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Health Man & Info Sci 2025, 12(3), 159–170

HMIS
Health Management and Information Science

Original Article

Preparedness of Earthquake Assessment in Alborz University of Medical Sciences: Turning Threats into Opportunities

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Abstract

Introduction: Since educational institutions are vital infrastructure, it is crucial that they be adequately equipped to withstand natural disasters. The goal of the current study was to evaluate and examine how prepared a higher education institution was for earthquakes.

Methods: In order to evaluate a higher education center's level of earthquake preparedness, a cross-sectional descriptive-analytical study was carried out in 2022. Strengths, weaknesses, opportunities, and threats (SWOT) analysis was carried out after data was gathered using a preparedness assessment checklist designed specifically for higher education institutions. Two categories of internal and external factors were then identified.

Results: The earthquake preparedness level was assessed to be 64.5% on average. Among the various dimensions evaluated, the laboratory (84.16%) and safety (80.22%) dimensions showed the highest level of preparation, respectively.

Conclusion: It is highly recommended that a comprehensive national-level preparedness tool should also be developed. In addition, measures such as budget allocation, incentive programs, and legal requirements should be implemented to prepare educational structures for potential earthquakes.

Keywords: Earthquake, Preparedness, Faculty, Natural Disasters, SWOT

Article History:
Received: 9 March 2025
Accepted: 21 May 2025

Please cite this paper as:
Norouzinia R, Dehghani A, Behmaneshpour MR, Eskandari Z. Preparedness of Earthquake Assessment in Alborz University of Medical Sciences: Turning Threats into Opportunities. Health Man & Info Sci. 2025; 12(3): 159-170. doi: 10.30476/jhmi.2025.107486.1288.

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Introduction

Education is a fundamental human right that is essential to achieving other rights and empowering people (1). Educational institutions are intricate structures that house a wide variety of staff members, students, and physical locations. As a result, evaluating and improving these institutions' safety is essential (2). In educational centers, maintaining the safety of the learning environment and encouraging lifelong learning are dynamic, ongoing processes that call for the participation of administrators, employees, students, and the community at large (3). Higher education institutions in particular are vital infrastructures that are extremely susceptible to earthquakes. Because of their distinctive qualities and varied functions, these institutions are important in both the pre- and post-disaster phases. In higher education institutions that are in charge of knowledge acquisition, exchange, production, training, research, and innovation, it is especially important to make sure that the right to education is not jeopardized by natural disasters (4). It is criticized when a university or other academic institution is unable to continue operating after a disaster.

Among the most dangerous natural disasters, earthquakes cause physical, psychological, and social harm to human societies. They can happen suddenly and without warning (4). More than two thirds of Iran's land are subject to very high or high earthquake risk, according to an analysis of

the zoning maps that measure relative earthquake risk (5). The geomorphological features of the nation and the regularity of earthquakes indicate that seismic activity is likely to continue as a significant threat to the nation (6).

More than 70% of Iran's largest cities are extremely vulnerable to earthquakes that cause significant damage. Not only have earthquakes claimed thousands of lives in recent decades, but they have also caused significant economic losses and the devastation of numerous cities and villages throughout the world (7, 8). Since that Iran makes up only 1% of the world's population, it is imperative that people prepare on an individual, household, and community level in order to increase society's ability to withstand natural disasters. This is especially crucial considering how vulnerable modern society is to earthquakes (9).

Disaster preparedness encompasses preventive measures and self-defense tactics meant to lessen the impact of calamities (10). The four phases of the disaster management cycle are mitigation, preparedness, response, and recovery. The most important stage is preparation. People are the largest and most important group in the world, yet they are frequently ignored in disaster management, according to earlier research conducted in Iran (11, 12). On the other hand, preparedness is crucial to disaster management since it can help avert unfortunate events, as demonstrated by the devastating effects of earthquakes that have struck Iran in recent decades (13).

The aim of this study was to assess the earthquake preparedness level of the faculties affiliated with Alborz University of Medical Sciences. The study findings can be utilized by managers to implement corrective measures to enhance the level of preparedness across the university's faculties.

Methods

This cross-sectional descriptive-analytical study was conducted to determine the level of earthquake preparedness in one of the higher education centers comprising six faculties (medicine, dentistry, pharmacy, health, paramedical, nursing and pre-hospital emergency medicine) in 2022. The data was collected over a period of one month using a checklist developed and validated by Sohrabizadeh et al. (13). The checklist has 56 items with yes-no response options and encompasses nine dimensions, including building and surrounding environment (13 items), facilities (5 items), incident command system (4 items), planning (8 items), safety (4 items), laboratory (3 items), training and practice (4 items), information and communication (5 items), and support (10 items). The validity and reliability of the tool were assessed and found to have a content validity index (CVI) of 88%, content validity ratio (CVR) of 85.98%, and a kappa coefficient of 98%

The researchers worked with representatives from each faculty to organize a field survey in which they gathered data using the checklist in order to assess the faculties' level of earthquake preparedness. Interviews, observations, trips to various faculty departments, and a review of the available materials were used to gather the needed data. One score for a "no" response and two for a "yes" response were assigned to each checklist question. By adding up the scores for each dimension, the overall average level of preparation as well as the various components of preparation were determined. Five categories were then created from the scores: very poor (less than 68), poor (69-79), moderate (80-90), good (91-101), and very good (102-112).

Strengths, weaknesses, opportunities, and threats (SWOT) analysis was carried out to assess the current state of affairs and create suitable preparation plan strategies following the evaluation and determination of the faculties' level of earthquake preparedness. Each faculty's results were grouped into SWOT tables, taking into account both external and internal elements that could affect earthquake preparedness, such as opportunities and threats, as well as internal factors that affect strengths and weaknesses. After these tables were designed, an assessment matrix of internal factors was created by enumerating the advantages and disadvantages of each factor, calculating its relative importance coefficient in relation to the other factors, and ranking each factor.

Three experts with expertise in emergency and disaster health assessed the matrices, and each matrix's final score was determined. With a zero coefficient denoting a factor of no significance and a 100 coefficient denoting a highly significant factor, the coefficients added up to 100. The factors were given a rank between 1

and 4, where 1 denoted a fundamental weakness or insignificance and 4 represented a high rank. The external factor matrix was assessed in the same manner following the enumeration of the opportunities and threats. Ultimately, the best ways to improve earthquake preparedness were identified by creating an integrated matrix of internal and external factors.

Results

The university's faculties' earthquake preparedness score was 64.5%, which indicates extremely poor preparedness, based on the results of the first stage. The Faculty of Medicine had the lowest level of preparedness, while the Faculty of Nursing and Pre-hospital Emergency Medicine, as well as Health, had the highest levels of preparedness (Table 1).

The dimension of laboratory (84.16%) and safety (80.22%) had the highest levels of preparedness, while the incident command system dimension had the lowest level of preparedness (52.38%). (Table 2).

Based on various factors including programs, budgets, infrastructure, and structural and non-structural conditions, each faculty's level of earthquake preparedness differed in several dimensions. Figure 1 illustrates these variations by comparing the various dimensions of earthquake preparedness within and between faculties.

Based on the results of the first SWOT analysis stage, the medical sciences faculties' preparedness for earthquakes was evaluated and interpreted in the second stage. As shown in Table 3 and Figure 2, the SWOT analysis entailed assessing and interpreting both external and internal elements, such as opportunities and threats, as well as strengths and weaknesses. Based on the extracted SWOT tables, internal and external factor evaluation matrices were created to evaluate the influence of each factor. Strengths and weaknesses were included in the external factor evaluation matrices, whereas opportunities and threats were included in the internal factor evaluation matrices. The factors in these matrices were ranked from 1 to 4 and their relative importance coefficient, which ranges from 0 to 100 when compared to other factors, were used to evaluate them.

The coefficient of each factor was multiplied by its rank to determine the final numbers for each matrix, and the results were then added up. As seen in Figure 2, the internal evaluation matrix, which evaluated the strengths and weaknesses, had a score between 3.42 and 3.95, while the external evaluation matrix, which evaluated the opportunities and threats facing the faculties' earthquake preparedness, had a score ranging from 3.85 to 3.9. Combining and locating the intersection point of the final scores from the internal and external evaluation matrices revealed a strength-opportunity (SO) strategy, which was the best course of action for improving

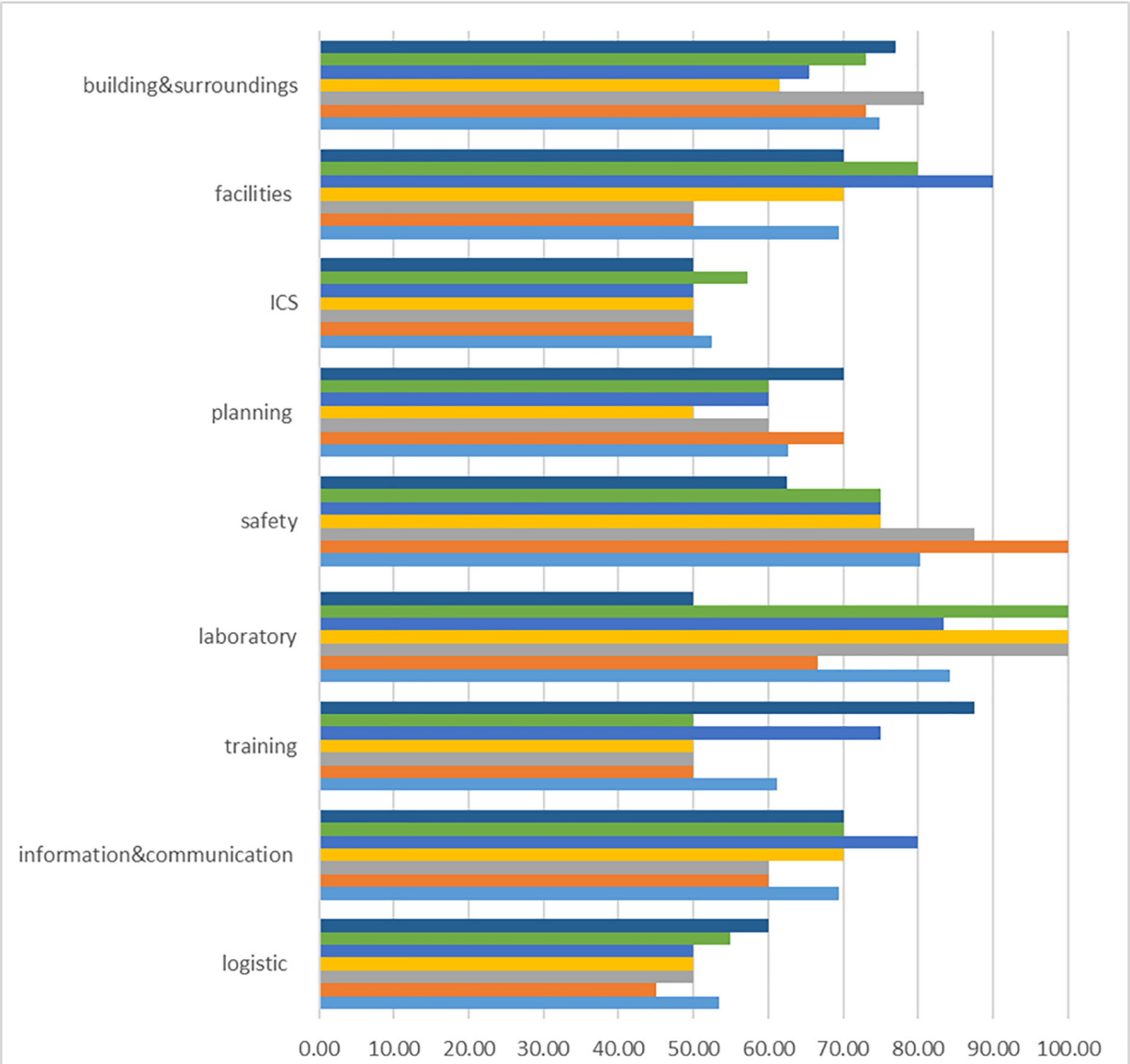
Table 1: Level of preparedness in faculties of Alborz university medical of sciences

Faculty	Level of preparedness %	Preparedness situation
A	66.96	Very poor
B	66.96	Very poor
C	66.07	Very poor
D	60.71	Very poor
E	64.29	Very poor
F	61.61	Very poor

Table 2: Level of preparedness across dimensions

Dimensions	Level of preparedness %	Preparedness situation
Building &surroundings	74.90	Poor
Facilities	69.47	Poor
Industrial Control Systems (ICS)	52.38	Very poor
Planning	62.69	Very poor
Safety	80.22	Moderate
Laboratory	84.16	Moderate
Training	61.22	Very poor
Information & communication	69.47	Poor
Logistic	53.38	Very poor

earthquake preparedness. This suggests that strategies should make use of internal strengths and potentials as well as external opportunities to address internal weaknesses or external threats in order to improve the faculties' preparedness for earthquakes.



	logistic	information&communication	training	laboratory	safety	planning	ICS	facilities	building&surroundings
A	60	70	87.5	50	62.5	70	50	70	76.92
B	55	70	50	100	75	60	57.1	80	73.08
C	50	80	75	83.33	75	60	50	90	65.38
D	50	70	50	100	75	50	50	70	61.54
E	50	60	50	100	87.5	60	50	50	80.77
F	45	60	50	66.67	100	70	50	50	73.08
total	53.38	69.47	61.22	84.16	80.22	62.69	52.38	69.47	74.90

Figure 1: Degree of preparation of faculties in different dimensions

Table 3: Integrated matrix of evaluation of internal and external factors

Faculty	Weaknesses	Strengths	Opportunities	Threats
A	No emergency exit Lack of non-structural immunization Failure to predict a suitable place to accommodate people Failure to design and operate the incident command system Absence of university preparation program Absence of an emergency evacuation plan Lack of emergency evacuation plan Lack of planning for the initial treatment of the injured Lack of continuous training of students and staff Failure to conduct training and maneuvers Absence of food for 72 hours Lack of depot	Periodic visit of the structure by technical engineers Having a suitable and safe space for emergency evacuation Access to medical centers The existence of the process of cutting off electricity, water and gas during accidents Existence of fire extinguishers 2000 liters of water storage The presence of electricity and water generators The presence of an internal messaging system	Proper urban engineering (proper distance between buildings) Presence of pre-hospital emergency code on the college campus The openness of urban space for accommodation and evacuation No traffic around the campus	Proximity to an active fault Lack of risk insurance Lack of immunization against dangerous substances Lack of backup and offline communication systems
B	No emergency exit Non-structural safety It is not possible to automatically cut off electricity and gas Failure to reestablish the flow of electricity, gas, and water automatically Lack of incident command system Absence of earthquake Preparedness program of the faculty Lack of emergency evacuation plan Absence of an emergency evacuation plan Lack of fire extinguishers Lack of laboratory safety Lack of safety instructions Lack of water and food storage Lack of depot	Periodic visit of the structure by technical engineers Open space for emergencies Access to medical centers Space to accommodate people Continuous training for staff and students Holding maneuvers and exercises The existence of a communication program in the faculty Availability of an alternative power source	Proper urban engineering (proper distance between buildings) Presence of pre-hospital emergency code in the college campus Existence of risk insurance The openness of urban space for accommodation and evacuation No traffic around the campus The presence of health professionals in disasters and emergencies to assess and manage the non-structural and functional vulnerability of faculties Communication and scientific cooperation with relevant experts from other national and international executive organizations Using the facilities of Red Crescent student centers to empower students	Proximity to an active fault Placement next to another faculty and crowded space
C	No emergency exit Non-structural safety Lack of space to accommodate people Inappropriate building and changed use Lack of incident command system Lack of preparation plan Lack of emergency evacuation plan Failure to perform maneuvers and exercises Lack of water and food storage Lack of backup resources Lack of space for facilities depot Open space for emergencies	Periodic visit of the structure by technical engineers Periodic visit of the elevator The possibility of automatic electricity and gas cut-off in an earthquake The possibility of automatic establishment of electricity, gas and water flow after the accident Immunization against hazardous substances Existence of fire extinguishers Firefighting training for employees Frequent training of employees and students A list of contact information	Proximity to the pre-hospital emergency code in the Faculty of Health	Proximity to an active fault Lack of backup and offline communication systems Being in a narrow alley Faculty street is one-way Congestion and traffic on Faculty Street

Faculty	Weaknesses	Strengths	Opportunities	Threats
D	Failure to hold disaster management meetings and define the roles and responsibilities of people in the disaster command system Failure to prepare a college risk map Not using active student centers in the faculty Absence of emergency stairs, protecting windows on the ground floor and floors and equipping the building with safety glass and protective glass tape, signs or emergency exit guide signs. Lack of connection and restraint of library shelves and heavy cupboards, refrigerators, instability of tools and equipment and unsafe arrangement in laboratory shelves. Failure to develop a Preparedness plan including emergency evacuation, initial treatment of the injured, establishment of the command system and defined communication with other units Failure to comply with safety standards in the storage of chemicals, dangerous substances and gas capsules in the laboratory, exposed to safety instructions Lack of awareness and training of employees and students in the field of disaster management and regular schedule, scenario and detailed and recorded report of maneuvers. lack of planning in the field of information and communication, Failure to conclude a memorandum of understanding with medical centers in the region Failure to plan the use of open space for emergency accommodation, rescue equipment, water and food storage for the first 72 hours of the disaster. Failure to conduct joint maneuvers with other organizations	Storage and backup of critical information Existence of fire extinguishers in different units and regular and periodic inspection CCTV cameras Existence of risk insurance Having 1000 liter water tank The presence of an emergency power generator		Risk of earthquake Lack of medical centers compared to the population of the region Lack of retrofitting and safety to strengthen the preparation of faculties The issue of safety of employees and students is not a priority

Faculty	Weaknesses	Strengths	Opportunities	Threats
E	Failure to prepare a college risk map Not using active student centers in the faculty. No emergency stairs Failure to connect and restrain the shelves of libraries and heavy cupboards, refrigerators Instability of tools and equipment and unsafe arrangement in laboratory shelves Lack of alternative emergency power and automatic water shut-off and connection after the earthquake Failure to design and formulate a comprehensive Preparedness plan including emergency evacuation, initial treatment of the injured, establishment of the disaster command system and defined communication with other academic units. Failure to comply with safety standards in the storage of chemicals, dangerous substances and gas capsules in the laboratory Lack of awareness and training of employees and students in the field of disasters management Lack of regular schedule, scenario and detailed and recorded report of maneuvers Lack of planning in the field of information and communication Failure to conclude a memorandum of understanding with medical centers in the region Failure to plan the use of open space for emergency accommodation, rescue equipment, water and food storage for the first 72 hours during a disaster. Failure to conduct joint maneuvers with other organizations Using homemade capsules in laboratories	Storage and backup of critical information Existence of fire extinguishers in different units and regular and periodic inspection Installation of CCTV cameras Existence of risk insurance Holding disaster management meetings and defining the roles and responsibilities of people in the disaster command system Existence of safety instructions for working with devices in laboratories The interest of professors, students and employees in learning disasters management standards Teaching first aid to students Exposure to safety instructions	Located near the main exit roads, the presence of wide streets Using the facilities of Red Crescent Student Centers to empower students	Proximity to the fault Risk of earthquake Lack of medical centers compared to the population of the region The issue of safety of employees and students is not a priority

Faculty	Weaknesses	Strengths	Opportunities	Threats
F	Failure to hold disasters management meetings and define the roles and responsibilities of people in the disaster command system Failure to prepare a college risk map Not using active student centers in the faculty, teaching first aid to students and the interest of professors, students and employees to learn disasters management standards. Absence of emergency stairs, protecting windows on the ground floor, and equipping the building with safety glass and protective glass tape, signs or emergency exit guide signs. Lack of connection and restraint of library shelves and heavy cupboards, refrigerators, instability of tools and equipment and unsafe arrangement in laboratory shelves. Lack of alternative emergency electricity and automatic connection of gas, disconnection and automatic connection of water after the earthquake Failure to design and formulate a comprehensive Preparedness plan including emergency evacuation, initial treatment of the injured, establishment of the disaster command system and defined communication with other academic units. Failure to comply with safety standards in the storage of chemicals, dangerous substances and gas capsules in the laboratory, exposed to safety instructions Lack of training of employees and students in the field of disasters management and regular schedule, scenario and detailed and recorded report of maneuvers Lack of planning in the field of information and communication Failure to conclude a memorandum of understanding with medical centers in the region Failure to plan the use of open space for emergency accommodation, rescue equipment, water and food storage for the first 72 hours of the disasters. Conducting joint maneuvers with other organizations	Storage and backup of critical information Existence of fire extinguishers in different units and regular and periodic inspection Installation of CCTV cameras Existence of risk insurance Proximity to Imam Ali Complex Medical Center	Proximity to the fire department	Proximity to the fault Risk of earthquake Lack of retrofitting and safety to strengthen the preparation of faculties The issue of safety of employees and students is not a priority Heavy traffic in the area

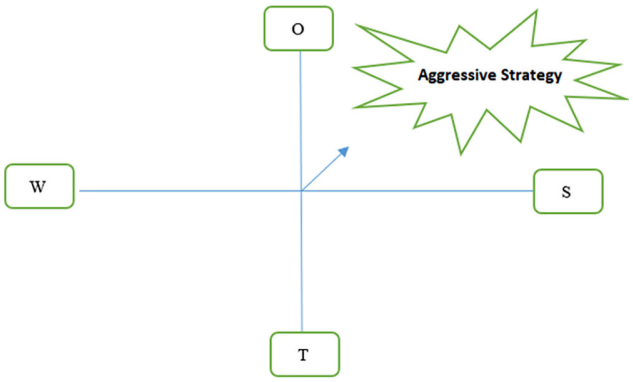


Figure 2: Integrated matrix of evaluation of internal and external factors

Discussion

The current study aimed to assess the earthquake preparedness level of faculties affiliated with Alborz University of Medical Sciences across various dimensions. The overall earthquake preparedness level was found to be very poor, indicating that the performance of this higher education center would be significantly affected in the event of an earthquake and may not be able to provide optimal services. The laboratory and safety dimensions had the highest levels of preparedness, while the incident command system had the lowest level of preparedness, highlighting the need for improvement in this area.

The building and surrounding environment dimension of the faculties affiliated with Alborz University of Medical Sciences varied significantly. Some faculties had adequate space for emergency evacuation and easy access to the medical center, while others had structural issues that increased their vulnerability to earthquakes. However, with plans to relocate some faculties to the university campus in the near future, it is anticipated that the weaknesses of these faculties will be addressed. The engineering and technical unit conducts periodic visits to assess the facilities, and alternative power sources are available.

It was determined that there was very little preparation in terms of command and control. An essential part of disaster management, the incident command system permits efficient countermeasure coordination in times of emergency. In order to manage resources during incident response, it includes a collection of buildings, tools, staff, protocols, and channels of communication that function inside a shared organizational structure.

The development of a comprehensive incident command system is an essential capacity that facilitates the effective use of human and physical resources in responding to disasters. To develop an incident command system chart, direct cooperation between senior managers and employees of the organization is necessary (14). This system helps to communicate roles and responsibilities to the people and enables each department to prepare risk maps or different plans based on their assigned duties (15). Failure to introduce an incident command system would hinder significant changes and improvements in the faculties' earthquake preparedness.

In the planning dimension, the faculties' level of earthquake preparedness was rated as poor. The faculties must create an extensive earthquake preparedness plan using the knowledge of disaster management and health experts, since there was inadequate planning in many areas to deal with disasters. Senior managers can facilitate the implementation of effective measures to ensure employee and student safety, as well as the continuous provision of university services and operations across its subordinate units, by developing a strategic, standardized plan for earthquake preparedness in all faculties and allocating adequate funds (16).

It is suggested that the faculties take a number of steps to enhance their earthquake preparedness, such as updating and reviewing their earthquake response plan in accordance with the number of students enrolled and allocating adequate funding to support the plan. At least twice a year, the incident command system should be activated, and all pertinent stakeholders should be informed about the program and its instructions. Enough communication systems, including satellite phones, cell phones, wireless devices, and landlines, must also be available. Faculty representatives should receive training so they can educate the public about incidents, and they should take steps to manage staff stress and think about personnel welfare issues. It is also necessary to make plans for supplying more troops and volunteers to deal with emergencies. In terms of safety, the faculties scored fairly well; positive aspects included having fire extinguishers on hand and having regular staff training. Nonetheless, action must be taken in the area of non-structural safety. Shelves, heavy closets, and other equipment must be secured because internal objects and items have the

potential to injure and damage people during an earthquake. To increase non-structural safety, actions like installing floor plans and emergency evacuation routes, fire alarms, alarm systems, emergency warning signs at emergency exits, locked cabinets, and drainage areas should be taken (3). The faculties received the highest score in the laboratory dimension, indicating that safety standards for the storage of chemical, biological, and hazardous materials were well implemented. Laboratory safety issues, such as the chemical and physical properties of materials, the nature of hazards, the warning system's physical and chemical properties, the associated risks, and the level of exposure to materials, have been highlighted in studies (17).

One of the most important components of earthquake preparedness is staff training. Disaster managers employ training as a crucial tactic to alter behavior and lessen the damaging effects of disasters. Increased safety, less damage, and disaster prevention are all possible with the right training (18). Jahangiri et al. conducted a study. employees at Shiraz University of Medical Sciences were rated as having an average level of earthquake preparedness (6). As stated by Kapuka et al. creating a disaster-resistant university requires creating an all-hazards preparedness plan, conducting regular training sessions and drills, and forming community partnerships (19). An additional study carried out in Kashmir emphasized the significance of teaching employees and students about earthquake safety in educational settings (20).

Given the importance of practice and training in earthquake preparedness, there are a number of obstacles to overcome, including staff and student ignorance of disaster management, a lack of a regular practice schedule, and a lack of thorough documented reports. In order to fully utilize the strengths and potentials of the faculty, including the scientific expertise of disaster management and health experts, the active involvement of student centers, and the interest of professors, students, and staff in learning disaster management standards, comprehensive educational programs focusing on earthquake preparedness, safety, rescue, firefighting, and operational coordination and planning should be designed and implemented. Senior management, employees, and students' cooperation, combined with the use of Red Crescent student centers' resources and collaborative actions with other organizations (like fire department), as well as creating public areas outside and surrounding the college, can be useful tactics. In order to deal with accidents and disasters, education and preparedness of the community and its members are essential (21).

Buildings that are earthquake-resistant, a management structure that works, and effective training for staff, students, and society as a whole can all help lower the vulnerability of higher education institutions (12). According to a study, managers and staff can be better prepared for accidents and disasters by taking training courses on these topics (22). The organization's information and communication strengths included the ability to store and back up important data, the existence of internal communication systems, and a current list of contacts for different departments. A shortcoming noted in the research was the absence of an individual possessing the necessary skills and understanding to efficiently distribute information about occurrences. The faculties' level of preparedness was evaluated as poor in the support dimension, highlighting the significance of having access to backup and replacement resources for necessities like gas, electricity, water, and telephone. To meet this need, senior managers must organize and carry out the necessary actions. One workable solution would be to sign an agreement with caterers to provide food and water to colleges in the event of an emergency or disaster. Disaster Medical Assistance Team (DMAT) teams can help other disaster-affected areas by storing enough personal protective and rescue equipment, which is in line with the University of Medical Sciences' faculty mission (23).

Conclusion

Given the inadequate level of preparedness, managers and policymakers should consider improving the faculties' earthquake preparedness as a critical strategy and a high priority. Focusing on command and control systems, like the incident command system, creating and implementing coordination patterns both within and between organizations, and attending to employee needs and expectations by enhancing their competencies and promoting their involvement in risk reduction programs through internal and inter-organizational exercises are

some ways to achieve this. The university's non-active defense committee and risk management for accidents and disasters might rank these tasks in order of importance. Crucial actions in this regard include allocating funds for faculty evaluation and improvement, as well as lobbying lawmakers and consulting with them to draft laws requiring educational institutions to assess and raise their levels of preparedness.

Limitations

It was difficult to find information about the efficacy and efficiency of response programs, practice and training programs, and agreements pertaining to communication and coordination between institutions. So, a qualitative study should be conducted in conjunction with future research to gain a deeper understanding of the current level of earthquake preparedness and strategies for enhancing it.

Acknowledgments

The authors of this article would like to extend their gratitude to the Research and Technology Deputy of Alborz University of Medical Sciences for their invaluable support. Furthermore, we appreciate the participants who contributed to this project

Authors' Contribution

Conceptualization and supervision: Zahra Eskandari, and Arezoo Dehghani; Data collection: Mohammad Reza Behmaneshpour, Zahra Eskandari, and Arezoo Dehghani; Methodology and data analysis: Roohangize Norouzinia; Investigation and writing: All authors

Ethical Considerations

This study was approved by the Ethics Committee of Alborz University of Medical Sciences (code: IR.ABZUMS.REC.1401.110).

Conflict of Interest

There are no conflicts of interest.

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