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Evaluating hospital safety index in Susa public hospital: An action research study



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Ahmad Reza Raeisi,¹ Amin Torabipour,² Leyla Karimi^{3*}

ABSTRACT

Introduction: The role of the hospital in maintenance and promotion of public health is more important in times of crisis because the hospitals also act as public shelters and a ray of hope for the affected population in the crisis. Therefore, preparation and continuous improvement of the hospital's safety against probable disasters is one of managerial key tasks. The aim of this research was to evaluate hospital safety index in Susa public hospital before and after interventions.

Method: This is an action research study which was conducted from July 2015 to July 2016 in Susa public hospital, Khuzestan, Iran. The study was performed using Hospital Safety Index (HSI) checklist of the Iranian National Institute of Health Research (INIHR). The checklist has three main modules and 145 measures. The hospital was categorized based on A, B, and C level of safety.

Result: The results showed that hospital safety index in the first year was at level C which after planned managerial interventions was promoted to the level B in the second year. Despite the partial improvement in the overall hospital safety index level in the second year, the safety level of three main modules including functional, structural, and non-structural safety was still at level C in both years. Despite the improvement of the overall hospital safety score in the second year, the safety score in three main modules remained at a level C.

Conclusion: Therefore, the hospital's managers should address the hospital safety weaknesses using safety improvement techniques and quality improvement tools.

Keywords: Hospital Safety Index, Functional safety, Non-Structural safety, Structural safety, Crisis

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¹Department of Health Services Management, School of Management and Medical Information Sciences, Isfahan University of Medical Sciences, Isfahan, Iran

²Department of Health Services Management, School of Health, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran. ORCID ID: orcid.org/0000-0002-8937-8004. torabi-a@ajums.ac.ir

³Department of Health Services Management, School of Management and Medical Information Sciences, Isfahan University of Medical Sciences, Isfahan, Iran.

*Correspondence to:
Leyla Karimi, Department of Health Services Management, School of Management and Medical Information Sciences, Isfahan University of Medical Sciences, Isfahan, Iran
leyla.karimi158@chmail.ir

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INTRODUCTION

Every year, in the world, hundreds of hospitals and other medical facilities are destroyed or lose their functionality due to natural disasters. This is despite the fact that these facilities are one of the most important contributing facilities in every country and that their loss of function leads to various economic and social problems. The Islamic Republic of Iran, with more than 900 hospitals, most of which are not prepared to face various disasters and crisis.¹

Evaluating the level of preparedness of the Iranian hospitals showed that, despite various guidelines on hospitals the general level of preparedness is very low in most hospitals and confusion and lack of effective management are frequent problems.^{2,3} Studies show that during accidents and disasters, the need for medical attention is highest in the first 24 to 48 hours and 85 to 95 percent of survivors are those that were rescued and received effective medical aid in the first 24 hours.⁴ Therefore, it is necessary to quickly improve the safety conditions in hospitals and increase their preparedness level and admission capacity. Adaptation to these changes requires pre-existing plans and qualitative and quantitative

preparedness of hospitals must be evaluated periodically with the help of hospital staff during a normal condition in order to identify their strengths and weaknesses and improve their efficiency in the times of crisis and disaster.⁵

The world health organization (WHO), following the biannual pattern of united nations (UN), named the years 2008 and 2009 as "Hospital safety against disasters" and developed a valid instrument to evaluate hospital safety. This instrument includes 145 measures in areas of structural, non-structural and functional safety.¹ Calculating the hospital safety index is important for risk management and improving the safety of hospitals in the healthcare sector.⁶ In this study, we used WHO hospital safety index tool translated and localized by Iranian National Institute of Health Research for evaluating hospital safety. Therefore, the aim of this study was to evaluate hospital safety index in Susa public hospital from 2015 to 2016.

METHODS

This is an applied research study which was performed from July 2015 to July 2016 in Susa

Nezam Mafi public hospital, Khuzestan province, Iran. Following the first assessment, the interventions were prioritized through focus group discussion for functional, non-structural and structural revision. After the implementation of the prioritized actions such as the organization of the hospital disaster committee, modernization of medical equipment, renovation of the hospital building, we reevaluated the impact of interventions on hospital safety index (HSI).

Hospital safety evaluation was performed using the checklist of the Iranian National Institute of Health Research center (INIHR). The checklist is divided into five modules; the first two modules in the checklist include general hospital information and risk awareness which are fully descriptive and the next three modules include functional safety, non-structural safety and structural safety with 145 measures upon which the hospital was categorized as A, B and C level of safety [Table 1](#). Every measure was weighted 0(low), 1(medium) and 2(high). Validity and Reliability of the checklist had been confirmed.¹ Calculations were carried out with the help of Excel software using the following formula:

$$\frac{(\text{number of each value type (low, medium, high)} \times 100)}{(\text{number of measures in each module})}$$

- a) The sum of the safety scores for all three modules for hospital safety index:

$$\frac{(\text{sum of the weighted score of the modules} \times 100)}{(\text{number of measures in each module} \times 3)}$$

- b) The Criteria for the three main modules of the checklist including functional safety, non-structural safety, and structural safety were set to 20, 30 and 50 respectively based on the original version of HSI.
- c) The following equation was used to calculate the total hospital safety index of the hospital:

$$\frac{(\text{sum of the weighted score of all modules} \times 100)}{(\text{maximum weighted score of all modules})}$$

- d) In order to determine the final level of safety of the hospital, total scores calculated in formula 4 for years 2015 and 2016 were compared to hospital safety level presented by a localized tool

(INIHR) and the general safety level of the hospital in each year was determined [Table 2](#).¹

RESULTS

The first two modules in the checklist include general hospital information and risk awareness were fully descriptive and other than some small changes in the descriptive data such as Bed occupancy rate fluctuating between 70 and 80% or small changes in the number of population serviced by the hospital, almost all descriptive data remained similar between July 2015 and 2016.

The probability of various risks incidence includes social phenomena 61.90%, weather-related risks 45.83%, technological and human-made risks 37.25%, environmental risks 33.33% and geographical risks 26.67%. There was also no significant change in the risks toward Susa Nezam Mafi Hospital between July 2015 and July 2016.

In order to determine the Hospital Safety Index (HSI), all calculations were carried out for the three main modules of functional safety, non-structural safety and structural safety in the checklist. The number of measures in functional safety, non-structural safety, and structural safety modules was 61, 71 and 13 measures respectively. Due to lack or Irrelevance of 4 measures in the module of non-structural safety, the total effective measures in this module were 67 with a total number of 141 measures in all three modules.

The findings showed that the scores in the modules of functional safety, non-structural safety and structural safety and total hospital safety index in the hospital were 5.67, 8.51, 14.18 and 28.36 in 2015 and 11.35, 17.02, 28.36 and 56.73 in 2016 which showed improvement. ([Table 3](#))

As [Table 4](#) shows the average difference between the hospital's safety Criteria and scores of three main modules compared with WHO standards were 71% in 2015 and close to 43% in July 2016. The difference shows a 28% decrease between July 2015 and July 2016 which indicates improvement.

Comparing the hospital safety index (HSI) of the hospital showed that the HSI of the hospital was level C (0.28) in July 2015 and level B (0.56) in July 2016 ([Figure 1](#)). However, based on the average score of each module, the safety scores of all three modules were at level C in both years ([Table 5](#)).

Table 1 Definition of hospitals safety levels based on WHO guide (7)

Safety index	Classification	What should be done?
0 – 0.35	C	Urgent intervention measures are needed. The hospital's current safety levels are inadequate to protect the lives of patients and hospital staff during and after a disaster.
0.36 – 0.65	B	Intervention measures are needed in the short-term. The hospital's current safety levels are such that patients, hospital staff, and its ability to function during and after a disaster are potentially at risk.
0.66 – 1	A	It is likely that the hospital will function in case of a disaster. It is recommended, however, to continue with measures to improve response capacity and to carry out preventive measures in the medium- and long-term to improve the safety level in case of disaster.

Table 2 Average rates of functional, non-structural and structural safety index from 2015 to 2016

Module	Functional		Non-structural		Structural	
	2015	2016	2015	2016	2015	2016
Low	54.09	14.75	37.31	13.43	61.54	38.46
Medium	44.27	45.90	56.71	59.70	38.46	61.54
High	1.64	39.35	5.98	26.87	0	0
Total	100	100	100	100	100	100

*Maximum total score of each module is equal to 100

Table 3 Hospital Safety Scores in Three modules of Functional, Structural and Non-structural and Total Hospital Safety Index (2015 and 2016)

Functional		Non-structural		Structural		Total Score		Hospital Safety Index	
2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
5.67	11.35	8.51	17.02	14.18	28.36	28.36	56.73	0.28	0.56

Table 4 Comparison of hospital safety scores in three modules with index in 2015 and 2016

	Functional		Non-structural		Structural		Total Safety	
	2015	2016	2015	2016	2015	2016	2015	2016
Safety Score	5.67	11.35	8.51	17.02	14.18	28.36	28.36	56.73
Criterion	20	20	30	30	50	50	100	100

DISCUSSION

The main aim of this study was to evaluate the hospital safety using the HSI checklist that was validated by Iranian National Institute of Health Research (INIHR) in order to improve the preparedness level of the hospital against natural disasters.

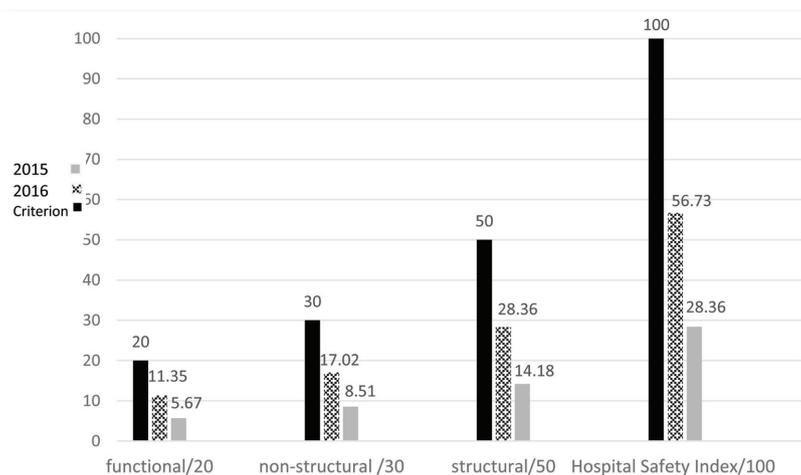
The Hospital Safety Index not only estimates the operational capacity of a hospital during and after an emergency, but it provides ranges that help authorities determine which facilities most urgently need interventions. Priority might be given to a facility where the safety of occupants is determined to be at risk during a disaster or to a facility where equipment is at risk, or where maintenance is needed. The safety index is not only a tool for making technical assessments, but it provides a new approach to disaster prevention and mitigation for the health sector. It is not an "all or nothing" approach to hospital safety but allows for improvement in a facility over time. How hospital personnel are organized to respond to disaster situations is central to evaluating a hospital's capacity to function during and after a disaster. This module looks at the general organization of hospital management, implementation of disaster plans and programs, resources for disaster preparedness and response, level of training and disaster preparedness of the staff, and the safety of the priority services that allow the hospital to function.⁷

The failure of non-structural elements does not usually put the stability of a building at risk, but it can endanger people and the contents of a building. Evaluators will verify the stability of non-structural elements (provided by, for example, supports, anchors, and secure storage and whether the equipment can function during and after a disaster for example, whether there are safety valves for reserve water tanks and alternative connections to networks, etc. Evaluating the structural safety of the facility involves assessment of the type of structure, materials, and previous exposure to natural and other hazards. The findings of this study showed that the average functional safety of the target hospital in 2015 was equal to 5% and at C level which had increased to 11% while remaining at C level. A level C means that the lives and safety of the hospital's occupants will be threatened in case of a disaster.⁷

It seems that some managerial interventions in the hospital such as Organization of the Hospital Disaster Committee, Provision of action plan for inside and outside threats and a plan for probably medical emergencies, Provision of Contingency plans for preservation and restoration of vital services and improving access to medicine and availability of

Table 5 Safety levels of Susa Nezam Mafi hospital in modules and total safety (2015 and 2016)

	Functional		Non-structural		Structural		Total Safety	
	2015	2016	2015	2016	2015	2016	2015	2016
	A (0.66 - 1)							
B (0.36 - 0.65)								0.56
C (0 - 0.35)	0.05	0.11	0.08	0.17	0.14	0.28	0.28	

**Figure 1** Comparison of total score of hospital safety and Achieved scores in three modules with index in 2015 and 2016

essential supplies in the event of an emergency has led to the 6% increase in functional safety score of the hospital in 2016. Ardalan et.al. Showed that the average functional safety score of hospitals were 27.3% which is at level C.⁸ Also, Pour Ebrahim et.al. Showed that safety management principals in support and clinical parts of the hospital were not followed in 80% of the investigated hospitals and only 20% of the hospitals used an incomplete version of these management principals. There was no sign of pre-planned controlling mechanical, electrical or medical equipment in any of the investigated units and inspections were also carried out when necessary.⁹ The results of these studies are similar to the current results. The results in the module of non-structural safety showed that like in the previous module, the average hospital safety level in to consecutive years did not move past C while an increase of the safety score from 0.08% to 0.17% was observed from 2015 to 2016, This increase was mostly due to the hospital's effort in improving the safety level of its vital systems and qualitative and quantitative improvement of its medical, diagnostic and laboratory equipment. Seyedain et al. showed that generally, the vulnerability of the hospital in the non-structural module was mediocre and that the target hospital did not showed desirable preparedness for disasters.¹⁰ These results are somewhat similar to the results of the current study. Our results showed

that in 2015, in the three different safety modules of functional, non-structural and structural safety, the score of the non-structural module was the highest compared to the other two. The results of the study by Mirzaei in Imam Khomeini Hospital of Ilam, Iran, showed that among three different safety dimensions, non-structural safety has the highest score¹¹ which is similar to the results of our study.

The average score of structural safety of the hospital in the year 2015 was equal to 0.14% and level C which had improved to 0.28% and level C in 2016. This limited increase showed that despite the hospital's opportunity to use the national health reform plan to renovate its building, it hadn't managed to reach a level B score in 2016 due to the age of the hospital building (more than 40 years) and the type of materials used in its construction.

The results of the study by Lari et al. showed that the average safety of hospital structures is at level C.¹² In another study, earthquake disaster management structure was investigated in 110 hospitals in Tehran. The results of this study showed that most of the hospitals were constructed using brick or steel building materials (in the load-bearing walls) which make them vulnerable to earthquakes. This study also showed that most of the hospitals in Tehran had old buildings and none of the hospitals (even ones with concrete and steel skeletons) had enough quake resistance.¹³ Another study in 2006 which was carried out in order to determine the preparedness of Gilan and Mazandaran university hospitals against accidents and disasters, showed similar results.¹⁴ These results are also similar to the results of the current study. Since the structural safety of the hospital is at a low level, one can't expect increased or uninterrupted services to be possible in the hospital in case of a disaster. Given the sensitive nature of this topic, the renovation and the resistant ability of the hospital building is of utmost importance.

The findings of this study showed that in 2015, the Hospital Safety Index of the target hospital was equal to 0.28% which is at level C while the HSI had increased to 0.56% and level B in 2016. Level B means that hospital can resist a disaster but its vital equipment and services are in danger. In a study on 45 Caribbean hospitals, the results showed that only 2% of the hospitals had a high safety with 80% having mediocre and 18% having low safety indexes.¹⁵ These results are somewhat similar to the results of the current study.

It is important, therefore, to identify the safety level of hospitals should a disaster occur. As part of risk reduction strategy in the health sector, hospital evaluations aim to identify elements that need improvement in a specific hospital and to prioritize interventions in hospitals that, because of their type or location, are essential during and after a disaster.

For that reason, the development of the Hospital Safety Index is a very important step toward the goal of less vulnerable hospitals. A checklist helps to assess different variables and safety standards for a hospital. A scoring system assigns the relative importance of each variable, which, when calculated, gives a numeric value to the probability that a hospital can survive and continue to function in a disaster.⁷

Although the group focused on improving some elements of the three modules, based on available hospital facilities, but the results showed that it became clear that critical systems including electrical system, telecommunications system, water supply system, fuel storage (gas, gasoline, diesel) and medical gases (oxygen, nitrogen, etc.) in this hospital, are in need of fundamental change.

Recommendations to the future research: First, implementing the studies by other hospital safety evaluation techniques and tools. Second, modeling the hospital performance evaluation based on the safety approach. Third, cost-benefit analysis of deferent interventions of hospital safety improvement.

CONCLUSION

Despite the increase in hospital safety index (HSI) of Susa Nezam Mafi hospital from level C in 2015 to level B in 2016, given the low score of hospitals in topics of functional, structure and non-structure safety in both years, various improvements are necessary. To this end, it is suggested for senior hospital managers and the managers of all units in the hospital to investigate all of the items in the checklist in several focus groups. Then after identifying the weaknesses and problems, an improvement plan should be created based on hospital needs and priorities in order to survey and improve hospital safety with an attitude toward continue improvement. Since the results of this study are not applicable to other hospitals, it is suggested for a similar evaluation to be carried out in all Iranian hospitals.

LIMITATION OF STUDY

In this study, key limitation of the study was the unavailability of the integrated hospital safety information system. Second important limitation of the study was the unavailability of experienced hospital safety evaluators to evaluate hospital safety performance.

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ETHICAL CONSIDERATIONS

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

CONFLICT OF INTEREST

There is no conflict of interest to be declared.

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