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Measuring Patient Safety Culture in Iran Using the Hospital Survey on Patient Safety Culture (HSOPS): an Exploration of Survey Reliability and Validity

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Abstract

Background and Objectives: Patient Safety Culture is increasingly recognized as an essential driver of patient safety. To establish patient safety culture, firstly the current status of the construct should be assessed. Valid assessment of patient safety culture is contingent on the availability of appropriate measurement tools. Hospital Survey on Patient Safety Culture (HSOPS) developed by the Agency for Healthcare Research and Quality (AHRQ) is frequently used for patient safety culture assessment. Dimensions of patient safety culture may vary between different cultures and this affects the utility of popular measurement models in different countries. This study aimed to examine the extent to which the dimensions of patient safety culture in Iran can be explained by the factor structure of HSOPS.

Methods: Healthcare workers in all university hospitals of Qazvin, the center of Qazvin province in Iran, were asked to complete the HSOPS survey (n = 231). Descriptive statistics were used for data summarization. Reliability of the questionnaire was evaluated by calculating Chronbach's alpha. Validity of the construct was assessed by correlation analysis among the factors. Exploratory factor analysis was used to investigate the extent to which HSOPS factor structure underlies our dataset. ANOVA and t-test were used to compare the score means between professions.

Findings: HSOPS's factor structure was not replicated by factor analysis. Reliability analysis yielded generally unacceptable internal consistency. By contrast, correlation analysis provided evidence for validity of construct by reproducing meaningful patterns of interrelations observed in precedent studies. The relative magnitude of factor scores generally followed the pattern in the benchmark study by AHRQ.

Conclusions: Based on our results, the reliability of HSOPS for use in Iran seems questionable. Our results, therefore, point to the necessity of large-scale studies to understand the dimensions of patient safety culture in Iran, and to develop a reliable and valid tool for its measurement.

Keywords: Patient Safety, Patient Safety Culture, Hospital, Survey, HSOPS, Reliability and Validity

Background and Objectives

Patient safety is one of the crucial aspects of quality of healthcare and a determining factor in patients' health and lives. While in developed countries patient safety is now recognized as a top priority in their healthcare systems [1], the medical adverse events still remain as a global challenge and no country has yet overcome all of its patient safety problems [2]. Data from well-funded and technologically advanced hospitals confirm that one in every ten patients admitted to hospitals is affected by an adverse event (incident rate of 10%). The situation is thought to be more challenging in developing countries with higher risk of patient harm due to the limitation of resources and lack of adequate infrastructures [3]. Medical error is unacceptably among the five most common causes of preventable death [4] and millions of patients are hurt each year due to unsafe care practices [5].

Such a situation has provoked global concern about patient safety issues, and exploring solutions to the problem. In this context, the experiences of high-reliability organizations (HROs) in hazardous industries such as aviation and chemical industries are particularly valuable. High-reliability organizations are those with low probability of adverse event occurrence while working in high-risk conditions [6]. Systematic review of publications on HROs by Weick et al. [7] indicates that high reliability is a result of mindful organizing—"the collective capability to detect

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and correct errors and unexpected events" [8]. Mindful organizing entails commitment of leaders and members to develop a relational foundation and a system of organizing processes and practices that combinedly describe the organization's culture of safety [7, 9, 10]. Organizational culture is identified as a source of high-reliability [11]; studies show that HROs have continuously monitored their safety culture over the past two decades [11-13], and their high safety performance is associated with their acknowledgement of organizational culture as a fundamental safety promotion factor [14]. The high rate of morbidity and mortality in healthcare organizations (HCOs) portrays healthcare as a high-hazard industry. Thus building a culture of safety is imperative for HCOs in order to become high-reliability organizations [13].

Organizational culture is defined as the "shared values (what is important) and beliefs (the why behind what happens) which guide the behavior of the members" [15]. Studies over the past decades have demonstrated that for organizations to successfully implement changes and to achieve their goals, the policies, practices and objectives should be deeply rooted in organizational culture [16, 17]. Culture establishes link between employees and the organization's mission, reinforces the essential values upon which the organization is based, supports commitment to organizational goals and instructs members how to act so that the goals are fulfilled [18]. In this context, the 'safety culture' emerges as the entire set of cultural elements, including values, beliefs and practices that support the progress of an organization towards the goal of safety.

Organizations with positive safety culture are characterized by trust-based relationships, collective acknowledgement of the importance of safety and strong belief in the efficiency of predictive approaches [19]. In safety culture, employees and managers within the organization are constantly aware that incidents can happen, they perceive the occurrence of mistakes as a fact, and try to learn lessons from them. The supportive and 'Just Culture' environment allows individuals to speak openly on safety issues, seek for help when safety of care being delivered is threatened, feel themselves accountable for their actions and at the same time, not to be blamed when an incident is a result of a system failure [20, 21].

Despite its benefits, however, creating a patient safety culture is a challenging task due to the complexity of both HCO and PSC as well as the magnitude of changes needed to be introduced [13]. Strong leadership and strong management commitment at the highest organizational level are crucial factors in driving safety culture [20, 22]. Management also needs to have a view of the current status of PSC to be able to identify high priority areas for improvement [23]. Assessment of the existing situation of safety culture is the starting point for developing PSC strategies [24]. This has induced numerous government-supported studies in different countries to yield a nation-wide snapshot of PSC [25-29]. In Iran, however, the concept is quite new, and related government activities and academic research in the field have only recently started. Until now, no report of an assessment of PSC in the Iranian context has been published in international journals. Given the prominent role of PSC in sustainable improvement of patient safety, and the existing PSC knowledge gap between Iran and developed countries, accelerated contribution of Iranian academic research to the evaluation and promotion of PSC is essential. As an initial attempt to address such a need, in this study we assessed perception of healthcare workers towards PSC dimensions in a number of Iranian university hospitals, and compared the result with those of the benchmark US survey [30].

Valid evaluation of organizational variables entails using valid measurement tools. A number of self-assessment questionnaires have been developed to measure PSC in healthcare facilities [31-33]. One of the most widely used questionnaires is the Hospital Survey on Patient Safety Culture (HSOPS) [34] developed by the Agency of Healthcare Research and Quality (AHRQ) [35]. The tool comprises 42 items grouped into 12 PSC measures. HSOPS has been used in numerous local and nation-wide studies and its reliability and validity is extensively examined in different cultures and environments. Studies show that the survey's psychometric properties and its utility for PSC measurement can be influenced by cross-cultural differences [36]. The extent to which this survey can capture the latent variables underlying PSC constructs vary from complete fitness to data from the US [25] and Japan [29], to weak representation of the construct in the UK [37]. In pursuit of the question whether HSOPS is suitable for use in the Iranian hospitals, we explored the factor structure of PSC measures in our dataset and compared it with the survey. In addition, we examined the reliability and validity of the constructs and discussed their implications.

Methods

Study Design and Sampling

A cross-sectional study was conducted from March to June 2011. Data was collected from all five university hospitals of Qazvin University of Medical Sciences, located in Qazvin city, the center of Qazvin Province in Iran. To enable comparing perception of safety among nurses, physicians, and paraclinical personnel, the stratified sampling method was used. The sample size was determined based on a formula that allows

for detection of a five-point difference in mean scores for perception of PSC dimensions [38] within an SD of 10 points, with the power of 0.8 at 95% confidence level. The required sample size was determined 64. However to cover a predicted non-response rate of 20%, 77 people were selected from each of the three groups. The questionnaires were administered by the members of the research groups. The participants voluntarily responded to the questionnaire.

Measurement

Survey Instrument

Hospital Survey on Patient Safety Culture (HSOPS) was used for data collection. The survey was developed by the Agency for Healthcare Research and Quality (AHRQ) in 2004 [34] and has been frequently used for measuring PSC in hospitals. HSOPS comprises 42 items grouped into 12 defined PSC dimensions. The questionnaire has been translated into around 20 different languages, and is currently used in over 30 countries.

The Persian version of the survey

HSOPS was translated into Persian by a member of the research group. Other members of the group reviewed the Persian version draft, and the concepts and phrases were reworded to adjust to the Iranian culture where necessary. A pilot study was carried out by inviting nine healthcare workers (three from each group of nurses, physicians, and paraclinicians) who were excluded from sampling. Based on their comments and suggestions, the questionnaire was revised for further comprehensibility. The resulting questionnaire was then translated back to English and an independent English language professor was asked to evaluate linguistic validity. The final Persian version was confirmed and used for the survey.

The Persian HSOPS is consisted of the same dimensions and items as in the study by AHQR [30]. The survey uses a five-point Likert scale which scores agreement (1 = “Strongly disagree” to 5 = “Strongly agree”) or frequency (1 = “Never” to 5 = “Always”). The questionnaire also includes two outcome questions that measure the respondents’ grading of overall patient safety in their hospital (1 = “Failing”, 2 = “Poor”, 3 = “Acceptable”, 4 = “Good” and 5 = “Excellent”) and the number of events they had reported during the past 12 months (“No events”, “1 to 2 events”, “3 to 5 events”, “5 to 6 events”, “6 to 10 events”, “11 to 20 events”, and “21 events or more”).

Statistical Analysis

Demographic data and the scores of patient safety culture dimensions were summarized using descriptive statistics. The scores of negatively worded items were reversed to ensure that higher scores always reflect more positive responses. The Likert-type scale was converted to a 100-point scale (1 = 0, 2 = 25, 3 = 50, 4 = 75, and 5 = 100). For the purpose of study, a score equal or higher than 75 (“Strong agree” and “Agree”, or “Always” and “Most of the time”) was considered to reflect a positive perception of the respondent towards the scored dimension.

Patient safety culture factors were analysed using analytical statistics. Exploratory factor analysis was used to examine to what extent the factor structure of HSOPS underlies our dataset. Bartlett’s test was used to determine the sufficiency of inter-item correlations. Sampling adequacy was determined using the Kaiser-Meyer-Olkin

Table 1 Professional characteristics of the participants

Variables	Number	%
Gender *(n = 145)*		
Male	121	83
Female	24	17
Profession *(n = 145)*		
Nurse	71	49
Doctor	20	14
Paraclinician	54	37
Laboratory personnel	41	28
Radiology personnel	13	9
Work unit *(n = 145)*		
Laboratory and radiology	54	37
Emergency	23	16
Surgery	14	10
Other	54	37
Work experience in current hospital *(n = 145)*		
< 1 year	26	18
1-5 years	47	32
6-10 years	26	18
>= 11 years	46	32
Work experience in current job *(n = 145)*		
< 1 year	17	12
1-5 years	43	30
6-10 years	35	24
>=11 years	50	34

Table 2 Intercorrelations of HSOPS's 12 patient safety culture factors

Factors	1	2	3	4	5	6	7	8	9	10	11	12
1. Teamwork within Units	1											
2. Leadership expectations and actions	0.309**	1										
3. Organization learning	0.443**	0.23**	1									
4. Management support	0.176*	0.445**	0.305**	1								
5. Overall perceptions of safety	0.321**	0.451**	0.392**	0.437**	1							
6. Feedback and communication	0.354**	0.256**	0.305**	0.335**	0.262**	1						
7. Communication openness	0.102	0.338**	0.115	0.413**	0.282**	0.560**	1					
8. Frequency of event reporting	0.21**	0.221**	0.169*	0.336**	0.237**	0.337**	0.320**	1				
9. Teamwork across Units	0.125	0.427**	0.100	0.521**	0.397**	0.124	0.150	0.303**	1			
10. Staffing	-0.129	0.151	0.006	0.165*	0.087	-0.073	0.054	-0.095	0.185*	1		
11. Hospital and transitions	0.175*	0.312**	0.125	0.360**	0.265**	0.129	0.207*	0.339**	0.485**	0.055	1	
12. Non-punitive response to error	0.071	0.308**	0.098	0.179*	0.265**	0.025	0.211*	0.004	0.294**	0.253**	0.02	1

** P < 0.01. * P < 0.05.

(KMO) measure. Principal component analysis with Varimanx rotation was used for factor extraction. The internal consistency reliability of the factors was evaluated using Chronbach's alpha. Mean values were compared using t-test and ANOVA, and Chi-square test was used to compare categorical data.

To investigate construct validity, correlation analysis was carried out among PSC factors. In addition, the correlations of all patient safety culture dimensions with single-item outcome measures 'Patient Safety Grade' and 'Number of Events Reported' were calculated to evaluate construct validity of individual dimensions. All statistical analyses were carried out using SPSS Version 18 software.

Ethics

The study was approved by the ethics committee of Qazvin University of Medical Sciences. Verbal consent of the participants was obtained before administering the questionnaires.

Results

Response Statistics

From 231 distributed questionnaires, 145 valid questionnaires was returned (response rate = 62%). The response rates were 92% (71/77) for nurses, 26% (20/77) for doctors, and 70% (54/77) for paraclinical staff. While 37% of the respondents were working in Laboratory or Radiology departments, 16% were working in the Emergency Department, 10% were surgeons, and 37% were working in other medical units.

Table 3 Correlations of single-item outcome variables with patient safety culture factors

Factors	Patient Safety Grade	Number of Events Reported
Teamwork within Units	0.124	-0.093
Management expectations and actions	0.263**	0.074
Organization learning	0.255**	-0.129
Management support	0.515**	0.047
Overall perceptions of safety	0.402**	-0.082
Feedback and communication	0.321**	0.058
Communication openness	0.306**	0.117
Frequency of event reporting	0.295**	0.043
Teamwork across Units	0.363**	0.141
Staffing	0.061	0.053
Hospital and transitions	0.241**	-0.025
Non-punitive response to error	0.094	0.054

** P < 0.01

Table 4 Comparison of average positive perceptions of patient safety culture factors between university hospitals affiliated to Qazvin University of Medical Sciences and hospitals from other countries

Patient Safety Culture Dimensions	United States [27] (n = 338607) %	Netherland[s] (n = 3779) %	Norway [23] (n = 358) %	Turkey [36] (n = 309) %	Iran (n = 145) %
Teamwork within units	80	84	57	70	65
Leadership expectations and actions	75	62	65	44	61
Organizational learning	72	47	46	41	62
Management support	72	32	22	40[b]	54
Overall perceptions of safety	65	52	57	62	60
Feedback and communication	63	49	32	38[c]	56
Communication openness	62	69	58	38[c]	53
Frequency of event reporting	62	38	31	15	58
Teamwork across units	58	28	32	40[b]	53
Staffing	56	62	52	44	47
Handoffs and transitions	44	40	31	54	60
Non-punitive response to error	44	67	72	24	44

[a] Source: Wagner C, Smits M. Patient safety culture. Differences between professions and countries http://internationalforum.bmj.com/2010-forum/presentationslides/wednesday/A7%20Wagner,%20Smits.pdf

[b] 'Teamwork across Units' and 'Management Support for Patient Safety' was merged to a single factor in Turkish study, therefore, the average score is considered for both factors.
[c] 'Feedback and Communication about Error' and 'Communication Openness' was merged to a single factor in Turkish study, therefore, the average score is considered for both factors.

The demographic characteristics of the final sample are described in Table 1. Nurses represented 49% of the respondents, physicians 14%, and paraclinical staff 37%. Among the participants, 82% had worked for one year or more and 50% had a professional experience of five years or more.

Table 5 Comparison of average positive responses to patient safety culture factors of HSOPS among professions

Patient Safety Culture Dimension	Nurses (n = 71) %	Physicians (n = 20) %	Paraclinicians (n = 54) %
Teamwork within units	64	63	67
Leader's expectations and actions	56[a]	55[a]	71
Organizational learning	63	61	61
Management support	54	47	58
Overall perceptions of safety	57[a]	58	65
Feedback and communication	56	55	57
Communication openness	51	51	57
Frequency of event reporting	56	58	60
Teamwork across hospital units	50[a]	49	59
Staffing	48	35[b]	52
Handoffs and transitions	63	54	62
Non-punitive response to error	31	28	36

[a] Significantly lower than paraclinical personnel ($P < 0.05$)
[b] Significantly lower than paraclinical and nursing personnel ($P < 0.05$)

Table 6 Comparison of responses to single-item outcome variable 'Patient Safety Grade' among professions

Patient Safety Grade	Nurses %	Physicians %	Radiology personnel %	Laboratory personnel %	Total %	United States (benchmark) [27] %
Failing	2	0	0	2	1	1
Poor	13	15	15	5	11	4
Acceptable	61	60	46	47	56	21
Very good	20	20	30	30	24	47
Excellent	4	5	8	15	8	27

Factor Analysis

Bartlett's test of 42 PSC items ($\chi 2 = 1893$; df = 861, $P < 0.01$) indicated that the inter-item correlations were sufficient. The KMO measure of sampling adequacy was determined to be 0.59, which is marginally higher than the 0.5 criterion. Exploratory factor analysis extracted 14 factors, of which 12 factors explained 62.9% of total response variance. The distribution of the items among dimensions was found to be substantially different from that in the HSPOS model; 'Feedback and Communication about Error' and 'Communication Openness' were grouped into a single factor. Items belonging to 'Handoffs and Transitions' were distributed among 'Teamwork across Units' and 'Management Support for Patient Safety'. 'Supervisor/Manager Expectation and Actions Promoting Safety' were splitted into two separate factors. Other items were clustered into several two- or three-item factors not consistent with the factor structure of HSOPS.

We grouped the items according to the AHRQ's survey to analyze the internal consistency reliability. The Chronbach's alpha for 42 items was determined as high as 0.855. However, reliability analysis of individual constructs identified seven factors with lower-than-adequate levels of reliability (alpha < 0.7). They included 'Handoffs and Transitions' (alpha = 0.583), 'Feedback and Communication about Error' (alpha = 0.547), 'Nonpunitive Response to Error' (alpha = 540), 'Organizational Learning-Continuous Improvement' (alpha = 0.463), 'Teamwork

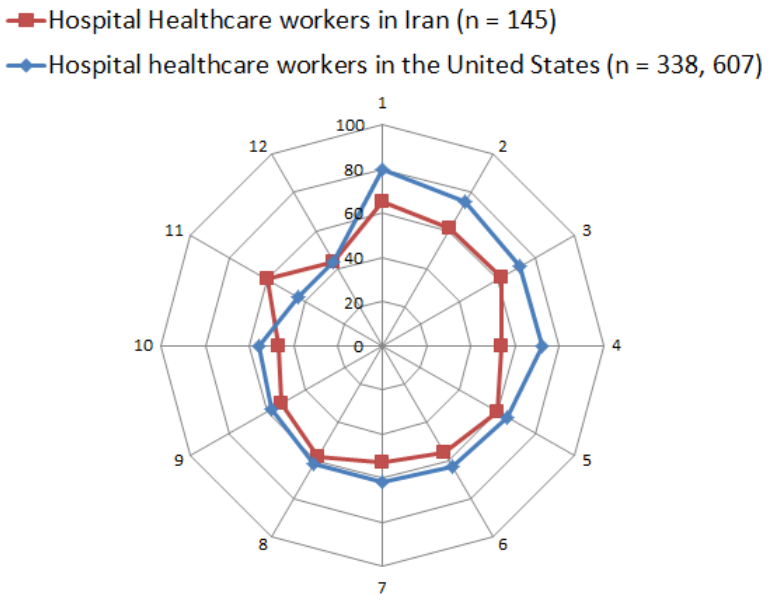

Figure 1 Comparison of average positive perceptions healthcare workers towards HSOPS's patient safety culture factors between university hospitals of Qazvin University of Medical Sciences and hospitals in the Unites States (HSOPS 2010 AHRQ's comparative database report). Variables: 1. Teamwork within Units. 2. Supervisor/Manager Expectations and Actions Promoting Patient Safety. 3. Organizational Learning-Continuous Improvement. 4. Hospital Management Support for Patient safety. 5. Overall Perceptions of Safety. 6. Feedback and Communication about Error. 7. Communication Openness. 8. Frequency of Event Reporting. 9. Teamwork across Hospital Units. 10. Staffing. 11. Hospital Handoffs and Patient's Information Transitions. 12. Non-punitive Response to Error.

Table 7 Comparison of number of events reported during the past 12 months among professions

Number of Events Reported	Nurses	Physicians	Radiology personnel	Laboratory personnel	Total	United States (benchmark) [27]
	%	%	%	%	%	%
No event	73	65	46	52	64	53
1 to 2 events	18	25	30	27	24	27
3 to 5 events	6	10	23	20	11	12
More than 6 events	3	0	0	0	0	7

within Unites' (alpha = 0.409), 'Overall Perception of Safety' (alpha = 0.362), and 'Staffing' (alpha = 0.112). No single-item deletion yielded better reliability.

This study was not designed for optimization of the PSC measurement model; however, we conducted a model modification effort to examine if a reduced model can yield more similar factor structure to that of HSOPS. Starting from the original model, we subsequently removed extremely cross-loaded factors, and in each stage observed clustering of items. Despite removal of 18 factors and reduction of the number of factors to eight, no considerably higher factor structure similarity with that of HSOPS appeared.

Correlation Analysis

The interrelation of the patient safety dimensions were studied to examine if the factors measure separated latent variables, and if they at the same time related to a common underlying construct (Table 2). The correlations ranged between 0.004 and 0.560 with the average being 0.232. The highest correlation was found between 'Feedback and Communication about Error' and 'Communication Openness' (r = 0.560) while 'Frequency of Events Reported' and 'Nonpunitive Response to Errors' showed the lowest correlation (r = 0.004).

The outcome variable 'Overall Perceptions of Safety Culture' showed significant correlation with all other factors except 'Staffing'. The correlations ranged between 0.087 and 0.451 with the average being 0.277. The highest significant correlation was obtained between perceptions of safety culture and 'Supervisor/Manager Expectations and Actions Promoting Patient Safety' (r = 0.451) followed by 'Management Support for Patient Safety' (r = 0.437) and 'Teamwork across Units' (r = 0.397). The lowest significant correlation was found between perceptions of safety culture and 'Frequency of Events Reported' (r = 0.237).

The outcome variable 'Frequency of Events Reported' significantly correlated with all other dimensions, with the exception of 'Staffing' and the 'Nonpunitive Response to Errors'. Correlations ranged between 0.004 and 0.363, averaging at 0.216. The highest correlation was obtained between event reporting and 'Management Support for Patient Safety' (r = 0.363) followed by 'Handoffs and Transitions' (r = 0.339) and 'Feedback and Communication about Error' (r = 0.337). The lowest significant correlation was found between event reporting and 'Organizational Learning Continuous Improvement' (r = 0.169).

The correlations between two outcome questions and PSC dimensions were also calculated to examine the extent to which the dimensions were associated with the self-reported outcome variables (Table 3). 'Patient Safety Grade' was found significantly correlated with nine out of twelve factors. The correlations ranged between 0.061 and 0.515 with the average being 0.27. The highest correlation was obtained between patient safety grade and 'Management Support for Patient Safety' (r = 0.515) followed by 'Overall Perceptions of Safety Culture' (r = 0.402) and 'Teamwork across Units' (r = 0.363). The lowest significant correlation was found between patient safety grade and 'Frequency of Events Reported'.

For the other single-item outcome variable 'Number of Events Reported', no significant correlation was observed with any of the PSC factors.

Comparative Results

The overall patient safety culture score in our study was 55.7%. The score means varied between 32% and 65% across the 12 factors. The highest scored dimension was 'Teamwork within the Units' (65%) followed by 'Organizational Learning – Continuous Improvement' (62%), and 'Supervisor/Manager Expectations and Actions Promoting Patient Safety' (61%). 'Nonpunitive Response to Error' received the lowest score (32%) among the dimensions. Table 4 compares perceptions of healthcare workers towards HSOPS's PSC factors in our hospital with those in hospitals of the US [30], Netherlands, Norway [26], and Turkey [39]. Figure 1 compares the variations in the scores of PSC dimensions between this study and the benchmark study in the US [30].

Cross-profession comparison of PSC overall score and

the score means of the dimensions are given in Table 5. The overall score was 54% for nurses, 51% for physicians and 59% for paraclinicians. No significant difference in PSC overall score was identified among professions. However, the dimension 'Overall Perceptions of Patient Safety' was scored significantly lower by nurses than by paraclinical personnel ($P < 0.05$). The 'Staffing' dimension was also rated significantly lower by doctors than by nurses and paraclinical staff. In addition, nurses and doctors had significantly lower perception of 'Supervisor/manager Expectations and Actions Promoting Patient Safety' as compared to paraclinicans. Ultimately, 'Teamwork across Hospital Units' scored significantly lower by nurses than by physicians and paraclinical personnel.

Regarding the single-item outcome variables ('Patient Safety Grade' and 'Number of Events Reported'), 32% of the participants had a positive evaluation of patient safety, and 64% stated that they had reported no error during the past 12 months. Table 6 and Table 7 present a cross-profession comparison of the responses to these outcome questions among professions.

Discussion

Reliability and Factor Analyses

The internal consistency reliability of the factors was found quite unsatisfactory. The highest obtained Chronbach's alpha was 0.727. Alpha for three factors was below 0.5, where 'Staffing' and 'Overall Perceptions of Patient Safety' showed extremely poor levels of internal consistency. Other studies also showed relatively low level of reliability for 'Staffing' [25-27, 29, 37, 39] and 'Overall Perceptions of Patient Safety' [27, 39].

Consistent with the reliability results, exploratory factor analysis also identified a lack of factor structure similarity between our data and HSOPS. With the exception of a few factors, distribution of the items among the extracted factors was very different from that in the AHRQ study [34]. Since it may be interpreted that the extracted factors measure constructs other than those in HSOPS, other statistical parameters should also be taken into account to draw valid conclusions. Indeed, the deviation of factor structure from HSOPS can be at least partially due to insufficiency of sample size for effective factor analysis (KMO = 0.59).

Correlation Analysis and Construct Validity

The result of correlation analysis indicated that the PSC factors are generally interrelated with significant and moderate correlation coefficients. This implies that while each factor measures a unique construct, it is at the same time related to a common underlying construct. Correlations of the dimensions with each other and with self-reported outcome variables indicated existence of meaningful and relevant interrelations that are at the same time consistent with the pattern of the relationships in previous studies [29, 34].

For instance, both 'Frequency of Events Reported' and the single-item outcome variable 'Patient Safety Grade' showed the highest correlations with 'Management Support for Patient Safety'. The other outcome variable 'Overall Perceptions of Patient Safety' along with 'Nonpunitive Response to Errors' were most highly correlated with 'Supervisor/Manager Expectations and Actions Promoting Patient Safety'. These findings clearly reflect the already evident importance of leadership commitment and support in developing patient safety culture [22, 33, 40].

Additional expressive patterns of relationship were observed for variables measuring perceptions of safety. While 'Patient Safety Grade' displayed the second highest correlation with 'Overall Perceptions of Patient Safety' (as in the Turkish [39] and Dutch [27] studies), both variables are most highly correlated with managerial factors followed by teamwork across the units. Both variables also show the lowest significant correlation with frequency of event reporting. The similarity between the patterns of relationships provides indication for the validity of the 'Overall Perceptions of Patient Safety' construct.

Another meaningful result was considerable correlation of 'Frequency of Events Reported' with 'Feedback and Communication about Error' (third to that with management support), which is congruent with finding reported in previous studies [25, 26]. The latter dimension also showed the highest correlation with 'Communication Openness', which was the strongest correlation among all interrelationships. The same pattern of relationship was also observed in a recent Japanese HSOPS-based survey [29]. This observation was consistent with combined arrangement of the corresponding items within a single factor during factor analysis in our study and the study in Turkey [39]. The strong relationship between the two scales is not surprising, as free and open communication plays a significant role in the circulation of information about errors and receiving feedback about changes put into place.

Our analysis identified significant correlation between 'Communication Openness' and 'Frequency of Event Report' and 'Nonpunitive Response to Errors'. The result also revealed that higher management support of patient safety and leadership actions for PSC promotion are coupled with improved open communication. In addition, it was observed that 'Overall Perception of Patient Safety' and the single-item outcome variable 'Patient Safety Grade' are significantly correlated with 'Communication Openness'. These findings again highlight the importance of management attention to promoting an open communication culture, which allows for free discussion about

the adverse events, sharing information about the errors happening, and reporting the identified errors without fear [14, 21, 41]. As data suggest, a consequence of such an environment will be higher frequency of events reporting and improved perception of patient safety.

Further indications for the validity of the construct can be found in the significant relationship between 'Nonpunitive Response to Errors' and 'Teamwork across the Units', 'Overall Perception of Patient Safety', 'Staffing' and 'Communication Openness' all of which being expected results. The correlation analysis however showed unexpected results such as lack of significant correlation between 'Frequency of Events Reported' and 'Nonpunitive Response to Errors' (the lowest correlation values). Nonetheless, these results are similar to those observed in analysis of the AHRQ Comparative Database [25]. In addition, in agreement with the findings from the US [25] and Japan [29], no significant correlation was observed between the single-item outcome variable 'Number of Events Reported' and any of the patient safety culture dimensions. This has been explained in terms of high proportion of respondents having reported no events or only one or two events in the past 12 months, which is also the case in our study.

Overall, the pattern of the correlations shows a satisfactory image of construct validity when the items are grouped according to HSOPS. The contradictory results from reliability and validity analyses highlight the need for further research in order to obtain a clear understanding of PSC dimensions in Iran.

Comparative Study

Despite low internal consistency of most variables, the scores of HSPOS's factors generally followed the pattern of the benchmark study [30]. However, with the exception of 'Handoffs and Transitions', all other scores fell below the corresponding values in the benchmark scores.

'Teamwork within Units' received the highest score which is a similar result as in other surveys in the US [30], Turkey [39], Taiwan [42], Belgium [43], the Netherlands [27], and Lebanon [44]. At the same time, the respondents seem unsatisfied with the cooperation among the hospital units and the way these units are coordinated with each other. Indeed, 'Teamwork across Units' exhibited the largest negative deviation from the US study [25]. The difference between personnels' perception of team work within and across the units is also seen in preceding surveys [39, 45, 46]. Patient safety is multi-faceted by nature, making it reliant on inter-department communication and collaboration. Hudson likens patient safety to a "team sport" where winning is contingent on the contribution of all players [47]. According to our data, cross-unit teamwork is related to the nonpunitive response to errors. Promotion of collaborative working among departments and inter-unit personnel cooperation, therefore, turned out to be a top priority for establishing PSC in our hospital.

The lowest score was received by 'Nonpunitive Response to Errors' which was also found as the weakest aspect of PSC in the US [30], Saudi Arabia [48] and Taiwan [42]. The factor was already shown to be correlated with 'Overall Perception of Patient Safety', which is in line with the findings of the Institute of Medicine (IOM) on positive influence of nonpunitive climate on improved safety in health systems [49]. Promoting a blame-free climate is considered a key strategy for improving error-reporting frequency. Developing such a climate is associated with promotion of trust in the organization, and using systems approaches to error identification with focus shifted from individuals to processes [41, 49]. A particular benefit of such a nonpunitive approach will be the feasibility of vulnerability assessment of processes and procedures based on reported errors and using the obtained data for continuous improvement of the health systems safety [4, 20, 50].

While several PSC dimension variables showed strongest relationship with 'Management Support for Patient Safety', the respondents' perception of the factor exhibited the second largest negative deviation from the AHRQ's survey [30]. A related result was also reported in the Norwegian study [26] where the surgeons rated management support lowest relative to the benchmark study. Management support is recognized as a uniquely important enabler for PSC development [22, 33]. Strong management commitment is considered as an integral part of positive patient safety culture, where safety is given top priority in the healthcare organization [20]. Senior managers' partnership with and support of hospital stockholders has been proven critical to the success of patient safety process improvement [41]. Low hospital management support was associated with low rate of error reporting and low frequency of feedback to staff [26]. In accord with these lines of evidence, this study found management support to be significantly correlated with all other PSC dimensions. Our results, therefore, recommends that further emphasis by leadership on patient safety priority along with higher management commitment to preventive strategies will positively influence the overall PSC status.

Near half of the respondents showed unsatisfactory perception of 'Communication Openness'. The WHO report [5] identifies poor communication between clinicians as an important factors contributing to unsafe care. Large-scale evaluations have indicated that the majority of unintended patient harm is due to communication gap [51]. In this study, we found that communication openness is correlated both with up-stream dimensions of PSC such as management support and leadership actions, and with

outcome factors, including frequency of event reporting and overall perceptions of patient safety. An implication of this relationship, given the low perception of respondents on communication openness, is that hospital managers need to focus on developing an interrelation infrastructure that facilitates free communication, open discussion and information exchange as an important part of a PSC development strategy.

Concerning single-item self-report variables, the data showed that only 32% of participants rated 'Patient Safety Grade' positively, which is far below the 74% in the benchmark study, and 86% in the Turkish survey. The scoring pattern was comparable between nurses and physicians, and between preclinical departments. However, paraclinical staff responded more positively to this outcome question.

On the other hand, 64% of the participants had not reported any error during the past 12 months, which is considerably higher than 53% in the benchmark rate [30], but far better than the 84% in Turkish hospitals [39]. While the low number of incident reports can be attributed to factors such as lack of open communication and punitive culture, many studies including ours failed to identify a relationship between the 'Number of Events Reported' and the relevant dimensions of PSC. As mentioned earlier, the observation can be explained by the excessive skewness of the variable distribution towards low order categories. Hence, it has been recommended that the variable be used as a descriptive measure rather than an outcome variable until the frequency of event reporting shows considerable improvement [25].

Congruent with grading of patient safety, paraclinicians report higher number of errors relative to nurses and physicians. Similar distribution of event reporting over departments was also observed in a large-scale survey in Lebanon. This observation has been attributed to factors such as limited contacts of paraclinicians with patients compared to the nurses and doctors, more organized nature of work in paraclinical units in comparison with other units, and responsibility of a group rather than simply an individual for error happening in the former departments [52].

Summary and Study Limitations

In general, all aspects of PSC, with the exception of handoffs and transitions, were identified as the area requiring improvement when compared with the benchmark study [30]. Judging by absolute values, teamwork within the units, handoffs and transitions, continuous improvement and leadership expectations, and actions for promoting patient safety were the hospital's areas of strength. Conversely, factors including nonpunitive culture, adequacy of healthcare workers, open communication, and cross-unit teamwork were identified as areas for improvement. In addition, increased management support of patient safety climate by giving the top priority to patient safety in policies and actions, and promoting preventive approaches were found as critical requirements of PSC establishment in the studied hospitals.

Our study produced mixed results concerning the applicability of the Persian version of HSOPS for Iranian hospitals. Reliability analysis yielded low internal consistency for several factors, which suggests that the items may not measure the same latent variable. On the other hand, exploratory factor analysis failed to replicate the factor structure of HSOPS, which indicates that the underlying relationship between the measured variables may be different from those proposed by the questionnaire. These results suggested that HSOPS may have measured different PSC constructs in our sample from those meant by AHRQ. This supposition is corroborated by the fact that gradual removal of highly cross-loaded items did not result in a more similar factor structure to that of the HSOPS. However, contrary to these findings, the pattern of intercorrelations provided strong indications for the validity of the factors and the entire construct. Relevant and consistent relationships were observed among dimensions and each input variables, and outcome variables. In addition, the trend and the relative magnitudes of dimensions' scores were congruent with benchmark scores from the US and many other surveys. These results support the notion that HSOPS has measured the same constructs as intended by the developer. It is, therefore, difficult to derive a robust conclusion about the applicability of HSOPS in Iranian hospitals based on the current level of information. To date, HSPOS has been used in three PSC surveys in Iran. Two of these studies have used the tool on the basis of its reported reliability and validity in previous studies [53, 54]. A recent survey conducted in four selected hospitals of Tehran University of Medical Sciences (TUMS) reported acceptable psychometric properties for the original 42-item-12-factor questionnaire [55]. The study, however, appears subject to severe research method problems that render its conclusions unreliable. Our study nonetheless, explicitly points to the necessity of large-scale and carefully designed studies to examine appropriateness of HSOPS use in Iran, and to develop a reliable and valid Persian survey for credible PSC measurement.

The results in this study should be interpreted cautiously due to study the limitations. While the targeted sample has been already of moderate size, the non-response rate exceeded the predicted value resulting in considerable reduction of sample size. Regarding the calculated KMO measure of sample size adequacy, there is the likelihood that the smallness of sample

size may have affected the performance of factor analysis.

The study was not conducted in Iran's capital or in a high population city. While the results even from surveys in country capitals or major cities can not necessarily be implied as a nation-wide profile of the PSC status, the fact that our survey was conducted in an ordinary city with moderate population size limits the scope of the conclusions even further.

Another limitation of this work was the homogeneity of selected healthcare facilities. We selected our samples only from university hospitals. However, studies show that the PSC dimensions may vary among different types of healthcare settings [39]. It is, therefore, important to include hospitals of different types in future studies to capture a more comprehensive view of PSC status.

Conclusions

This study discussed the applicability of the HSOPS for assessing the patient safety culture (PSC) in Iran. While factor analysis could not replicate HSOPS's factors structure, the reliability analysis yielded generally unacceptable internal consistency. By contrast, the intercorrelations of the factors demonstrated meaningful patterns of relationship that was in good agreement with precedent studies. The poor reliability results and factor structure discrepancy may have been either due to fundamental deviation of PSC dimensions in our dataset from HSOPS, or due to the limitations of the study, including marginal adequacy of sample size. Therefore, this study points to the necessity of large-scale and carefully designed studies to understand the nature of PSC in Iran, and developing reliable PSC measurement methods.

Abbreviations

PSC: Patient safety culture; HSOPS: Hospital Survey on Patient Safety Culture; AHQR: Agency for Healthcare Research and Quality; HCO: Healthcare organization; HRO: High-reliability organization;

Competing Interests

The authors declare no conflict of interests.

Authors' Contributions

FEFA and AR jointly designed the study and determined the settings. JA, AR and YM were involved in development of the Persian version of HSOPS. JA and AR participated in data collection. JA, AR, FEFA and YM contributed to statistical analysis and interpretation of the results. JA, RA and YM contributed to preparation of the initial manuscript. JA and FEFA revised and finalized the manuscript. All authors read and approved the final manuscript.

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