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Effective Components in the Structure of Temporary Medical Centers in Biological Emergencies: A Qualitative Study

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Abstract

Background: The release of a biological agent can cause many casualties. This study aimed to identify the structural components of temporary medical centers in biological emergencies.

Methods: The present research is a study with a qualitative approach to contractual content analysis in the period of 2021–2022 in Tehran. The participants in this study consisted of 22 managers who were experts in constructing, equipping, and maintaining temporary medical centers and had experience in responding to biological agents and working in the emergency health system in Tehran. Purposeful and snowball sampling was used to select the samples. The main question of the interview was, "In your opinion, what are the effective components in the design of a temporary medical center in biological emergencies?" The collected data were analyzed using MAXQDA-2020 software, using the Graneheim and Lundman method. Guba and Lincoln's criteria were used to confirm the quality of the study results.

Results: The essential components of temporary medical center structures in biological emergencies can be grouped into two main categories: prerequisites (including resources, infrastructures, and concepts) and effective management. The prerequisites category includes subcategories, such as adequate and skilled personnel, strategies for establishing and using suitable infrastructures, provision and support, training and practice, a health-oriented approach, communication and community involvement, cultural sensitivity, allocation of financial resources, inter-agency collaboration, legal authorization, location, and spatial accessibility. The second category, "effective management," includes subcategories like planning, a needs-based approach to service provision, defining the service delivery process, preparing protocols for center management, reducing disaster risk, treatment management, information and communication management, strategic design, and monitoring and evaluation.

Conclusion: Biological emergencies are one of the world's most important challenges, and there are still many shortcomings in the proper preparation and performance in addressing them. The results of this study can effectively improve the level of biological disaster management by identifying the components needed in the design of temporary centers.

Keywords: Temporary medical centers, Biological emergencies, Qualitative study, Content analysis

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Introduction

In today's world, accidents and disasters, which are considered a great challenge for human life, have increased significantly (1). Disasters have many physical, psychological, and financial consequences for societies and can affect human life, the environment, and the economy (2-4). Infectious disease epidemics have impacted the global population throughout history, resulting in significant loss of life (5). Biological incidents can arise within human populations as a result of intentional actions or natural outbreaks of infectious diseases (6).

In the last two decades, emerging and reoccurring infectious diseases such as SARS, MERS, Crimean Congo fever, Ebola, and COVID-19 have caused many concerns in the healthcare sector (7). The release of a contagious microorganism can cause many casualties. As a result, planning for preparedness for and response to such disasters is one of the most important issues and health requirements, especially in developing countries (8,9). Disasters and their consequences can quickly affect

available resources (10) and create a great demand for health care (11).

As places of care and treatment, hospitals are vital in response to biological emergencies. Despite the progress made in this regard, there are still no internationally accepted standards for hospital preparedness and disaster response (12). Even in developed countries, evidence worldwide indicates that hospitals are not adequately prepared against biological disasters (13-17). In such cases, emergency medical measures are needed to promptly fill the gap in medical resources. After natural disasters, wars, or famine, hospitals face challenges due to limited resources and cannot meet the increasing needs of affected people. Active hospitals may become inoperable during disasters or due to a surge in patient admissions within a short time frame, creating significant challenges for organizations (18). The critical shortage of resources and facilities during recent global outbreaks, including SARS, MERS, and COVID-19, illustrates this issue (18,19). In pandemics, hospitals and temporary medical centers can serve as supplemental resources. For instance, during the COVID-19 outbreak, setting up facilities like the Hong Kong Hospital in Wuhan, China, helped reduce hospital workload and the COVID-19 mortality rate between January 21 and February 21, 2019 (20).

Experiences of such centers regarding rapid response, diagnosis, disease control, and mortality reduction, especially in China (21-23) and America (24), have been published. These indicate that temporary medical centers should be prepared to respond to disasters and biological emergencies and have appropriate planning and structure. However, a standard structure for these centers has not been reported to this date. Thus, the present study aims to identify the structural components of temporary medical centers in biological emergencies.

Methods

Study design

The present research is a qualitative study of contractual content analysis in Tehran from 2021 to 2022. The qualitative method emphasizes understanding the complexity and details of the studied phenomena, and the researcher is actively involved in the research process (25).

Participants

The study population consisted of managers specializing in constructing, equipping, and maintaining temporary medical centers who had a history of dealing with biological agents and working in the emergency health system in Tehran. The inclusion criteria were operational experience, managerial experience, and academic expertise in this field, ability to communicate with the interviewer, and informed consent to participate. The exclusion criteria were lack of ability to communicate with the interviewer and unwillingness to continue the study.

Data collection

This study used the purposeful, snowball, and theoretical sampling methods (26).

Below are some examples of the questions used in the first interviews. The questions could change according to the analysis of the interviews and the study objectives.

- Please describe your experience in responding to a biological incident requiring increased capacity.
- In your opinion, what effective components should be considered when designing temporary medical centers?

The approximate time of each interview was between 60 and 120 minutes. Sampling continued until reaching theoretical saturation.

Data analysis

Following the method of Graneheim and Lundman, the text of each interview was transcribed and then read multiple times to ensure immersion in the data. Primary codes were then derived with keywords and phrases, and the participants' body language was identified and labeled as descriptive codes (examples). In the next phase, after moving to a more abstract level of analysis, the initial codes were refined into analytical codes. After adjustments, they were defined as interpretive codes (categories) (27,28). Finally, based on similarities and differences, the codes were grouped into various categories (29). MAXQDA-2020 software was used to manage the data.

Trustworthiness

The Guba and Lincoln criteria (30) were used to confirm the quality of the results. To increase the study's credibility, the researchers followed the principle of maximum variation in sampling. At the end of each interview, the researcher's general understanding of the statements was briefly stated to the interviewee and approved by them. Also, at the end of the coding process and data analysis, the table of categories, subcategories, and codes, along with the quotes, was provided to six participants to determine whether their experiences were reported correctly. In order to obtain confirmability, the researchers sent the result of data analysis and their findings to four prominent researchers in the field of qualitative research, as well as five experts and managers, and the necessary corrections were made according to their opinions while maintaining the authenticity of the results and data. Also, the raw data and field notes were kept for later revisions. In order to increase the dependability, all research team members were included in the data analysis and coding process, and they were encouraged to express their opinions in the meetings. Finally, the names of categories and subcategories were finalized with the approval of the research team. A complete description of the entire research process was prepared to increase the transferability. This description also included large

numbers of the participants' direct quotes.

Results

Most participants were male, had doctorates, and specialized in health management (Table 1).

According to the results, the effective components in the structure of temporary medical centers in biological emergencies can be divided into two main categories: prerequisites (resources, infrastructures, and ideas) and effective management. These two categories also had 20 subcategories, which are shown in Table 2.

Prerequisites (resources, infrastructure, and ideas)

One of the practical components in the structure of temporary medical centers was found to be prerequisites, which include resources, infrastructures, and ideas. This component refers to the issues and factors that are important in the design of temporary medical centers.

Sufficient and specialized workforce

Most participants stated that a sufficient and specialized workforce is the first and perhaps the most important prerequisite for setting up a temporary medical center. A sufficient number of nurses, paramedics, paramedic assistants, managers, physicians, safety and health officers, administrative personnel, etc. should be considered for a temporary medical center. It should also be noted that in case of staff shortages, volunteers should be used to cover the staff shortages.

"*Without sufficient experienced and specialized workforce, these centers cannot operate effectively. Expert workforce should also be used along with less expert staff because the stronger these human resources are, the better services they can provide.*" (Interviewee No. 6)

Table 1. Demographic characteristics of study participants

Variable		Frequency (%)
Gender	Male	17 (77.3)
	Female	5 (22.7)
Age	30–40	5 (22.7)
	40–50	9 (40.9)
	≥50	8 (36.4)
Education level	General practitioner	2 (9.1)
	PhD	11 (50)
	Masters	3 (13.6)
	Specialist	6 (27.3)
Specialty (field of expertise)	Health in disasters and emergencies	3 (13.6)
	Emergency physician	3 (13.6)
	Combat medicine	4 (18.2)
	Passive defense	2 (9.1)
	Red crescent	1 (4.55)
	Health management	8 (36.4)
	Hygiene	1 (4.55)

Strategies for building and using suitable infrastructure

Infrastructure refers to the facilities, systems, and buildings that serve a city, a country, or a population. According to the participants, infrastructure is one of the important components in setting up a temporary medical center.

"*Other than the sanitation system that I mentioned, the sanitary facilities, the required water, food, and non-food items such as bed sheets, pillows, daily washing, and other things that we need for the well-being of personnel were among the challenges. These effective factors are important issues that should be considered in the design of a temporary medical center.*" (Interviewee No. 8)

Supply and support

Another essential factor in setting up a temporary medical center is the issue of supply and support. These centers need oxygen systems, beds, monitors, ventilators, special drugs, vaccines, up-to-date equipment, strong transportation, support systems, computers, technical equipment, and personal protective equipment, which must be prioritized.

Education and practice

According to the participants, education and practice were another important prerequisite. Participants cited various training methods, including pre-event, just-in-time, and periodic training, as well as conducting training sessions, the center's training program, and training related to staff activities.

Table 2. Categories and subcategories of the practical components in the structure of temporary medical centers

Categories	Subcategories
Prerequisites (resources, infrastructures, and ideas)	Sufficient and specialized workforce
	Strategies for building and using suitable infrastructure
	Supply and support
	Education and practice
	Health-oriented approach
	Communication and social participation
	Culture-centeredness
	Allocation of financial resources
	Inter-sectoral cooperation
	Legal legitimacy
	Location and spatial access
Use of effective management	Planning
	A need-based approach to providing services
	Determining the service delivery process
	Preparing protocols for the management of the center
	Disaster risk reduction
	Treatment management
	Information and communication management
	Design strategy
	Monitoring and evaluation

Health-oriented approach

Another subcategory emphasized by the participants was a health-oriented approach and the importance of prevention over treatment. The participants believed that the challenges of setting up these centers would be minimized if there were a health-oriented view in society and among the policymakers. In this regard, they referred to issues such as paying attention to health needs, having a memorandum of understanding with other health and welfare organizations, having a plan before the accident, and being prepared as the most important issues that should be considered in setting up a temporary medical center.

"*The established approach in society should be that the resources, treatment, and rehabilitation should be considered before the incident. We should not sit back and wait for an accident to happen.*" (Interviewee No. 11)

Communication and social participation

Communication and social participation are another important issue in setting up a temporary medical center. These centers need social participation and strong and continuous communication with all organizations. Establishing supervisory structures, considering people's contributions, having governmental and ministerial support, welcoming people, using volunteers, identifying stakeholders, and clarifying the center's raison d'être were among the items mentioned by the experts in this study.

"*Considering people's participation and using volunteers in setting up temporary medical centers can be very helpful, and without social participation, these centers are not very successful.*" (Interviewee No. 17)

Culture-centeredness

When setting up a temporary medical center, special attention should be paid to the region's situation, traditions, and customs. Iran is vast and has different customs and traditions, so this issue should be addressed. Paying attention to the local people's culture and values and considering their customs and traditions when designing and building temporary medical centers can increase the efficiency and quality of service they provide.

Allocation of financial resources

All healthcare systems in the world face the problem of limited resources. Therefore, fair allocation of resources is one of the important challenges of any health system. It is also the main part of the decision-making process. In order to establish justice in the health care system and for fair allocation of resources, we need to apply ethical criteria. Temporary medical centers must be included in the annual budget, and the financial resources should be considered before starting a temporary medical center. Therefore, having the necessary budget, providing reliable financial resources, allocating sufficient resources, cooperating with donors and volunteers, and forming relevant associations are among the issues that should be considered.

"*A budget must be considered for these centers. All of this requires money. The employees require payment.*" (Interviewee No. 5)

Inter-sectoral cooperation

Inter-sectoral cooperation is a recognized relationship between different sectors of society that is established to work on a specific issue to achieve medium-term health results. The medium-term health results obtained in this way are more efficient or sustainable than those obtained from a health sector's performance alone. Inter-sectoral performance in the health field is the core of achieving equality in health, especially when improvement depends on the decisions and performances of other sectors. Inter-sectoral cooperation refers to the cooperation between different sectors of society, such as the public, private, and non-governmental sectors. Therefore, having a memorandum of understanding with organizations and institutions that provide services can be one of the prerequisites for setting up a temporary medical center.

Legal legitimacy

Legal legitimacy is one of the main factors to consider when setting up temporary treatment centers. The experts in this study pointed out the most important factors, including strong support, a license from the ministry or organizations with legal legitimacy, the power and credibility to provide services, and a legal agreement to build a temporary medical center.

"*The temporary medical centers should be under the supervision of a university and the ministry of health. The cooperation and approval of other institutions and bodies are also needed.*" (Interviewee No. 1)

Location and spatial accessibility

Places have objective appearances, perspectives, and characteristics that change over time. Choosing the right place to set up a treatment center is one of the important decisions that can significantly affect the operation of that center. Temporary medical centers are considered one of the primary urban services and one of the key factors in measuring the realization of sustainable development in cities. When accidents happen, these centers face the sensitive decision of location selection and choice of space. Choosing a suitable and optimal place to establish medical centers and hospitals is so important, as it affects the health and lives of people. Thus, the location of these medical centers cannot be ignored because it can cause irreparable damage to the health of citizens and society.

Effective management

Another main category extracted in this study was

effective management, which indicates that management is one of the central and integral components in the design of temporary medical centers. The idea of effective management has received significant attention in today's world. Developing practical management skills to deal with specific challenges is considered an urgent need in many companies and organizations that compete globally. This issue becomes more important regarding temporary medical centers.

Planning

One of the subcategories of effective management in this study was planning. Planning precedes all efforts and actions because it determines the type of decisions and activities necessary to achieve the desired goals. Planning is the act of determining what needs to be done in advance. This function includes the selection of goals, policies, programs, methods, and other measures necessary to achieve the goals. Regular and accurate planning is needed to make management more effective in setting up a temporary medical center.

The needs-based approach in service delivery

One important issue in effective management is the needs-based approach. It means considering people's concerns at every stage of designing and providing services so that people's needs become an organizing principle based on which public interests are determined and service delivery is planned. Prioritizing services with more needs, arranging tasks based on needs, prioritizing services and needs, and managing the center based on the need to provide services are among the factors that should be considered in this field.

Preparing protocols for the center's management and determining the service delivery process

According to the participants, formulating and developing appropriate and applicable protocols and determining the service delivery process were among other important factors in effective management. Considering the extent of services and the consequences of the crisis, these factors are necessary to manage temporary medical centers. While specifying the services, the manager should design and implement the service delivery process and mechanism.

"*A successful manager in the center is a manager who has an incident command system, zoning, and a plan to deal with new crises.*" (Interviewee No. 7)

Disaster risk reduction

Crisis management refers to the conscious coordination of efforts and the maximum use of human, technical, financial, and non-financial capacities in the design and implementation of different programs and activities before, during, and after a crisis, ensuring the maximum effectiveness of rescue operations.

"*A successful manager in the center is a manager who has an incident command system, a zoning system, and a plan on how to deal with the new crises.*" (Interviewee No. 7)

Treatment management

This study also formed a subcategory for treatment management. It refers to medical management, nursing management, infection control and prevention, triage, decontamination, and other necessary and fundamental factors in effective management.

Information and communication management

Every development and transformation requires accurate planning and a correct strategy. Today, we are witnessing a rapid shift in societies toward communication and information technology. Attention to communication and information management is vital in setting up temporary treatment centers.

Design strategy

The need to provide easy and quick access to people's basic healthcare needs during a crisis is one issue that prioritizes a suitable design strategy for setting up temporary medical centers.

"*The design should be appropriate, and everyone should feel comfortable in the center. The departments should be separate, the patients and personnel should be in touch while maintaining distance, and the travel routes should be clear.*" (Interviewee No. 8)

Monitoring and evaluation

We need a monitoring and evaluation system to ensure the quality of services provided in temporary medical centers. Activities are monitored, evaluated, measured, and recorded to control the program. Evaluation determines to what extent the program's implementation has achieved the goals. Therefore, in evaluating the effectiveness, the consequences and effects of the program are examined.

"*These centers should have a continuous monitoring system to determine the strengths and weaknesses, and this will allow us to have effective management and reach our goals sooner and better.*" (Interviewee No. 15)

Discussion

This study aimed to identify the structural components of temporary medical centers in biological emergencies. The findings indicated that these components could be grouped into two main categories: prerequisites (resources, infrastructure, and conceptual frameworks) and effective management.

According to the results, adequate and specialized human resources are the most crucial prerequisites for establishing a temporary medical center. Other research

has also emphasized the necessity of skilled personnel in healthcare facilities, particularly in response to emergencies (20,31).

The study further showed that attention to infrastructure is another essential component in setting up a temporary medical center. Reliable emergency water and power supplies, appropriate sanitary systems, sewage disposal, dedicated areas and equipment for waste segregation and incineration, adequate ventilation, a strong decontamination system, sturdy and reliable structures, suitable transportation, air support, and accessible facilities for patients and staff are factors that must be considered before establishing temporary medical centers. Reports from temporary medical centers worldwide have highlighted the importance of addressing these aspects (32,33).

Temporary medical centers require oxygen systems, sufficient beds, monitors, ventilators, specialized medications, vaccines, up-to-date equipment, robust transportation and support systems, computers, technical tools, and personal protective equipment. Other studies have also recognized the importance of these resources (32,34).

As highlighted in previous research (20,35,36), training staff on infection control and using personal protective equipment is critical for temporary medical centers to optimize the use of limited resources. Thus, specialized training should be provided to all employees, as training and practice enhance knowledge and skills, leading to a more effective response to disasters (37,38).

These centers also require strong, ongoing communication with all organizations and social participation, both of which have been noted in previous studies (39,40). Experts believe that special attention should be paid to the region's situation and local customs and traditions when setting up temporary medical centers. Neglecting these factors can probably lead to the project's failure (10,40).

Allocation of resources is one of the important challenges of the health system. It is also central to the decision-making process, especially in setting up temporary medical centers. Although setting up temporary medical centers is cheaper than building hospitals, governments must allocate the necessary funds to create these centers rapidly during crises and disease epidemics. The government, as well as the private sector and donors, can fund these centers (41). Some studies have shown that lack of financial resources is one of the main obstacles to success in responding to disasters (10,42).

The present study showed that one of the most important factors in setting up temporary medical centers is the cooperation of different groups and organizations, which has also been mentioned in other studies (31). Inter-sectoral cooperation between public and private sectors helps to set up temporary medical centers and achieve the planned goals. Inter-sectoral cooperation can be aimed at providing and equipping personal protective equipment, power supply, and daily needs of these centers. Many studies have found that medical centers can provide the best services when cooperating with other organizations (10,43).

The participants also mentioned legal legitimacy concerning setting up temporary medical centers. When a medical center is legitimate and receives support at national levels, it can be efficient and provide timely response to disasters (44,45).

The results indicate that location is a key component for temporary medical centers. Given the area's population, such centers should be established in safe locations near residential zones with reliable access to water and electricity. Community members should have convenient access to main roads and face no obstacles in reaching medical facilities. Consistent with this finding, other studies have also emphasized the critical role of location in establishing these centers (31,46).

Designing a hospital incident command system and developing a recovery plan, a contingency plan, an incident action plan (IAP), emergency operations plan (EOP), and a standard operating procedure (SOP) program, as well as designing a modern warfare system, assigning roles and responsibilities, setting goals, and performing regular monitoring are among activities that require careful planning (39). Other studies have referred to the lack of planning as the major challenge of medical centers in responding to disasters (10).

One of the important issues in effective management is the needs-based approach to providing services. Prioritizing services with more needs, arranging tasks based on needs, prioritizing services and needs, and managing the center based on the need to provide services are among the factors that should be considered in this field. Given the wide range of services and the use of staff from different centers as a united team during a crisis in a temporary medical center, we need quick and coordinated work for the success of these centers. Therefore, appropriate and applicable protocols must be developed and applied in these centers (47).

Risk analysis, identification of high-risk areas, traffic control, alertness to future incidents, zoning, and a suitable strategy are among the measures that should be considered in disaster risk reduction. These measures should be taken by a multidisciplinary management team consisting of physicians, nurses, and environmental health workers (41,48).

Treatment management refers to medical management, nursing management, infection control and prevention, triage, decontamination, etc. It is also one of the necessary and fundamental issues in effective management. The present study's results, in line with the findings of other studies, have highlighted the importance of treatment

management in temporary medical centers (47).

A crucial element in disaster and emergency response is guaranteeing efficient, frequent, and timely exchange of information. This exchange and management of information should be guided by a structured information and communication management system (49,50).

The findings of the present study indicate that standard design, path design, paying attention to previous experiences and weaknesses, engineered design, paying attention to commuting routes and minimizing direct contact between patients and staff, providing enough space for the transfer of food stretchers and employees, and paying attention to the different departments of the temporary medical center are among the strategies for the correct design of temporary medical centers. Previous studies have also mentioned similar strategies (40,46).

This study's strengths included using experts working in different areas of the health system, including health experts in disasters and emergencies. However, the present study was qualitative, so one should be careful in generalizing its results.

Conclusion

The findings of this study indicate that designing temporary centers for biological emergencies requires attention to essential prerequisites and the application of effective management principles. By outlining the key components of temporary medical center structures, these results can inform future management of biological emergencies.

Future research is recommended to explore tools for assessing and enhancing the readiness and performance of these centers and to develop clinical guidelines tailored for temporary treatment centers in biological incidents.

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Competing Interests

The authors declare that they have no competing interests.

Ethical Approval

The present study was approved by the Iran Army University of Medical Sciences, with the ethics code IR.AJAUMS.REC.1400.254.

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