitor the quality of healthcare. However, the patient safety culture instrument should be re-validated periodically because the psychometric properties of patient safety culture change over time [22]. Moreover, previous reviews of safety culture measures have indicated that most of the measures were developed in English-based culture [23,24]. Cultural variation regarding the perception of medical staff toward patient safety in different country settings must be taken into account [25]. Thus study was performed to re-validate the Chinese version of the SAQ and identify mechanisms for improving patient safety culture.

II. RESEARCH METHOD

A cross-sectional study using convenience sampling was conducted in Taichung City, Taiwan. Samples from two categories of hospital (one regional teaching hospital and one medical center) were selected due to their high ranking among the 79 general and teaching hospitals in Taiwan [26]. Both hospitals feature medical personnel with excellent skills and strong professional reputations.

Measure and data sample

An intra-organizational survey was used to investigate patient safety culture in the case hospitals in November 2017. All respondents (physicians and nurses) were informed that their participation was anonymous and voluntary, and all responses would be treated confidentially. A reminder e-mail was sent approximately 7 days after the survey was distributed. At the regional teaching hospital, a total of 450 questionnaires were issued, and 384 completed questionnaires were returned, for an 85.33% response rate. For the medical center, 950 questionnaires were distributed, and 742 valid questionnaires were obtained from the medical center (response rate = 78.10%).

Measurement

The Chinese version of the SAQ was adopted in the current study, which included six dimensions and 30 questions (Table 1). The six dimensions of the SAQ were teamwork climate (relationships and cooperation among staff), safety climate (the perceptions concerning organizational commitment to patient safety), perceptions of management (the approval of managerial actions), job satisfaction (feeling positive about the work experience), stress recognition (stress factors that could influence work performance), and working conditions (perceived work-environment quality and logistical support in relation to staffing and equipment). Each item was assessed on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Data analyses

A two-stage data evaluation was employed. In the first stage, the regional teaching hospital with a sample size of 384 was used to conduct exploratory factor analysis (EFA) to extract items with factor loading values greater than 0.5 and to extract potential dimensions as well. Later, the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were used to confirm whether EFA was appropriate. In the second stage, 742 samples obtained from the medical center were used to perform confirmatory factor analysis (CFA) to estimate the stability of the relationship between the structural factors and measurement variables from the aforementioned EFA results and verify whether cross validity exists for this developed scale [27]. Following Doll et al.'s research [28], the model fit of the factors were tested individually using four CFA models, namely, Model 1 (one first-order factor), Model 2 (three uncorrelated first-order factors), Model 3 (three correlated first-order factors), and Model 4 (three first-order factors and one second-order factor). Following this, the goodness-of-fit (GFI) indices of the four models of CFA were compared to select the best model fit in terms of root mean square error of approximation (RMSEA), normed fit index (NFI), and comparative fit index (CFI).

Ethical approval

Ethical approval for this study was provided by the Institutional Review Board (IRB) of an area hospital in Taiwan (approval no: HP190028). Consent to use their response data was implied by the respondents' participation in the study.

III. RESULTS

Exploratory factor analysis

Two steps were implemented to estimate the dataset of the first group sample (n = 384) in the EFA procedure. First, common factor extraction using principal components analysis was executed to retain the common factors with eigenvalues greater than one. Then, varimax solution was set as an orthogonal rotation for factor axes to maximize the variance of the squared loading of the factors in a factor matrix. From the EFA results, 20 items were moved from the 30 items of the Chinese version of the SAQ due either to lower factor loading values (<0.5) or the existence of cross-loading among factors. The same EFA procedure was performed repeatedly on the 10 retained items, resulting in a two-factor solution that explained 61.58% of the overall variance. The KMO measure of sampling adequacy value for items was 0.81 and the approximate chi-square value obtained from Bartlett's test of sphericity was significant, with $p < 0.01$, indicating that the retained items were adequate for EFA [29]. We labeled the two extracted dimensions collaborative commitment (TC4, TC5, TC6, SC5, JS1, and PM4) and stress recognition (SR1, SR2, SR3, and SR4). The respective Cronbach's alpha values of these two dimensions were 0.80 and 0.88, respectively.

Confirmatory factor analysis

The CFA was conducted to re-examine the results proposed in the EFA procedure and verify the cross-validity

of the scales. Four CFA models were assessed from Doll et al.'s research [28]. As indicated in Table 3, Model 3 had the best model fit, with an RMSEA of 0.072, an NFI of 0.98, a GFI of 0.97, and a CFI of 0.99 [30].

In addition, composite reliability (CR), and average variance extracted (AVE) demonstrated convergent validity for Model 3 (Table 4). The results showed that the factor loading for the two dimensions range between 0.64 and 0.90, and the CR of the two dimensions (0.91 and 0.91) were superior to the recommended of 0.60 threshold, and the AVE estimates (0.63 and 0.72) were above 0.50 [31]. The AVE was greater than the square of the inter-dimension correlations between two dimensions. Accordingly, all of these values met the criteria of composite reliability, convergent validity, and discriminant validity. To sum up, two dimensions and 10 items were recognized in our Chinese version of the SAQ.

IV. DISCUSSION

We re-verified the Chinese version of the SAQ by investigating the perceptions of medical staff (physicians and nurses) with regard to patient safety from two categories of hospital in Taiwan. The valid response rate was satisfactory and higher than those of similar studies (59% to 70%) [32–35], which indicated that the results might accurately reflect health professionals' attitudes concerning patient safety. In other words, hospital managers and medical staff are willing to contribute to the establishment of patient safety culture. Studies agree that management commitments to patient safety in hospitals can help medical staff better integrate the organizational culture and enable them to deal more clearly with patient safety issues in nursing work [36, 37]. Günalan and Ceylan [38] found that the support of hospital managers plays an important role in reducing turnover intention and job dissatisfaction in medical staff. This study suggests that in healthcare organizations, managerial involvement, commitment, and encouragement should focus on patient safety culture. The transformational leadership style should be promoted to strengthen the safety climate in hospitals.

The results of the reliability and validity examination were good for all scales, which indicates that the psychometric properties of the Chinese version of the SAQ were reliable. The Cronbach's alpha values for two dimensions were 0.80 and 0.88, indicating high reliability and internal consistency for the measurement scales. Furthermore, the values of GFI, CFI, and NFI were above 0.90, and the RMSEA value was 0.074, demonstrating a good model fit in our study. Accordingly, this study has produced a reliable and streamlined Chinese version of the SAQ and rendered it in a way that is a more accurate means of estimating health professionals' safety attitudes in Taiwan.

The distribution of the questions among the dimensions was different from that of the original English version and Chinese version of the SAQ [13, 21]. In our study, the questions regarding teamwork climate, safety climate, job satisfaction, and perceptions of management were merged into one dimension. A new dimension was created, which included three questions for teamwork climate, one for safety climate, one for job satisfaction, and one for perceptions of management. This dimension was named "collaboration and commitment," and it emphasized the importance of cooperation mechanisms, patient safety promotion, and managerial commitment and should be prioritized when examining the status quo of patient safety culture in healthcare organizations. Huang et al. [6] found that a cooperative environment in hospitals helps promote the delivery of safer healthcare, thus ensuring enhanced patient safety. Further, Freischlag [39] showed that training and coaching programs in healthcare can enable medical staff to develop cooperative and communication skills. Therefore, we suggest that regular training courses should be conducted to help medical staff share information and cooperate with each other when managing work problems. In addition, interval-valued intuitionistic fuzzy preference relation can be introduced to deal with group decision making using complex and uncertain information during medical encounters [40].

No changes were made regarding stress recognition in four questions. Medical staff work in a complex and high-pressure working environment for a long time. The accumulated pressure may cause physical and mental injury and burden, and directly affect medical quality [12]. We suggest that nursing managers can reduce work pressure through reasonable resource scheduling via cloud computing [41] and the creation of a harmonious working condition. In addition, a linkage pattern-mining method that considers the interval and appearance order of frequent mental and physical pressure-patterns is also suggested to predict risks associated with stress conditions [42].

Items on working conditions were removed in this Chinese version of the SAQ. Possible reasons leading to this asymmetry could relate to the basis of potential cultural differences and diversities. Asian health professionals are commonly characterized as collectivists, who view themselves as parts of a group and consider their work to be important if it benefits the whole group rather than their own personal goals. They tend to prioritize the goals of others over their own preferences, needs, and rights. By contrast, in Western individualist culture, individuals concentrate more on rewards, personal achievements, and initiatives. In other words, the individual needs outrank the needs of the group [43, 44].

Implications

First, the hospitals selected for our study were representative general and teaching hospitals in Taiwan, so the respondents (both physicians and nurses) likely represent the safety attitudes of health professionals in Taiwan. Second, from our findings, hospital managers could either precisely assess the level of care of patient safety or provide clear guidance for initial steps to take to heighten patient safety culture in practice. Third, the current study provides the potentially critical factors that would better promote patient safety culture, and provides reference for future intervention studies.

Limitations

The generalizability of the findings of this study is limited. We only investigated physicians' and nurses' perceptions of patient safety in hospitals, so our results are not generalizable to other types of health professional, such as pharmacists,

medical laboratory scientists, and medical technologists. Furthermore, the questionnaire results may be limited to the sample investigated. Because regional teaching hospitals and medical centers are funded by diverse sources and according to different policies in Taiwan, differences concerning patient safety-related attitudes may exist among hospital managers and personnel.

V. CONCLUSION

In the context of a growing number adverse medical adverse events, it is essential to periodically evaluate the status quo of patient safety culture in any healthcare accreditation. The re-verified Chinese version of the SAQ demonstrates adequate composite reliability, convergent validity, and discriminant validity. The analysis of measurement validity through EFA and CFA renders an acceptable model, although further modification and evaluation of some items could be considered if the psychometric soundness is being reconstructed for use in other cultures/contexts. Initiatives are needed to concentrate on collaborative commitment and stress recognition to improve safety attitudes of healthcare workers in Chinese hospitals.

TABLE I THE CHINESE VERSION OF THE SAQ

Teamwork climate (TC)	(1) Nurse input is well received in this clinical area (2) In this clinical area, it is difficult to speak up if I perceive a problem with patient care* (3) Disagreements in this clinical area are resolved appropriately (i.e., not who is right, but what is best for the patient) (4) I have the support I need from other personnel to care for patients (5) It is easy for personnel here to ask questions when there is something that they do not understand (6) The physicians and nurses here work together as a well-coordinated team
Safety climate (SC)	(7) I would feel safe being treated here as a patient (8) Medical errors are handled appropriately in this clinical area (9) I know the proper channels to direct questions regarding patient safety in this clinical area (10) I receive appropriate feedback about my performance (11) In this clinical area, it is difficult to discuss errors* (12) I am encouraged by my colleagues to report any patient safety concerns I may have (13) The culture in this clinical area makes it easy to learn from the errors of others
Job satisfaction (JS)	(14) I like my job (15) Working here is like being part of a large family (16) This is a good place to work (17) I am proud to work in this clinical area (18) Morale in this clinical area is high
Stress recognition (SR)	(19) When my workload becomes excessive, my performance is impaired (20) I am less effective at work when fatigued (21) I am more likely to make errors in tense or hostile situations (e.g., emergency resuscitation, seizure) (22) Fatigue impairs my performance during emergency situations
Perceptions of management (PM)	(23) Managers support my daily efforts (24) Managers do not knowingly compromise patient safety (25) I get adequate, timely information about events that might affect my work (26) The levels of staffing in this clinical area are sufficient to handle the number of patients
Working conditions (WC)	(27) Problem personnel are dealt with constructively (28) This hospital does a good job of training new personnel (29) All the necessary information for diagnostic and therapeutic decisions is routinely available to me (30) Trainees in my discipline are adequately supervised

* Indicates the question item is worded negatively.

TABLE II THE RESULTS OF EFA

	Scale Items	Factor 1	Factor 2
TC4	I have the support I need from other personnel to care for patients	.82	
TC5	It is easy for personnel here to ask questions when there is something that they do not understand	.85	
TC6	The physicians and nurses here work together as a well-coordinated team	.84	

SC5	In this clinical area, it is difficult to discuss errors	.53	
JS1	I like my job	.64	
PM4	The levels of staffing in this clinical area are sufficient to handle the number of patients	.53	
SR1	When my workload becomes excessive, my performance is impaired		.86
SR2	I am less effective at work when fatigued		.86
SR3	I am more likely to make errors in tense or hostile situations		.83
SR4	Fatigue impairs my performance during emergency situations		.86
eigen value		3.17	2.94
cumulative % of variance		31.77	29.81
Cronbach's alpha		.80	.88

Note: COP: collaboration; SC: safety climate; SAT: job satisfaction; MGT: perceptions of management; SR: stress recognition

TABLE III THE MODEL FIT RESULTS OF FOUR DIFFERENT CFA MODELS

Model	χ^2	RMSEA	NFI	GFI	CFI
1. one first-order factor	2840.05	.300	63	.57	.63
2. three uncorrelated first-order factors	188.25	.084	.97	.95	.98
3. three correlated first-order factors	129.64	.072	.98	.97	.99
4. three first-order factors and one second-order factor	523.05	.140	.93	.88	.94

TABLE IV THE RESULTS OF FACTOR LOADING, CR, AVE FOR MODEL 3

Dimensions and items	Factor loading	R^2	CR	AVE
Collaboration and Commitment			.91	.63
TC4 I have the support I need from other personnel to care for patients	.64**	81		
TC5 It is easy for personnel here to ask questions when there is something that they do not understand	.90**	.75		
TC6 The physicians and nurses here work together as a well-coordinated team	.87**	.71		
SC5 In this clinical area, it is difficult to discuss errors	.84**	.64		
JS1 I like my job	.80**	.47		
PM4 The levels of staffing in this clinical area are sufficient to handle the number of patients	.68**	.41		
Stress Recognition			.91	.72
SR1 When my workload becomes excessive, my performance is impaired	.87**	.75		
SR2 I am less effective at work when fatigued	.90**	.82		
SR3 I am more likely to make errors in tense or hostile situations	.76**	.57		
SR4 Fatigue impairs my performance during emergency situations	.87**	.76		

** $p < .01$

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