

Resilience Analysis of Crisis in Medical Environments: A Structural Equation Modeling based on Crisis Management Components

SAMIRA GHIYASI¹, FATEMEH VERDI BAGHDADI¹, FARSHAD HASHEMZADEH¹, AHMAD SOLTANZADEH^{2*}

¹ Department of Environmental Engineering, Central Tehran Branch, Islamic Azad University, Tehran, Iran

^{*2} Department of Occupational Health & Safety Engineering, Research Center for Environmental Pollutants, Faculty of Health, Qom University of Medical Sciences, Qom, Iran

Received January 01, 2021; Revised May 29, 2021; Accepted June 19, 2021

This paper is available on-line at <http://ijoh.tums.ac.ir>

ABSTRACT

Enhancing the index of crisis resilience is one of the key goals in medical environments. Various parameters can affect crisis resilience. The current study was designed to analyze crisis resilience in medical environments based on the crisis management components. This cross-sectional and descriptive-analytical study was performed in 14 hospitals and medical centers, in 2020. A sample size of 343.5 was determined based on the Cochran's formula. We used a 44-item crisis management questionnaire of Azadian et al. to collect data. The components of this questionnaire included management commitment, error learning, culture learning, awareness, preparedness, flexibility, and transparency. The data was analyzed based on the structural equation modeling approach using IBM SPSS AMOS v. 23.0. The participants' age and work experience mean were 37.78 ± 8.14 and 8.22 ± 4.47 years. The index of crisis resilience was equal to 2.96 ± 0.87 . The results showed that all components of crisis management had a significant relationship with this index ($p < 0.05$). The highest and lowest impact on the resilience index were related to preparedness ($E=0.88$) and transparency ($E=0.60$). The goodness of fit indices of this model including RMSEA, CFI, NFI, and NNFI (TLI) was 2.86, 0.071, 0.965, 0.972, and 0.978. The index of crisis resilience in the medical environments was at a moderate level. Furthermore, the structural equation modeling findings indicated that the impact of each component of crisis management should be considered in prioritizing measures to increase the level of resilience.

KEYWORDS: Resilience, Medical Environment, Crisis, Structural Equation Modeling

INTRODUCTION

Different natural and man-made hazards may be a crisis or focal point in organizations [1-2]. Medical environments including hospitals and other medical centers due to the nature of the activities should implement a clear and systematic resilience program to manage the crisis and increase the level of resilience in crisis situations. Operational interruptions in medical

centers and hospitals could worsen the consequences of crises and the associated damages [3- 4].

Generally, crises may result in catastrophic human, economic, social, and sometimes strategic consequences. Therefore, it is of particular importance to specifically evaluate the crisis resilience indexes in the medical environments. Thus, it is recommended to implement an

Corresponding author: Ahmad Soltanzadeh

E-mail: soltanzadeh.ahmad@gmail.com



effective preparedness and recovery plan in possible crises to minimize the adverse impact of the crisis on the medical centers [5-6].

The crisis resilience modeling, processes, and analysis should be identified to improve the level of resilience in the medical environments. The crisis resilience has different definitions depending on the resilience functions in different environments. Thus, resilience in a system means that the system can perform its functions despite a variety of environmental hazards and the possibility of emergencies and crises. In other words, the degree of preparedness and rapid response to all kinds of abnormal conditions that can threaten the assets of a system is called resilience [7]. Resilience has been widely used in various scientific disciplines during the past four decades. Resilience is the capacity to withstand shocks and return to the original state in a functional form or sufficient resistance to prevent vulnerability or even collapse of systems [8-9].

Although the components affecting resilience have been mentioned in various studies [10-12], Azadian et al., determined seven components affecting resilience in the medical environments including management commitment, error culture, learning culture, awareness, preparedness, flexibility, and transparency [13]. According to the results of this study, crisis resilience was depend on these components. In addition, by increasing the level of these components, the rate of crisis resilience in the medical environments could be improved.

Accordingly, the current study was designed to analyze crisis resilience in the medical environments and based on the seven components of crisis management. So, we aimed to analyze the resilience indexes in the studied medical environments and to evaluate the relationship between these indexes and the components of crisis management. The results of the present study can be used as a decision tool to increase the index of crisis resilience in these treatment settings.

METHODS

In the present cross-sectional and descriptive-analytical study, 14 hospitals and medical centers were selected (3250 people). Therefore, Cochran's formula was used to calculate sample size (343.5) with a confidence level of $d=0.05$. We considered a 10% more sample size to increase the level of confidence. So, 380 people included physicians, nurses, administrative staff and maintenance technicians were participated in the study. All participants completed informed consent form. A systematic random selection method was applied to select participants.

Data Gathering:

The selection of these seven elements of crisis resilience management was consistent with the results of Azadian et al's., study [13-14]. Data collection in this study was performed using the crisis resilience management questionnaire designed by Azadian et al. [14]. This questionnaire has seven components for crisis management questionnaire included 1) management commitment (nine questions), (2) error culture (six questions), (3) learning culture (four questions), (4) awareness (fifteen questions), (5) preparedness (three questions), (6) flexibility (five questions) and (7) transparency (two questions). The reliability of this questionnaire with 44 questions was calculated by Cronbach's alpha (0.977). Additionally, the validity of this study was evaluated using exploratory factor analysis and confirmatory factor analysis and its goodness of fit [13]. The scoring scale in this questionnaire was based on a five-point Likert scale from very low (1) to very high (5). Study data were collected through a field study based on this questionnaire and interview. The scoring range for each component as well as the index of crisis resilience was determined as 1 to 5.

Data Analysis:

Data analysis was performed based on the objectives of the study including analysis of crisis resilience in the studied medical environments. This analysis was done based on the structural equation modeling (SEM) approach via IBM SPSS AMOS v. 23.0.

The significance level of the current study was considered 0.05.

The SEM is a robust multivariate regression analysis technique that can reveal complex relationships between variables. It provides a useful application for understanding the complex relationships between variables. In order to determine the goodness of fit, general indices were used including χ^2/df (2-3), RMSEA (0.05-0.08), adaptive indices CFI (0.95-1.0), NFI (0.95-1.0), and NNFI or TLI (0.95-1.0) [15].

RESULTS

In the present study, 372 people were participated (response rate=97.9%). Demographic data showed that the participants' age and work experience mean were 37.78 ± 8.14 and 8.22 ± 4.47 years. The average daily and weekly working times were 8.87 ± 3.05 and 58.54 ± 5.34 hours. More than half of the subjects were male and about two-thirds were married. Educational background data showed that a quarter of the respondents had a master's or Ph.D. degree and more than half of the individuals had a bachelor's degree (see Table 1). Also, the results of occupational variables evaluation showed that 74 physicians (19.89%), 158 nurses (42.47%), 42 technicians (from logistics and maintenance unit) (11.29%), and 98

(26.34%) administrative personnel participated in this study.

The evaluation results of crisis resilience in the medical environments showed that the average of these seven components included management committee, error culture, learning culture, preparedness, awareness, flexibility, and transparency, were equal to 2.47 ± 0.44 , 3.22 ± 0.28 , 3.18 ± 1.11 , 2.74 ± 1.53 , 3.14 ± 1.02 , 2.88 ± 1.06 and 3.08 ± 0.64 , respectively. The crisis resilience indices' mean and SD was calculated 2.96 ± 0.87 (see Figure 1).

The SEM results of crisis resilience analysis showed that all seven components of crisis management had a significant relationship with the index of crisis resilience ($p < 0.05$). These results showed that the highest impact of the resilience was related to the components of preparedness, awareness, and management committee (0.88, 0.83, and 0.79). In addition, the lowest correlation with this index was related to the components of transparency, flexibility, and error culture (0.60, 0.68, and 0.72). The goodness of fit indices outcomes showed that the values of indices including χ^2/df , RMSEA, CFI, NFI, and NNFI (TLI) were 2.86, 0.071, 0.965, 0.972, and 0.978. Therefore, the presented model was a good model.

Table 1. Demographic findings of the subjects (n=372)

Variable		Means \pm SD / Frequency (%)
Age (years)		37.78 ± 8.14
Work experience (years)		8.22 ± 4.47
Daily working hours (hours)		8.87 ± 3.05
Weekly working hours (hours)		58.54 ± 5.34
Gender	Female	178 (47.85%)
	Male	194 (52.15%)
Marital Status	Single	132 (35.5%)
	Married	240 (64.5%)
	U pper-diploma \geq	86 (23.1%)
Education	Bachelor	196 (52.7%)
	Masters	61 (16.4%)
	PhD	29 (7.8%)

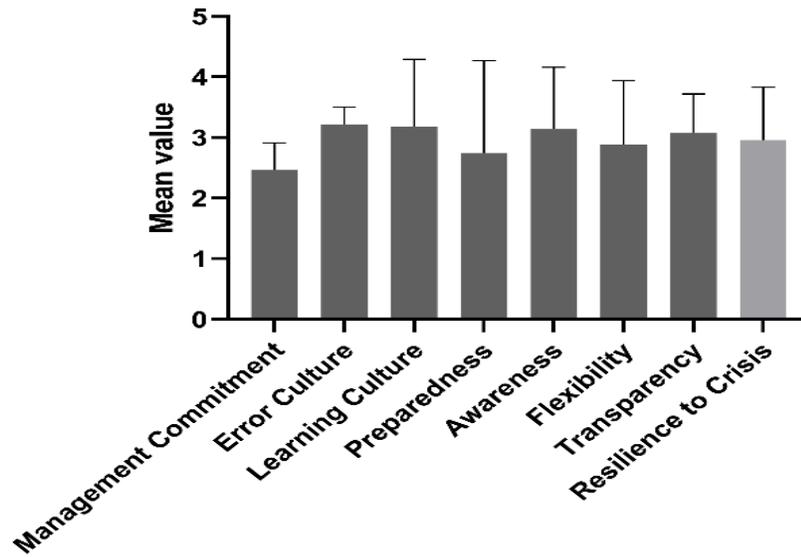


Fig 1. Results of resilience and crisis management components in the study group (n=372)

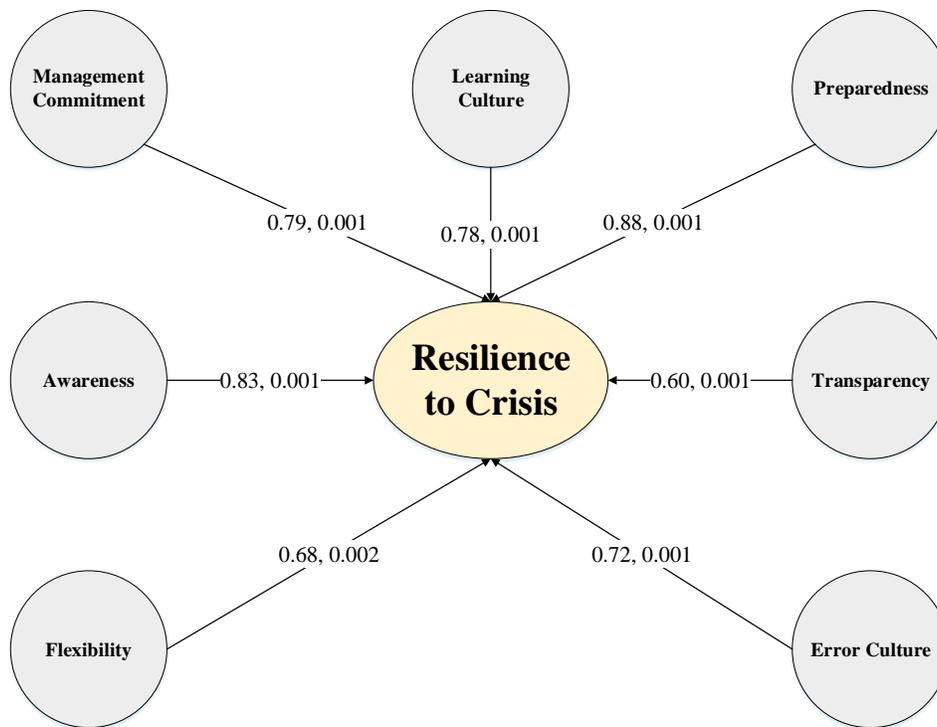


Fig 2. Findings of crisis resilience modeling

DISCUSSION

Crisis resilience is one of the most important and challenging issues in the medical environment. Due to the vital roles of hospitals and medical centers in the occurrence of various crises, it draws a lot of attention to crisis resilience management studies. In addition, it is very important to design and implement a systematic structure that could maintain the resilience of the system through a learning structure in the cases of various crises [16-17].

The findings of this study indicated that the crisis resilience indexes and the seven components of crisis management had a medium impact in the study environments. In accordance with this study, Azadian et al. (2016) in the study of crisis preparedness and culture of hospitals from the perspective of resilience engineering showed that all selected hospitals are poorly prepared for crisis management. Therefore, appropriate management and policies are required in the fields of education, culture, and active preparation of hospitals [13]. Also, the results of Mastane et al. study entitled evaluating the relationship between capabilities in crisis management showed that the relationship between the areas studied in this study including information registration system, management policies, security, crisis committee, training, crisis command system, preparedness maneuver, and new technologies application in crisis management has been poorly assessed. Thus, the promotion of resilience in the studied medical environments requires a re-designing approach and management of resources for each of these areas [18].

Furthermore, Rahmanian et al. in a study evaluated the physical preparedness of a hospital in the face of crisis. Results proved that hospitals have a high probability of facing the occurrence of hazards such as earthquakes, weather hazards, epidemic biological hazards, and man-made fire. So, considering the possibility of damages caused by these accidents, strategic crisis management planning for medical centers and also designing a plan of mutual cooperation is necessary for medical environment in dealing with the crisis [19].

Depending on the estimated resilience of the studied hospitals and medical centers, these 14 study environments need to design or redesign their resilience program in the case of potential crises. However, the important to answer the following question: 1) What features should a crisis resilience program have? and 2) Which of the relevant and effective parameters on resilience should be given more attention?

In answering these questions, the findings of crisis resilience analysis in medical environments revealed that all seven components of the crisis management model presented by Azadian et al. [13] had a positive and significant relationship with the resilience index. In addition, based on the results of this modeling, it was found that the components of preparedness, awareness and management committee, learning culture, error culture, flexibility, and transparency had the greatest impact on the resilience in these medical environments.

Therefore, it should be noted that management decisions, design, and redesign of a comprehensive program should be based on the findings of this modeling to improve the level of resilience to crisis and the implementation of corrective measures in these medical environments. Thus, one of the functions of these results was determining the priority for developing and implementing a comprehensive program to improve the level of crisis resilience in the hospitals and medical centers based on the evaluation findings of the crisis resilience and crisis management components in each medical environment [20-21].

CONCLUSION

The findings of the present study indicated that crisis resilience had a medium impact in the study environments. Therefore, crisis resilience in these medical environments should be improved by designing a comprehensive crisis management plan based on the seven components. In addition, with respect to the results of structural equation modeling, any planning should consider the impact of these

components on resilience in these medical environments to improve the level of resilience to crisis. It would be interesting in future studies to investigate a bigger sample size, comparing the index of crisis resilience among different medical environments and considering other components of crisis management.

CONFLICT OF INTEREST

There is no conflict of interest in present study.

ACKNOWLEDGMENT

The authors appreciate the management of the hospitals and medical centers and the participants in this study. This study was extracted from a master's thesis in Health, Safety and Environment (HSE) in Islamic Azad University, Central Tehran Branch.

REFERENCES

- Soltanzadeh A, Gohari Motlagh M, Ghiyasi S. Assessing the Efficiency of Muster Point in Crisis: A Case Study in Tehran City. *Archives of Occup Health*. 2020;4(1):516-520.
- Abbassinia M, Kalatpour O, Soltanian AR, Mohammadfam I, Ganjipour M. Determination and score of effective criteria to prioritize emergency situations in a petrochemical industry. *Occup Hyg and Health Promo J*. 2019;3(1):16-25.
- Hattenbach L-O, Reinhard T, Walter P, Roeder J, Feltgen N, Hesse L, Heinz P, Hoerauf H, Kohnen T, Priglinger S, Bachmann W, Rieks J, Eter N. Crisis management strategies of hospitals during the pandemic. *Der Ophthalmologe: Zeitschrift der Deutschen Ophthalmologischen Gesellschaft*. 2020;117(7):652-658.
- Gile PP, Buljac-Samardzic M, Van De Klundert J. The effect of human resource management on performance in hospitals in Sub-Saharan Africa: a systematic literature review. *Human Resources for Health*. 2018;16(1):34.
- Köhler M. *Comprehensive crisis management. Fortress Europe?*. In: Jünemann A., Scherer N., Fromm N. (eds) *Fortress Europe?*. Springer VS, Wiesbaden. 2017: pp 73-82.
- Haghighi SM, Torabi SA. A novel mixed sustainability-resilience framework for evaluating hospital information systems. *Intl J Med Informatics*. 2018;118:16-28.
- Paton D, Johnston D. *Disaster resilience: an integrated approach*. 2 nd ed. Charles C Thomas Publisher Ltd, 2017, USA.
- Shirali GA, Shekari M, Angali K. Quantitative assessment of resilience safety culture using principal components analysis and numerical taxonomy: A case study in a petrochemical plant. *J of Loss Prevention in the Process Indus*. 2016;40:277-284.
- Shirali GA, Motamedzade M, Mohammadfam I, Ebrahimipour V, Moghimbeigi A. Assessment of resilience engineering factors based on system properties in a process industry. *Cognition, Tech & Work*. 2016;18(1):19-31.
- Kabir MH, Sato M, Habbiba U, Yousuf TB. Assessment of Urban Disaster Resilience in Dhaka North City Corporation (DNCC), Bangladesh. *Procedia Engin*. 2018;212:1107-1114.
- Khazai B, Anhorn J, Burton CG. Resilience Performance Scorecard: Measuring urban disaster resilience at multiple levels of geography with case study application to Lalitpur, Nepal. *Intl J of Disaster Risk Reduction*. 2018;31:604-616.
- Thekdi SA, Santos J. Decision-Making Analytics Using Plural Resilience Parameters for Adaptive Management of Complex Systems. *Risk Analysis*. 2019;39(4):871-889.
- Shirali GA, Azadian S, Saki A. A new framework for assessing hospital crisis management based on resilience engineering approach. *Work*. 2016;54(2):435-444.
- Azadian S, Shirali GA, Saki A. Evaluation Reliability and Validity a Questionnaire to Assess Crisis Management Based on Seven Principles of Resilience Engineering Approach in Hospitals. *Iran Occup Health*. 2016;13(1):15-26.
- Mueller RO, Hancock GR. Structural equation modeling. The reviewer's guide to quantitative methods in the social sciences. *Psychology*. 2018;9(11): 445-456.
- Burkle Jr FM. Challenges of global public health emergencies: development of a health-crisis management framework. *The Tohoku J of Experimental Med*. 2019;249(1):33-41.
- Williams TA, Gruber DA, Sutcliffe KM, Shepherd DA, Zhao EY. Organizational response to

- adversity: Fusing crisis management and resilience research streams. *Academy of Management Annals*. 2017;11(2):733-769.
18. Mastane Z, Mouseli L, Jahangiri M, Doost M, Eshghi A. Strength and weakness of crisis management in Hormozgan medical university's hospitals. *J Fasa Uni Med Sci*. 2012;1(4):244-250.
 19. Rahmanian E, Mardani M, Abbasi M, Sharifi R. Assessment of physical preparedness of Farabi Hospital to deal with the crisis. *J Neyshabur Univ Med Sci*. 2016;4(3):48-55.
 20. Min-Seok K, JEON Y-M, LEE J-S. A comparative analysis of the level of urban resilience in the city comprehensive plan. *WIT Transactions on Ecology and the Environ*. 2017;223:517-526.
 21. Cucuzza M, Stoll JS, Leslie HM. Comprehensive plans as tools for enhancing coastal community resilience. *J Environ Planning and Management*. 2020;63(11):2022-2041.