A Study of the Readiness of Hospitals for Implementation of High Reliability Organizations Model in Tehran University of Medical Sciences

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Abstract- Creating a safe of health care system requires the establishment of High Reliability Organizations (HRO_s), which reduces errors, and increases the level of safety in hospitals. This model focuses on improving reliability through higher process design, building a culture of accreditation, and leveraging human factors. The present study intends to determine the readiness of hospitals for the establishment of HRO_s model in Tehran University of Medical Sciences from the viewpoint of managers of these hospitals. This is a descriptive-analytical study carried out in 2013-2014. The research population consists of 105 senior and middle managers of 15 hospitals of Tehran University of Medical Sciences. The data collection tool was a 55-question researcher-made questionnaire, included six elements of HRO_s to assess the level of readiness for establishing HRO_S model from managers' point of view. The validity of the questionnaire was calculated through the content validity method using 10 experts in the area of hospitals' accreditation, and its reliability was calculated through test-retest method with a correlation coefficient of 0.90. The response rate was 90 percent. The Likert scale was used for the questions, and data analysis was conducted through SPSS version 21 Descriptive statistics was presented via tables and normal distributions of data and means. Analytical methods, including t-test, Mann-Whitney, Spearman, and Kruskal-Wallis, were used for presenting inferential statistics. The study showed that from the viewpoint of senior and middle managers of the hospitals considered in this study, these hospitals are indeed ready for acceptance and establishment of HRO_s model. A significant relationship was showed between HRO_s model and its elements with demographic details of managers like their age, work experience, management experience, and level of management. Although the studied hospitals, as viewed by their managers, are capable of attaining the goals of HRO_s, it seems there are a lot of challenges in this way. Therefore, it is suggested that a detailed audit is conducted among hospitals' current status regarding different characteristics of HRO_s, and workshops are held for medical and non-medical employees and managers of hospitals as an influencing factor; and a re-assessment process afterward, can help moving the hospitals from their current position towards an HRO_s culture.

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Introduction

Creating a safe system of health-care requires effecting a separate paradigm called High Reliability Organizations (HROs), which brings about fewer errors and greater safety in health-care organizations (1). HRO_s are complex and hazardous, but safe and effective organizations (2). The main characteristics of these organizations are a commitment to observing safety indicators, creating the culture of safety, and learning of safety (3). These organizations focus on improving reliability through higher process design, building a culture of accreditation, and leveraging human factors, and an intuitive understanding of reality which helps things to do better (4).

HRO_s were first introduced in University of Berkeley by a group of researchers who worked on aircraft carriers, the Air Traffic Control System (and more generally, commercial aviation), and nuclear power operations. Although, HRO_s may seem diverse, but these

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organizations have a number of similarities. First, they operate in social and political environments. Second, their technologies are risky, and present the potential for error. Third, the scale of possible consequences from errors or mistakes precludes learning through experimentation. Therefore, to avoid possible failures, these organizations use complex processes to manage complex technologies and complex work (4-8).

By definition, High Reliability Organizations (HRO_s) are organizations that have succeeded to avoid catastrophes in an environment. Although, natural accidents can happen in these organizations due to risky and complex factors (9). The key characteristics of these organizations are managers' tolerance of criticism at the organizational level, periodical assessment in order to prevent errors, being informed and positive about reasons of errors, and a high level of responsibility and accountability by managers. Focusing on designing reliable standardized systems which support the participation of employees in decision-making, and having opportunities for feedback, ongoing change and constant improvements based on decisions and activities within the framework of HRO_s theory, identifying risky patients as soon as possible, reducing the risks until the patient is safe again, managing by prediction and developing robust plans, and finally, maintaining a positive perspective towards human resources in the organization, and having an appropriate relationship with employees, and taking them into account for the benefit of patients, employees and visitors in hospitals, are the other elements of HRO_s (9-14).

Researchers have recognized other common characteristics in HROs, for example, a high level of technology, job design, using highly trained and qualified employees, continuously training, effective reward system, effective constant verification of processes and mechanisms, and a constant effort for progress. Although, in many of these organizations, excellent performance is accompanied by high quality, volunteerism, commitment to responsibility and accountability for reliability, widespread concern about misperception, misconception, and misunderstanding in performing organizational tasks (15).

On the other hand, health-care systems managers are continuously seeking a safer and more reliable patient care. In fact, regarding performance and continuously process, it is worth for health care organizations to endeavor constantly to establish high reliability systems (16).

Pronovost *et al*., point out a number of measures for high reliability models in health care organizations: recognizing based evidence interventions on which would lead the improvement of consequences selection interventions with the most impact on outcomes, and converting to behaviors, development of measures to assess reliability, measurement and assessment of performance, and ensuring that patients receive purposeful evidence-based interventions. One of the most important measures of HROs in health care systems is a comprehensive unit-based safety program or CUSP in order to improve safety culture in hospitals and guide organizations in learning to compensate for failure (17).

Dixon and Shofer report that the Agency for Healthcare Research and Quality (AHRQ) in the healthcare system of the United States is to support healthcare research, and disseminate the research findings. In the recent years, the responsibility of this agency has moved towards improving healthcare quality, safety, effectiveness, and performance. In addition, the employees of health care organizations have been asked to know more about AHRQ in order to guarantee patient safety. In this study, Dixon and Shofer interviewed healthcare system executives of the United States, and announced that these people were not much aware of how to implement patient safety activities (rapid response teams and reduction in surgical site infections). Using HRO_s model provides an opportunity for guiding health care systems towards ensuring patient safety in hospitals (18).

Nowadays, hospitals face many challenges, including high expectations from patients. Complexity and difficulty of tasks, as well as heavy workload, cause medical practitioners, especially specialists physicians to make mistakes (19).

In most cases, errors originate from malfunctioning equipment, insufficient training, and a lack of safety culture in hospitals (20). In the HRO_s model, hospital leaders are required to increase employees reliability, and to compensate for mistakes and failures as quickly as possible, so that errors are prevented, and hazardous technology be managed effectively through controlling possible hazards (21).

Weick *et al*., declared five distinctive characteristics of HRO_s not observable in other models. These are preoccupation with failure, reluctance to simplify interpretations, sensitivity to operations, and commitment of managers to resilience, and finally deference to expertise (22).

Weick *et al*., and also McLaughlin *et al*., believed that there had been organizations in the past which were completely destroyed by an error-driven accident.

Implementing the HRO_s model reduces failure costs, and increases employees' reliability and service quality in hospitals; in addition, it can introduce new processes and environmental conditions, and open new horizon to establish safety culture and improve safety operations under particular and critical conditions (24,25).

Achieving safety and high reliability is the main goal in hospitals as part of the health care system; therefore, they should do their best and take advantage of effective management in this regard (25,26).

Since many hospitals of Tehran University of Medical Sciences have already been accredited and certified by Iranian Ministry of Health and Medical Education, and other international accreditation organizations, but there are new opportunity for these hospitals to join high reliability organizations. In this regard, the present study is aimed to determine the extent of readiness of these hospitals to establish HRO_s models from the viewpoint of their key managers in Tehran University of Medical Sciences (TUMS).

Materials and Methods

This study was a descriptive-analytical and cross-sectional research conducted in 2013-2014 in order to assess the level of readiness of Tehran University of Medical Sciences hospitals regarding acceptance and establishment of HROs models. The research population was consisted of a total of 150 senior and middle managers of medical sections of hospitals including directors, deputy of educational affairs, deputy of research affairs, hospitals administrators, the managers of nursing services, the managers of clinical laboratories, the managers of medical imaging, the health care information managers, and managers of the emergency departments of 15 affiliated hospitals of TUMS. Data collection tool was induced by a researcher-made questionnaire which was determined using high reliability organization, hospital, and managers keywords in Google, Google Scholar, Medline, PubMed, Web of Science, Science Direct, and Emerald search engines, and referring to Medical Subject Headings (MESH), and selection of 75 books, articles, and scientific websites from 1990 to 2014 which were mostly about HROs, and their characteristics. Utilizing old resources was unavoidable due to their originality in explaining the historical development of HROs.

The questionnaire was consisted of 55 main questions about HROs under six main topics: "observing safety considerations in hospitals" (8 questions), "preoccupation with tolerance of failure correction" (9 questions), "reluctance to simplify interpretations" (17 questions), "sensitivity of managers to hospital performance" (8 questions), "commitment of managers to resilience and flexibility" (10 questions), and "deference of managers to expertise" (8 questions). Moreover, the demographic details of the hospital senior and middle managers were collected. In order to validate the questionnaire, Content Validity method was used. In this regard, 10 experts in the area of hospital accreditation from Ministry of Health, and Tehran University of Medical Sciences confirmed the questionnaire. An index of 0.83 was obtained for this questionnaire using Content Validity Index (CVI) tool. Reliability of the questionnaire was assessed through Test-retest method and the Interclass Correlation Coefficient (ICC) method. Therefore, the questionnaire was distributed to 15 people not in the population for two times, the second being after a two-weak interval. The result was a 0.90 correlation coefficient which indicated the high reliability of the questionnaire. After that, the researchers presented the questionnaire to the population in person. To observe the ethics of research, the required permissions were obtained first from the hospitals' managers. Furthermore, the participants were informed about the objectives of the study and the confidentiality of the collected data. Moreover, the demographic information of the participants was also recorded. 105 questionnaires were distributed from which 98 were completed. As a result, the response rate was 90%. Questions responses were ranked based on Likert scale as follows: disagree, partly agree, and agree, with the numerical values 1,2, and 3. Data analysis was done using SPSS 21.0. Tables and normal data distributions were used for descriptive statistics, and t-student, Mann-Whitney, Spearman, and Kruskal-Wallis tests were used for analytical statistics.

Results

From 98 senior and middle managers participated in the study, 70% were male, and 30% were female. More than half of the managers were between 45 and 55 years old, and the majority 64 (65.3%) were married, while 36 (36.7%) held bachelor's degree. The majority had 16 to 20 years of work experience, and 11 to 15 years of managerial experience in hospitals. Kolmogorov-Smirnov test showed that distribution of the variables or HROs model characteristics was normal with a significance level more than 0.05.

Table 1 shows that hospitals of Tehran University of

Medical Sciences are ready enough to accept and establish the HRO_s model, and its characteristics based on what their senior and middle managers believes and conception. This is shown in the table by a high mean and $P<0.001$ using t-student method. Among different characteristics of the HRO_s model, commitment of managers to resilience, and flexibility when faced with human errors and unexpected accidents, and also reluctance to simplify interpretations, contain the highest mean.

Table 1. The extent of readiness of the hospitals for establishment of HROs model

HROs model characteristics	Number	Mean	t	df	*P*-value	Mean difference
Observing safety considerations	98	17.30	46.087	72	<0.001	15.30
Preoccupation with tolerance of failure and error correction	98	18.75	38.807	72	<0.001	16.75
Reluctance to simplify interpretations	98	24.01	51.807	72	<0.001	22.01
Sensitivity of managers to hospital performance	98	17.79	44.044	72	<0.001	15.79
Commitment of managers to resilience and flexibility when faced with human errors and unexpected accidents	98	21.19	47.409	72	<0.001	19.19
Deference of managers to expertise	98	17.15	45.793	72	<0.001	15.15
The extent of readiness of the hospitals in establishing HRO_s model	98	116.20	60.306	72	<0.001	114.20

Regarding the significant difference between HRO_s characteristics and demographic factors, and a significance level lower than 0.005 using Kolmogorov-Smirnov test, it seems that demographic details of the hospitals' managers have a non-normal distribution.

Using Spearman correlation test to assess the relationship between HRO_s characteristics and the managers demographic details, the results showed that there was direct significant relationship between "observing safety considerations" with age (r=0.320 and *P*=0.006), work experiences (r=0.329 and *P*=0.004), and management experiences (r=0.299 and *P*=0.010), but a reverse correlation between this characteristic with job position of the managers was observed (r=-0.317 and *P*=0.006). This means that by getting older, and gaining more work experiences, and management experiences, the managers believe more in acceptance and establishment of HRO_s in hospitals. However, by getting higher in job position, this belief becomes less in this process.

"Preoccupation with tolerance of failure correction" had a direct significant relationship with work experiences (r=0.265, *P*=0.022), and management experiences (r=0.309, *P*=0.008), but reverse significant relationship with job position (r=-0.364, *P*=0.002). Therefore, more work and management experiences fortify the belief that establishment of HRO_s model is applicable in hospitals, whereas job position weakens this belief. Such a relationship was observed between "reluctance to simplify interpretations" and work, and management experience of the managers and their job position as well.

A significant positive relationship was observed between "sensibility of managers to hospital performance", and their marital status (r=0.228, *P*=0.05); this relationship was negative between job position with marital status which indicates that married managers have a stronger belief in establishing the HRO_s, while this belief is not so strong in those which have higher job position.

This kind of relationship between "commitment to resilience" and "deference to expertise" and generally, "the extent readiness of the hospitals in acceptance and establishment of the HRO_s model" was showed with work and management experiences, and a negative significant correlation with managers' job position (Table 2).

Table 2. The relationship between the HROs model characteristic and demographic factors of senior and middle managers of the hospitals

HRO_s characteristics	Kind of relationship	Sex	Age	Marital status	Educational degree	Work Experience	Management experiences	Job position
Observing safety considerations	Correlation coefficient	0.105	0.320	0.149	0.121	0.329	0.299	-0.317
	Significance level	0.376	0.006	0.207	0.310	0.004	0.010	0.006
Preoccupation with tolerance of failure and errors correction	Correlation coefficient	0.156	0.207	0.124	0.124	0.265	0.309	-0.364
	Significance level	0.188	0.079	0.298	0.298	0.023	0.008	0.002
Reluctance to simplify problem interpretations	Correlation coefficient	0.069	0.168	0.088	0.088	0.325	0.359	-0.313
	Significance level	0.561	0.156	0.457	0.457	0.005	0.102	0.007
Sensitivity of managers to hospital performance	Correlation coefficient	-0.026	0.124	0.228	0.228	0.177	0.180	-0.407
	Significance level	0.826	0.297	0.05	0.053	0.134	0.127	0.001
Commitment of Managers' resilience and flexibility were faced with human errors and unexpected accidents	Correlation coefficient	-0.026	0.251	0.094	0.091	0.349	0.304	-0.405
	Significance level	0.825	0.032	0.446	0.446	0.003	0.009	0.001
Deference of managers to expertise	Correlation coefficient	0.023	0.199	-0.041	0.41	0.307	0.313	-0.229
	Significance level	0.825	0.091	0.730	0.730	0.008	0.007	0.052
The extent of readiness of the hospitals to establish the HROs model	Correlation coefficient	0.051	0.232	0.087	0.087	0.358	0.358	0.379
	Significance level	0.669	0.048	0.465	0.465	0.002	0.002	0.006

Discussion

The HRO_s model can be applied to hazardous environments because of multiple complex characteristics and tasks, and the close strong connections between them (27); and therefore, the establishment of HRO_s model prevent the unwanted occurrence of events and errors through a re-engineering of management processes (28). Additionally, HRO_s respect safety considerations in the organization (29).

The conceptual model in figure 1 shows that a conscious consideration of different characteristics of HRO_s model, such as *commitment to resilience*, *sensitivity to performance*, *deference to expertise*, *reluctance to simplify interpretations*, and *preoccupation with failure* results in a mindful attention and prediction of unwanted events and failures, and thus, safety development, in the organizations (30-32).

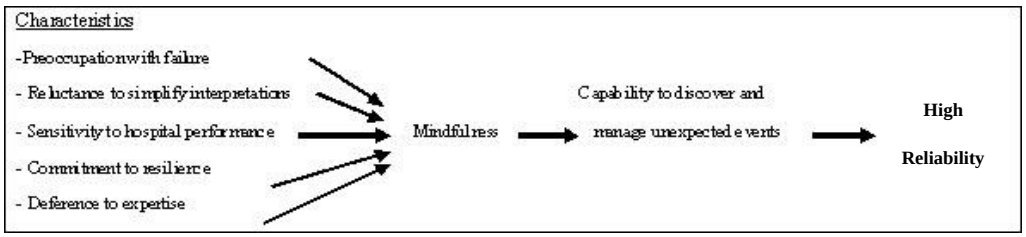

Figure 1. The conceptual model of HROs

The success of HRO_s model has a close relationship with organizational teams, and the behavior of their members, which indicates the characteristics and values of such organizations (20). Baker *et al*., believe that modern organizations are increasingly moving towards dynamism, constant changes, and instability. Therefore, organizations need to have more trust in organizational teams and their members, the required skills, and their risk propensity. Team working is an important element in implementation and achievement of HRO_s goals, especially in health care organizations. In this regard, providing guidance and strategies for training teams, and recognizing the specific challenges in these organizations, especially the hospitals will enhance teamwork and the High Reliability Model (33).

However, the previous researches show that

organizational teams are not effective in all circumstances, especially in complex environmental situations. Nevertheless, there is a subset of organizations which can balance safety and efficiency, despite complex internal and external environmental conditions. These are High Reliability Organizations which endeavor to reach high reliability conditions within the healthcare system. High Reliability Teams (HRT_s) contain behavioral markers by which one can depict the values of HRO_s, and push healthcare organizations, such as hospitals towards the High Reliability Model as quickly as possible (34).

According to the above, the current study is the first of research in determining the extent of readiness of hospitals of Tehran University of Medical Sciences for acceptance and establishment of HRO_s model within the healthcare system. The results showed that these hospitals were ready enough according to their senior and middle managers who can play an important role in implementing HRO_s model.

The senior and middle managers of these hospitals believed that the HRO_s model, including preoccupation with tolerance of failure and errors obtained a high score. However, Weick *et al*., criticized revealing errors and mistakes in this type of organizations, since it will introduce negative results. Accordingly, it seems that there are some limitations regarding this process in hospitals (15). In addition, Weick and Sutcliff argued that if errors and failures were not managed properly, there would be undesired consequences in any type of organization, including HRO_s. An undesired consequence in hospitals causes death of patients, which can be a threat to their reputation (35).

In order to prevent undesired consequences, HRO_s need to use software management processes; this means that hospital managers need to improve the ability of HRT_s in providing creative and smart responses in the face of error and failure. They also need to provide more continuous training for employees and develop regular process audit and reward systems (36-39). On the other hand, in HRO_s element, a constant research for near misses errors can act as a tool for performance improvement, organizational health, learning opportunities, providing a realistic image of organizational activities, and finally as a warning (22). In addition, there should be another warning system, so that in the case of negligence of employees not reporting the errors or hiding them a punishment is given based on the guilt (40). By developing a learning culture, the employees are encouraged not to hide their mistakes. Such encouragement should begin with the highest ranks in the hospital and spread through to others. In this system, the cause of an error together with the consequences is considered, and when the cause is determined, all hospital employees receive training accordingly (41). Weissman *et al*., declared that reporting errors, when obligatory, will result in discouragement and frustration of employees (42). On the other hand, based on "Carrol and Edmondson," HRT members who freely discuss unsuccessful experiences in the operation room, learn more than those team members who suffer from communication barriers (43).

The learning culture is an advantageous intervention factor in improving patient safety, because the employees of hospitals fear reporting their faults, even though the patients' life are exposure to hazard. This means loss of information beneficial for other employees (44-45).

Managers of hospitals of Tehran University of Medical Sciences stated that they were reluctant to simplify interpretations of problems, and therefore these hospitals had received a high score as an indication of the acceptance of this character of HRO_s model. Within the framework of this process, managers should think deeply upon uncertain hypotheses, and have a detailed image of the situation of their organization in mind (35). They should also believe that failures and errors occur systematically, and are potentially inside the cause and effect chain. Simplifying problem interpretations would result the loss of information, and limit the ways to achieve organizational goals. High reliability hospitals do not accept simple solutions when confronted with complicated challenges, and their employees are expected not to view failures and errors as a result of just a simple cause (46).

Sensitivity to hospital performance is another characteristic of HRO_s model. The present study indicated that the aforementioned hospitals were indeed ready for acceptance and implementation of this process. Sensitivity to daily operations in a hospital is developed through managers' support, and its objective is to coordinate different departments of the hospital through constant monitoring, and discussing unexpected errors and events in order to improve patient safety (47). For hospital managers, this sensitivity is shown in searching for causes of errors and giving feedback to the employees in order to prevent future ones (48). Previous researches show that managers can show their sensitivity to hospital performance by encouraging positive behavior, regarding safety regulation, and accomplish safe methods (49).

Managers' commitment to resilience and flexibility

when faced with human errors and unexpected accidents is another characteristic of HRO_s model for which senior and middle managers of hospitals in this study have received a higher average compared to other characteristics. This process is related to effective prediction of errors, learning experiences and mistakes, and the ability to tolerate unexpected accidents (50). Resilience and flexibility in the HRO_s model means developing a strategy to handle error prediction with flexibility and error tolerance. In this regard, HRO_s model are far more reliable than organizations that rely solely on error prediction. In high reliability hospitals, employees need to be trained about preventing future similar failures and errors, a quick assessment of the situation after failure, and effective performance and quick response (22).

The last characteristic of HRO_s model is *deference to expertise* for which managers under study received a lower score compared to other characteristics. Deference to expertise is the ultimate characteristic of HRO_s model which define a hierarchical structure based on clear roles and responsibilities which in turn are based on experience and expertise. However, in emergency situations, this structure is switched, and decisions are made solely by experts in the organization who solve the problems regardless of the hierarchical order (51). In HRO_s model, employees are trained to recognize and respect expertise (52). In a high reliability hospital, for instance in the surgery department, there are a lot of different experts who are required to respect each other despite common objectives. Therefore, when error occurs, the surgery team share their concerns with each other enthusiastically, and propose appropriate ideas through direct, clear, and respectful communication with their colleagues (53). Finally, in high reliability hospitals a culture is developed in which even managers and directors do not necessarily have the best answer for the reasons behind errors and unexpected accidents, but within the framework of this culture, everyone at whatever level shares knowledge with others (54).

Today, in spite of extensive efforts to improve healthcare quality in hospitals, a lot of patients still suffer from serious harm. Until now, no hospital has successfully achieved a consistent excellence in this process. The HRO_s model which was first used in nuclear and aviation industries, and achieved acceptable results in maintaining different levels of safety in those industries, has recently been applied to hospital care, so that hospitals can reach the best possible level, namely high reliability (55). In the current study, the researchers combined JCI indices with HRO_s standards for the first time in Iran's health care system, and provide a questionnaire to assess the extent of readiness of hospitals of Tehran University of Medical Sciences from the viewpoint of their managers and directors. The results showed that these hospitals were ready to establish the HRO_s model, and reach a high level of safety. However, it seems they need to undertake a lot of changes for this purpose, if they want to prevent any harms to patients. Furthermore, a functional establishment of a safety culture and an extensive use of effective tools in improving processes in hospitals, and manager's commitment to make changes, will speed up the movement towards the HRO_s model (56).

"Quigley" argued that using the HRO_s model, a lot of hospitals can minimize the number of errors that risk patient safety and reach an exceptional level of performance and quality. The results of this study showed that patients in hospitals received only 55 percent of desired care, i.e. approximately 50 percent of major patient care processes are deficient. By establishing the HRO_s model, hospitals can continually improve quality through supporting patient safety (57).

Furthermore, hospitals need to face many challenges before actually reaching the reliability. These challenges are: 1) high complexity, so that patient safety depends on the coordination of a number of teams such as physicians, nurses, pharmacists, and non-medical employees, 2) strong interdependency of hospital teams, e.g. a surgical operation requires complete coordination and concomitance of different related teams, 3) the huge distinctiveness between different levels of organizational hierarchy which can harm teams collaboration and coordination, although HRO_s believe in using the most knowledgeable expert at the time of crisis, regardless of organizational position, 4) having committed policy makers which requires effective communications in a complex network of relations, which is a characteristic of HRO_s, 5) taking responsibility for medical errors by managers, 6) a need for repeated quick feedbacks in emergency situations, and predicting problems before they become crises HRO_s need to develop a culture of responsibility against patients, and prevent managers the involve in routine work information, 7) time limitations which is one of the most important challenges in accomplishment all organizational tasks for all employees. In the HRO_s model, the required time for providing effective health care is predictable and additional support can be available (58-60).

In addition, in a hospital system, decision making is affected by emotions and feelings. However, in high reliability hospitals, the emphasis is on logical decision

making in order to maximize productivity (61). In different departments of a hospital, the interactions between patients and the medical practitioners is different, regarding complexity and time limitation. For example, time-limitation and complexity of patient-employee interaction in the emergency department and operation room is much different from ICU and transplant departments. The difference is also observable in the medical device, from scissors to complicated automatic smart instruments used in these departments (62). In such circumstances, it is possible for any of the medical practitioners, including expert physicians to make mistakes. In high reliability hospitals, however, there is no such thing as "humans make mistakes" for this group of employees. Using this phrase means simplifying interpretations of errors and problems. Although errors and mistakes are inevitable in hospital care, using the knowledge based on errors and mistakes means reluctance to simplify interpretations in high reliability hospitals (63).

According to the findings of the present study and previous research, converting Tehran University of Medical Sciences hospitals to HRO_s is applicable to the hospitals considered here from the viewpoint of their senior and middle managers, but such a conversion is a difficult task to the point that it may even fail. The reason is that there is a need for developing a safety culture in these hospitals which takes a long time to show its positive effects.

In order to achieve the goals of a high reliability hospital, the prerequisite is to eliminate the old safety culture in which errors are treated as crimes. In the HRO_s model, errors and mistakes may be happen, not because the employees are fallible nor because they are criminals, but the errors can be seen as sources of experience that could be used to train the other people others (64-65). In other words, when dealing with errors, both the responsible employees, and the situation and worker procedure should be considered. Therefore, ethically an error is not just guilt, but a type of responsibility (66). Hence, changing the old safety culture to a new one includes not hiding errors, but admission of responsibility for mistakes instead of being blame and punishment, and clarification of errors in order to share the experience with others. This change will bring desirable cultural, social, and organizational results (67). Moving towards high reliability hospitals depends on different factors, including appropriate environment, employees training, and strict monitoring, implementing and assessing processes in specific time spans (68-70).

The current study also showed that there was a significant relationship between age, work experiences, management experiences, and job position of senior and middle managers with acceptance of HRO_s model in studied hospitals. "O'Brien" and "Garavan" (2001) showed that sex does not have a significant relationship with HROs concepts, although they believed sex has an important effect on avoiding unsafe behavior (71). "Harrison and Lee" also showed that female employees observe safety considerations more than male employees, and they prefer to work in low risk conditions (72). These findings do not confirm the findings of the present study.

O'Brien and Garavan and Harrison and Lee clearly showed the relationship between age and safety considerations and deference to expertise; however, such a relationship was not obtained in the current study (71,72). Lapane and Hughes report that experience does not have a significant effect on safety, but it even increases the chance of error (28). According to Singer *et al*.,"managers with low experiences have a lower commitment to resilience (1), which is in line with the findings of the current study. Finally, the work of "Rudman *et al*.," indicated that senior managers of hospitals like physicians or directors of the clinical departments were more sensitive to implementing the HRO_s model compared to nurses and other managers (60). Although, Rudman *et al*., study conducted in small rural hospitals, showed that there was a difference between the size, beds number, specializations and sub-specializations, and the degrees of senior and middle managers of these hospitals with those studied in the current study. Therefore, it does not seem to compare these to results with each other.

The findings of current study show that senior and middle managers of hospitals of Tehran University of Medical Sciences declare that these hospitals are capable of moving towards establishing the HRO_s model. In addition, based on what these managers report, reluctance to simplify interpretations of problems and errors and managers' sensitivity to hospital performance have a higher average score compared to other HRO_s characteristics. However, the most important result of this study is the low score of observing safety considerations. Managing errors and unexpected accidents is a result of mindfulness of managers about HRO_s characteristics, and it is the only way of achieving HRO_s goals; therefore, having more regard for assessing and observing safety considerations becomes more important. As a result, the authors believe that future research needs to concentrate on a combined study of

assessing Joint Commission International (JCI) indexes and the HRO_s model characteristics in these hospitals. The researchers also believe that although senior and middle managers indicate possibility of establishing the HRO_s model which shows their high perception of this model in TUMS hospitals, but there are certainly a lot of challenges in this way. We suggest that a careful audit of the current status of the aforementioned hospitals be conducted regarding HRO_s characteristics. Afterwards, training workshops could be held in which the model is explained for all medical, and non-medical employees as the intervention factor and a serious movement be started towards a change in the current culture to a high reliability one.

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