Hazard Assessment in Fars Province Hospitals in Iran in 2017

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Original Article

Abstract

INTRODUCTION: Fars is a disaster-prone province which is affected by a myriad of disasters, such as floods, earthquakes, fires, and traffic accidents. Therefore, the present study aimed to evaluate the disaster risk of hospitals in Fars province in 2017.

METHODS: This descriptive cross-sectional study was performed in 2017. Out of 90 hospitals in Fars province, 51 centers cooperated in the presented study. Six prevalent disasters and crises in Fars province were identified using the recorded incidents in the last 20 years in the Emergency Operation Center (EOC) of Shiraz University of Medical Sciences. A book entitled "National tools for the assessment of risks and indicators of specialized competencies of the health sector in response to hazards and disasters (risk map), which was written for the Ministry of Health of Iran in 2014, was used to assess and obtain the risk score. The maximum and minimum risk scores were obtained at 95 and 19, respectively, and the data were analyzed in Excel 2016.

FINDINGS: The mean and standard deviation of the obtained scores for different hazards were reported as 56.039±175.785 (earthquake), 45.962 ± 322.17 (seasonal flood), 575.786.195±19.57 (drought), 909.18±686.36 (chemical threats), 47.764±18.066 (human-caused fires), and 50.235±15.709 (power outage). In most hospitals, the risk of earthquakes and the negative impact of drought were higher than other hazards, while the chemical threats obtained the lowest score.

CONCLUSION: Since Fars province is a disaster-prone area, the risk assessment should be periodically performed at short intervals to identify hazards with higher risk scores and implement corrective measures in this regard.

Keywords: Disasters, Fars Province; Hospital; Risk Assessment.

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Introduction

Natural disasters exert numerous adverse effects on people's health through injury and death, increase physical and mental illnesses, displace and disrupt social networks, and demolish physical surroundings and personal properties (1). Almost all countries are exposed to natural disasters, such as hurricanes, floods,

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earthquakes, fires, famines, terrorist attacks, volcanic eruptions, chemical disasters, and diseases. Natural disasters can strike suddenly or occur gradually over time. In any case, they exert devastating effects on residents' health, society, and the economy (2).

Iran is located in Central Eurasia and the Middle East holding a population of about 75 million. This country is susceptible to a wide range of natural hazards. Within 1900-2013, more than 180 disasters were recorded in Iran which resulted in 160,000 deaths. The most important natural hazards in this region are earthquakes and droughts (3); moreover, Iran's strategic position in the Middle East causes major man-made disasters (4). About 77% of the regions in 300 cities of Iran are located on faults and in earthquake-prone areas, and 50% of its areas are flood-prone (5).

On average, every 10 years, thousands of people are affected by large earthquakes with a magnitude greater than 7; in addition, some other citizens are exposed to storms or coastal waves. Consequently, we are witnessing an annual number of 5,000 death and thousands of casualties, as well as financial losses of more than 100 billion tomans due to natural disasters in Iran (6). Among the organizations and institutions involved in disaster response, healthcare systems, especially hospitals, play the most critical role in the provision of services (7).

The significance of hospitals and other health care providers is not limited to saving peoples' lives. Hospitals are a powerful symbol of social progress and a prerequisite for economic development and stability (8). The provision of health care in the affected area is one of the main responsibilities of health systems during natural disasters (9). Disaster has always had a profound impact on hospital readiness to provide health services to the disaster-affected people (5). In times of crisis, when hospitals and health care centers are structurally or functional impaired, they will no longer be able to treat disaster survivors.

This inefficiency in the health sector provokes a secondary crisis; therefore, it is of utmost importance to ensure the maintenance of the physical and operational capacity of hospitals in emergencies (8). In recent years, several hospitals around the world have been affected by disasters. For instance, within 2001-2011, 119 natural disasters occurred in primary health care centers and threatened the lives and safety of health workers in 25 provinces of Iran (11.9 cases per year). These disasters resulted in physical damage or functional failure of 1401 health centers, the injury or illness of 644 people, and the death of 127 health workers.

The health centers in Kerman, Sistan and Baluchestan, and Lorestan reportedly experienced the most adverse effects of natural hazards (10). Within 1990-2010, more than 100 hospitals and 650 health centers were affected by natural disasters across the globe. Under these circumstances, numerous hospitals were demolished or were evacuated due to their vulnerable conditions (11). From 1981 to 1996, 93 hospitals and 538 health centers were affected in Latin America and the Caribbean. Moreover, 52 health centers were destroyed in the 2005 Kashmir earthquake.

In the same way, 49 sanitary facilities were damaged in the 2007 Jakarta flood; moreover, 322 hospitals and 90% of health facilities were damaged in the 2004 Indian Ocean tsunami and 2003Bam earthquake, respectively (3). The sanitary facilities in New Orleans were also evacuated in the flooding that followed Hurricane Katrina (August 2005) since power generators in hospitals may have stopped working and the distribution of medical supplies was delayed due to road network flooding (12).

The 1985 Mexico City earthquake reportedly demolished 13 hospitals. In just three hospitals, 866 people died, 100 of whom were health workers; moreover, nearly 6,000 hospital beds were destroyed in the metropolitan areas. In a similar vein, Hurricane Mitch in 1998 damaged or destroyed the water supply systems of 23 hospitals and affected 123 health centers in Honduras. Peru reported that nearly 10% of health centers in this country were damaged by the 1997-98 El Niño event (13).

In light of the aforementioned issues and due to the fact that Fars province is a disaster-prone area, the current study aimed to assess disaster risk in Fars province hospitals in 2017.

Methods

This descriptive cross-sectional study was conducted in 2017. The research setting was all university and non-university hospitals affiliated to Shiraz University of Medical Sciences. During the research period, the existing hospitals in Fars included 24 centers in Shiraz and 24 hospitals in

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other cities of Fars, among which 51 hospitals were willing to cooperate. Moreover, six prevalent crises and disasters in Fars province were identified and evaluated by studying books, documents, previous sources, historical data, and events in the last 20 years recorded in the Emergency Operation Center (EOC) of Shiraz University of Medical Sciences.

These disasters encompass earthquakes, seasonal floods, human-caused fires, droughts, chemical threats, and power outages. A book entitled " National tools for the assessment of risks and indicators of specialized competencies of the health sector in response to hazards and disasters (risk map), which was written for the Ministry of Health of Iran in 2014, was used to assess and obtain the risk score. This method has been already standardized by holding numerous meetings and expert consultation and is currently approved by Iranian crisis experts and health managers. To obtain the risk score, four domains of relapse/recurrence, severity, vulnerability, and probability were scored.

Disaster relapse/recurrence: It refers to the recurrence of disasters in a geographical area. The hazard will fall in level 5 in case of a high frequency of occurrence in the last hundred years. It is noteworthy that the relapse period has a coefficient of 2. The level of a disaster is defined based on Table 1.

Disaster severity: It is defined based on the number of people killed or injured. In the event of several occurrences in the concerned area, the number of killed and injured in the worst-case scenario determined the severity of a hazard. It should be noted that disaster severity has a coefficient of 5. The level of a disaster is determined based on Table 2.

Vulnerability: It is a set of characteristics that makes a community susceptible to the adverse effects of a hazard. It is worth mentioning that the vulnerability has a coefficient of 5. The level of a disaster is determined based on Table 3.

Probability: It refers to the likelihood of a hazard in a given time interval in the future. It is predicted by scientific observations or based on previous experiences and according to changes in the relevant geographical area. It should be emphasized that the probability has a coefficient of 7. The level of a disaster is determined based on Table 4.

Table 1. Classification of disasters based on relapse period

Level	Return period	Definition
1	Very low	The hazard has not been recorded over the past 100 years.
2	Low	The hazard has occurred once over the past 100 years.
3	Medium	The hazard has occurred 2-3 times over the past 100 years.
4	High	The hazard has occurred 3-5 times over the past 100 years.
5	Very high	The hazard has occurred more than 5 times over the past 100 years.

Table 2. Classification of disasters based on severity

Level	Intensity	Definition
1	Zero	The hazard has not affected the health of the general public.
2	Low	Dead: 1-2 individuals Injured: 1-5 individuals
3	Medium	Dead: 3-5 individuals Injured: 6-9 individuals
4	High	Dead: 6-9 individuals Injured: 10-99 individuals
5	Very high	Dead: ≥10 individuals Injured: ≥100 individuals

Note: The fulfillment of one condition is sufficient, *i.e.*, intensity is determined based only on the number of injured cases or the number of deaths. The larger figure is taken into account. For example, a hazard which has killed 5 people and injured 100 individuals is placed in the fifth level.

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Table 3. Classification of disasters based on vulnerability

Level	Vulnerability	Definition
1	Very low	Less than twenty percent of the population at risk may be physically, financially, or functionally affected.
2	Low	Twenty to forty percent of the population at risk may be physically, financially, or functionally affected.
3	Medium	Forty to sixty percent of the population at risk may be physically, financially, or functionally affected.
4	High	Sixty to eighty percent of the population at risk may be physically, financially, or functionally affected.
5	Very high	Eighty to one hundred percent of the population at risk may be physically, financially, or functionally affected.

Table 4. Classification of disasters based on probability

Level	Probability	Definition
1	Zero	The hazard never occurs in the desired area.
2	Low	The hazard may occur once over the next 75-100 years.
3	Medium	The hazard may occur once over the next 35-75 years.
4	High	The hazard may occur once over the next 5-35 years.
5	Very high	The hazard may occur once over the next 5 years.

It is important to note that the coefficients of the relapse period (2), intensity (5), vulnerability (5), and probability (7) are constant. The final score of the disaster is obtained by summing the scores of the four sections. The maximum and minimum scores of disaster are 95 and 19. The maximum score indicates that the disaster exerts its full impact, while the minimum score signifies the minimum effect and intensity.

To collect data, a crisis management committee was formed in each hospital consisting of 5-15 people, including the head of the hospital, director of treatment deputy, hospital manager, director of nursing services, emergency medicine specialist, service manager, facility manager, quality improvement manager, finance manager, emergency department manager, and patient safety officer. The methods of holding meetings and individual/group interviews were used to complete the checklist.

In addition, the members of this group vary according to the conditions and characteristics of each hospital. The members of the Hospital Crisis Committee are directly elected under the supervision of the hospital director, and meetings are held. Usually, apart from sufficient knowledge, these members are experienced in crisis management. Furthermore, another set of data was derived from expert consultation, as well as regional crisis management organization, meteorological organization, the Institute of Geophysics of Tehran University, the Red Crescent, the Fire Department, and local trustees. The obtained data were analyzed in Excel 2016.

Findings

Out of 58 hospitals in Fars province, 51 centers cooperated in the current study and underwent risk assessment. The characteristics of the studied hospitals are displayed in Table 5.

The results of the risk assessment of the studied hospitals regarding six prevalent disasters in Fars province are presented in Table 6. The mean and standard deviation of the obtained scores for different hazards were reported as 56.039±175.785 (earthquake), 45.962 ± 322.17 (seasonal flood), 575.786.195±19.57 (drought), 909.18±686.36 (chemical threats), 47.764±18.066 (human-caused fires), and 50.235±15.709 (power outage).

Diagram 1 displays the results of risk assessment of the studied hospitals regarding six prevalent disasters in Fars province in terms of percentage. In most hospitals, the risk of earthquakes and the negative impact of drought were more pronounced than other hazards. Moreover, the risk of chemical threats achieved the lowest score.

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Table 5. Characteristics of assessed hospitals in Fars province

		n	Percentage
Hospitals	Shiraz	29	56.86
	Other cities of Fars province	22	43.13
	Total	51	100
Type of hospital	Public (social security organization, university, and educational)	40	78.43
	Private	8	15.68
	Military	2	3.92
	Charity	1	1.96
	Total	51	100
Number of beds	Small (less than 100)	27	52.94
	Medium (100-400)	22	43.13
	Large (more than 400)	2	3.92
	Total	51	100

Table 6. Disaster risk score of hospitals in Fars province regarding six disasters, namely earthquakes, seasonal floods, droughts, human-caused fires, and power outages

Hospital	Risk score*					
	earthquake	seasonal flood	droughts	chemical threats	human-caused fires	power outage
1	48	36	36	34	24	31
2	48	36	36	34	24	31
3	64	67	76	62	55	61
4	60	38	88	57	57	62
5	78	55	76	58	76	76
6	50	21	24	19	19	33
7	70	61	47	50	58	50
8	62	53	36	31	31	53
9	67	76	86	67	57	52
10	79	36	57	19	57	57
11	64	57	38	48	57	39
12	62	40	64	19	40	57
13	62	48	38	39	93	47
14	19	19	19	19	19	19
15	38	19	19	19	19	38
16	95	59	69	60	45	67
17	53	41	48	51	48	62
18	49	38	57	19	45	49
19	48	36	41	19	36	47
20	31	38	45	19	38	31
21	76	24	38	19	57	38
22	34	57	49	40	53	53
23	43	43	69	31	62	55
24	76	76	66	46	55	49
25	52	41	36	34	47	38
26	43	38	57	38	38	57
27	66	36	24	19	56	60
28	62	76	57	76	57	38
29	19	33	61	19	59	35
30	47	31	83	19	19	55
31	57	38	38	38	57	57
32	31	43	55	57	48	57
33	33	36	57	19	21	43
34	69	38	71	19	67	81
35	61	61	59	26	70	٢٧
36	62	55	60	19	29	41

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Table 6. Continued

37	55	57	95	38	76	76
38	38	55	57	52	57	38
39	55	47	74	28	31	66
40	61	69	76	19	57	55
41	36	28	64	19	62	38
42	76	55	58	91	83	64
43	90	64	90	71	56	71
44	99	95	95	76	57	95
45	74	31	57	19	19	26
46	55	28	85	66	66	66
47	66	43	74	57	50	52
48	61	79	76	31	67	62
49	31	57	66	41	38	43
50	45	19	66	19	38	38
51	47	24	43	43	26	26
Mean	56.039	45.96	57.784	36.686	47.764	50.235

* (Maximum and risk score are 95 and 19, respectively)

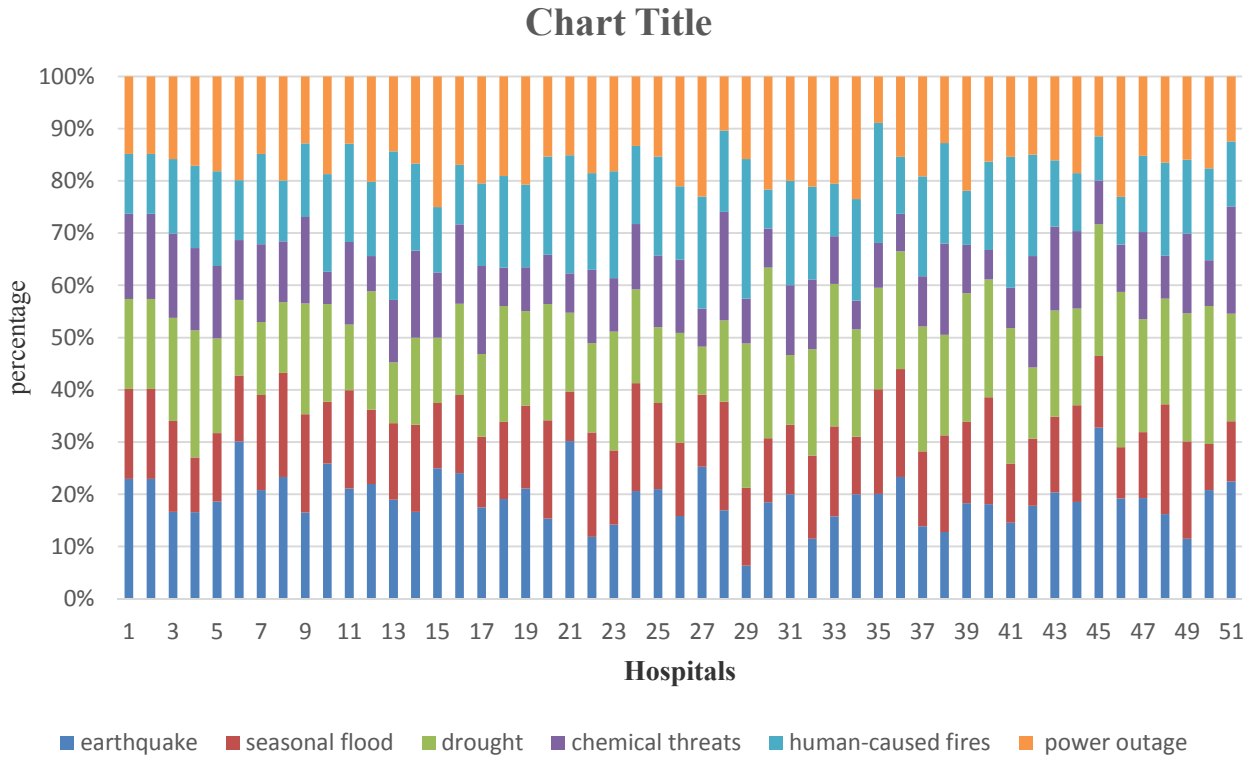

Diagram 1. Percentage risk of six prevalent disasters in the studied hospitals in Fars province

Discussion and Conclusion

Out of 51 hospitals participating in the current study, 56.86% of centers are located in Shiraz and other hospitals are in other cities of Fars province. Moreover, 78.43% of these hospitals are public (social security organization, university, and educational), and 3.92 and 1.66% are military and charity hospitals, respectively. Regarding the size of hospitals, 52.94 of hospitals are small with less than 100 beds, 43.13% are medium (400-400 beds), and 3.92% are large (more than 400 beds).

The results of risk assessment demonstrated that the risk of drought obtained the highest score (57.78%), compared to other risks, with a maximum score of 95 and a minimum of 19 among the studied hospitals. In agreement with

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the results of this section, drought was the most damaging natural disaster in the report issued by the United Nations (14). According to studies which were conducted within 2011-2012, continental droughts covered 62% of the adjacent land area of the United States and affected approximately 150 million people (15).

The results of risk assessment showed that the earthquake (56.03%) ranked second among the studied hazards, and the maximum and minimum scores of the studied hospitals were reported as 95 and 19, respectively. In 2013, Ardalan et al. identified that earthquakes posed the most serious risk to health facilities. Moreover, similar to the score calculated in the present research, the risk of structural damage was reported as 53.8% in the mentioned study. It is also worth noting that earthquakes are the cause of death among health personnel, as well as structural and non-structural damage to primary health centers (3).

The results also pointed out that educational hospitals were less affected by risks, and there was no relationship between the number of hospital beds and the affectability of hospitals from disasters. The third disaster risk was the power outage (50.23) with maximum and minimum scores of 95 and 45, respectively. Moreover, the fourth risk was human-caused fires (47.76%) with maximum and minimum scores of 81 and 19, respectively. The fifth risk was seasonal floods with an average of 45.96, as well as the maximum and minimum scores of 76 and 19.

The 2015 World Disaster Report demonstrated that in the last 10 years (2005-2014), floods were one of the deadliest disasters in the world. It was reported that 1751 floods which occurred across the globe in these years resulted in 59,092 deaths, 866417 casualties, and economic losses of about 342,836 million dollars (15). The worst flood disaster in at least five decades struck in Thailand in 2011 with 1,085 deaths and economic losses of 45.7 billion dollars. It is recognized as the fourth most costly natural disaster in recent history (16). Since Fars province is a disaster-prone area, the risk assessment should be periodically performed at short intervals to identify hazards with higher risk scores and implement corrective measures in this regard.

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Conflict of Interests

Authors have no conflict of interests.

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