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Research Article

# Explaining the Challenges Hospitals Face in Managing Mass Casualty Incidents: A Qualitative Study in Teaching Hospitals

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**Abstract**

**Introduction:** Mass casualty incidents (MCIs) impose unprecedented pressure on hospital capacities and resources, complicating the provision of standard services. Continuous preparedness for regional crises is essential. This qualitative study was designed to identify and analyze the challenges faced by teaching hospitals affiliated with Shahid Sadoughi University of Medical Sciences in Yazd when addressing mass casualties.

**Method:** This qualitative descriptive study used conventional content analysis and was conducted in 2025 at teaching hospitals under Shahid Sadoughi University of Medical Sciences, Yazd. Participants included 33 purposively selected managers, physicians, nurses, health professionals specializing in disasters and emergencies, and members of crisis and passive defense committees. Data collection continued until code saturation was achieved, which was confirmed after the 30th interview and validated through three additional interviews. Data were gathered through semi-structured, recorded interviews and analyzed using conventional content analysis. MAXQDA version 22 software was used for coding and organizing data, with methodological rigor ensured through Guba and Lincoln's framework, including credibility, transferability, dependability, and confirmability.

**Result:** Data analysis revealed that effective hospital responses to mass incidents encounter multifaceted obstacles. At the macro level, weak governance and policymaking, ineffective risk management, and inadequate training in command structures create uncertainty in critical decision-making. On the support level, this results in exacerbated physical constraints, shortages of vital resources (such as medicines and equipment), and inadequacies in supply chains and psychosocial support. From an organizational perspective, both interdepartmental and intra-organizational information flows were severely disrupted, and the existing technical infrastructure was unable to handle the high volume of data or establish necessary communications. Additionally, clinical service delivery declined significantly due to poor management of incoming patient volumes and a lack of trained specialists to manage multiple casualties simultaneously.

**Conclusion :** The findings indicate that enhancing hospitals' resilience in the face of mass casualties requires a comprehensive policy approach from senior management. This involves strengthening hospital infrastructure with dedicated budgets, empowering healthcare staff at all levels, providing psychosocial support, and conducting regular exercises based on local hazards. Implementing these layered solutions will significantly improve hospitals' response capacities and fortify the health system against future crises.

**Keywords:** Mass Casualty Incidents, Hospital, Emergency, Disaster, Management, Challenge.

## Introduction

Hospitals are a cornerstone of the healthcare system, playing a critical role in maintaining and promoting community health. Under steady-state conditions, these centers function as primary hubs for diagnostic,

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therapeutic, and rehabilitation services[1]. However, during sudden-onset disasters—ranging from natural hazards like earthquakes and floods to human-induced events such as terrorist attacks, mass casualty traffic accidents, and infectious disease outbreaks—hospitals undergo a radical transformation in their operational roles. These events necessitate an immediate transition from routine care to emergency response, positioning hospitals as the first line of defense in disaster mitigation[2].

MCIs are characterized by a sudden surge in patients that exceeds the hospital's immediate facilities, resources, and standard operational capacities[3,4]. During such crises, hospitals must confront a sharp, non-linear increase in demand for medical services while operating within the constraints of a finite workforce and infrastructure. The diverse nature of medical needs further exacerbates the complexity of MCIs; victims often present with a spectrum of acute physical traumas and psychological distress, all occurring within a high-pressure environment. Effectively managing this surge requires more than just resource availability; it demands a strategic realignment of hospital functions to prevent systemic collapse during the critical initial hours of an event5.

Hospitals are a crucial component of the health system, playing a vital role in maintaining and promoting community health. Under normal circumstances, these centers provide diagnostic, therapeutic, and rehabilitation services [1]. However, during unexpected events—such as earthquakes, floods, fires, terrorist attacks, mass traffic accidents, and outbreaks of infectious diseases—hospitals experience a dramatic shift in their roles. These events can lead to situations where a large number of individuals are simultaneously injured or ill, requiring urgent and specialized services [2]. This phenomenon, known as "mass casualty exposure," places unprecedented strain on hospital resources, facilities, and workforce, challenging their ability to deliver appropriate services [3]. Mass casualty incidents are characterized by several casualties that exceed the hospital's current facilities, resources, and standard operational processes [4]. Hospitals suddenly confront a sharp increase in demand for medical services, which occurs amid limited resources and facilities and a defined capacity for patient treatment. The complexity and diversity of medical needs in mass casualties can be extensive, as victims may suffer from various physical injuries and psychological issues due to the prevailing critical environment [5].

Effective hospital management during mass casualty situations necessitates meticulous planning, comprehensive preparation, and the ability to respond promptly to crises. This entails a broad range of activities, including rapid situational assessment, casualty triage, resource and equipment provision, coordination among teams, information management, and psychological support for both casualties and medical staff [6,7]. Any shortcomings in these activities can lead to diminished service quality, increased waiting times, and ultimately, heightened mortality and complications8. A systematic review conducted by Belinda J. Gabb et al. (2020) demonstrated that hospitals with established and practiced plans for handling mass casualties perform better and more efficiently in critical situations [9]. Therefore, effective hospital management in mass casualty scenarios necessitates adopting specific measures that address the immediate and extensive needs of casualties while preventing disruptions to normal hospital operations and services for other patients. This requires careful planning, effective interdepartmental coordination, optimal resource allocation, and thorough staff training and preparedness. However, achieving these objectives is often hindered by numerous obstacles that affect hospitals' crisis management capabilities and their ability to provide optimal services to mass casualties. This study aims to conduct an in-depth examination of these challenges to enhance preparedness and responsiveness in teaching hospitals affiliated with Shahid Sadoughi University of Medical Sciences, Yazd, in the face of mass casualty incidents.

## Methods

This study employed a qualitative descriptive design using conventional content analysis to explore the challenges of MCIs in teaching hospitals in Yazd, Iran, in 2025. A qualitative descriptive approach was chosen because it allows for a rich, low-inference description of participants' experiences and perceived challenges, while remaining closely grounded in their own words. The interview target population included 33 managers, physicians, head nurses, nurses, health specialists in disasters and emergencies, and members of crisis and passive defense committees in the university and pre-hospital emergency services in Yazd. Participants were

selected using purposive sampling. Data collection and analysis were conducted concurrently to monitor for data saturation; recruitment continued until code saturation was achieved, defined as the point where no new codes or conceptual themes emerged from the interviews. Saturation was reached after 30 interviews, and three additional interviews were conducted to ensure the robustness of the findings, bringing the total to 33. Inclusion criteria included at least two years of work experience in the target hospitals and direct involvement in MCI management or response. Participants unwilling to cooperate or engage in the interview were excluded.

Data collection was conducted through semi-structured interviews. Prior to the main interviews, three exploratory interviews were conducted with key informants to test the interview protocol and refine the wording of questions. Following this pilot phase, the revised interview protocol was implemented. The central question posed was: “What have been the most significant challenges you have faced in managing mass casualty incidents in Yazd teaching hospitals?” Supplementary probing questions were used to clarify specific experiences and ensure depth. The principal investigators conducted all interviews to maintain methodological consistency and minimize bias. Interviews were audio-recorded with written informed consent and lasted between 45 and 90 minutes.

For textual data analysis, conventional content analysis was utilized, allowing for codes and categories to be derived directly from the data. This method is appropriate when the objective is to describe a phenomenon without being limited by a specific pre-existing theory. The analysis involved multiple stages: first, audio recordings were transcribed verbatim. During the coding stage, the text was divided into semantic units, and initial codes were created based on the concepts identified. Subsequently, codes were organized into sub-categories and categories based on conceptual similarities. Finally, these categories were interpreted through repeated immersion in the data to extract the main research domains. MAXQDA (version 22) was employed to manage and organize the textual data.

The quality and methodological rigor of this study were ensured through the application of Guba and Lincoln’s10 framework. To ensure credibility, long-term participant engagement and member checking were utilized to validate interpretations, along with peer review from an external analyst. To facilitate transferability, a “rich and detailed description” process was implemented to document the research context thoroughly. Dependability was ensured by meticulously recording all methodological decisions to allow for an audit trail, while the simultaneous use of two independent coders verified consistency in the coding process. Finally, confirmability was established through direct reference to multiple explicit quotes from participants, affirming that the results were derived directly from the raw data.

## Results

To ensure comprehensive coverage of managerial and operational dimensions, the research population was structured around five key organizational levels, encompassing a total of 33 professionals. These levels include senior policymakers, senior hospital managers, technical/safety specialists, clinical service providers, and support staff (Table 1).

Table 2 presents a set of challenges identified by hospitals in managing mass casualty incidents, ordered by code frequency. The most pressing management challenges included structural weaknesses in governance, risk management, and command-and-control systems. Significant issues were also observed in organizational communication, including weaknesses in internal and external coordination, inadequate information management and exchange, and technical and infrastructural challenges. Physical space limitations, difficulties in securing and developing human resources, weaknesses in the supply chain, and a lack of psychosocial support were categorized as support and logistics challenges. Finally, operational clinical challenges, patient flow management issues, care and treatment challenges, and deficiencies in clinical capabilities and competencies further undermined hospitals’ response capacities.

**Management Challenges**

This domain reflects the systemic and structural gaps in hospital leadership during disasters. Within the sub-domain of "Weakness in Risk Management," participants highlighted codes such as "lack of proactive vulnerability assessment" and "non-operational disaster response plans." A participant noted: "Most of our plans are only on paper and are not tailored to the actual capacity of the hospital during a mass influx" (P4, Hospital Manager). In the "Command and Control System" sub-domain, the

analysis revealed issues like "role confusion" and "overlap of responsibilities."

**Weakness in Risk Management**

This subcategory highlights the organization's structural inability to effectively identify, quantify, and prioritize potential threats while developing strategies to reduce vulnerability to high-probability incidents and disasters. Qualitative findings indicate that formal assessments of potential risks (e.g., earthquakes, floods, chemical accidents) have not been conducted with specialized experts, and actions remain largely theoretical. This lack of assessment has resulted in an inability to recognize which hospital departments and critical equipment are vulnerable to various threats.

Furthermore, hospital management has shifted focus from prevention to immediate issues and daily costs, seemingly disregarding the possibility of significant incidents. Consequently, existing crisis management documentation is often general and not tailored to the real and prioritized risks within the region or the hospital's actual human resource capacities during crises. This disconnect between planning and real-world needs signifies a systemic failure to translate risk knowledge into actionable operational strategies.

*"…We have never sat down with specialized experts to assess the risks seriously… It is just talk…" (P14, Member of the Hospital Disaster and Risk Management Committee)*

*"…Our management is more concerned with daily expenses than considering potential catastrophes…" (P5, Hospital President)*

*"…We do not know which parts of our hospital are most vulnerable to explosions or fires…" (P18, Hospital Safety Officer)*

**Weakness in Command and Control System**

This section addresses the absence of a well-defined and practiced operational command and control structure for effective mass incident management. Key findings reveal a lack of a crisis operations command structure equipped with necessary equipment and documented task assignments. Consequently, critical decisions are often made late or interfered with during crises, leading to operational chaos. Data indicate that command team members lack adequate training, and their roles are not well-defined, exacerbating confusion among personnel due to the absence of a practiced hierarchy. The lack of a properly equipped command center and interruptions in communication among team members waste time and critical resources during crises.

*"…When a real crisis occurs, no one knows exactly what to do because we have not conducted operational exercises…" (P2, Deputy of Pre-Hospital Emergency Operations)*

*"…We have a room designated as the command center, but it lacks communication equipment… it serves more as a symbol…" (P16, Disaster and Emergency Health Specialist)*

*"…In mass incidents, every minute of delay in decision-making can mean the loss of lives…" (P6, Hospital Manager)*

**Governance and Policy Challenges**

This subcategory highlights structural and legal shortcomings at the macro level that hinder coherent responses. At the health system level, structural and financial gaps are evident, as existing legislation lacks necessary updates for managing mass casualty incidents, and no specific budget line is allocated for disaster preparedness. Additionally, organizational incoherence among key institutions (the Ministry of Health, the University of Medical Sciences, and the Governorate) results in conflicting and divergent decision-making during crises.

*"…Existing legislation is primarily designed for normal conditions. Our legal frameworks are restrictive…" (P1, Deputy of Medical Services at the University of Medical Sciences)*

*"…Hospitals operate on a day-to-day budget. There is no specific budget line for disaster preparedness…" (P7, Deputy of Clinical Affairs)*

*"…The Ministry of Health, the University, and the Governorate are all operating independently…" (P3, Head of Hospital Emergency Supervision Unit)*

**Organizational Communication Challenges**

Communication was identified as a critical bottleneck. In the "Intra/Inter-organizational Coordination" sub-domain, codes such as "fragmented communication channels" and "lack of integrated command center" were prominent. One participant stated: "During the MCI, we did not know which organizations were sending patients and when to expect them; there was no unified voice" (P9, Emergency Department Coordinator). Regarding "Information Management," the focus was on "delayed data transmission" and "paper-based reporting errors."

**Weaknesses in Internal and External Coordination**

This subcategory examines the gaps in infrastructure and processes for interdepartmental and inter-agency information exchange during mass casualty scenarios. Findings indicate reliance on outdated and inefficient communication equipment (such as worn-out radios) and the absence of an integrated platform for exchanging critical information, which severely hampers effective communication with pre-hospital providers, rescue services, and neighboring hospitals. This inadequacy results in delays in receiving pre-hospital data (such as injury severity and resources required) and uncertainty in cross-referring critically ill patients between medical facilities. This situation emphasizes the need for binding legal and operational agreements with relevant institutions to shift crisis coordination from a reactive to a commitment-based approach.

*"...In times of crisis, our communications are limited to outdated radios and a few phones..." (P17, Secretary of the Hospital Disaster and Risk Management Committee)*

*"...The information we receive from ambulances is often incomplete... leaving us underprepared..." (P26, Pre-hospital Emergency Technician)*

*"...If our hospital cannot handle all the casualties, which hospital do we coordinate with?" (P8, Nursing Director)*

**Inadequate Information Management and Exchange**

This section addresses disruptions in the flow and accuracy of information at internal operational levels. During a crisis, real-time data on bed occupancy, critical drug inventories, and urgent departmental needs are not effectively communicated between the emergency department, inpatient units, and warehouses. The absence of standard and transparent reporting and decision-making processes leads to the loss of crucial data and delays in resource allocation. Additionally, the lack of crisis-specific medical record formats that are simple, fast, and comprehensive complicates initial registrations, follow-ups, and triage of incoming patients, increasing the likelihood of errors.

*"...Vital information about the status of available beds... is not effectively communicated between the ER and warehouse..." (P31, Expert in Paraclinical Units)*

*"...When an incident occurs, it is unclear who should inform whom and through which channel..." (P9, Supervisor)*

*"...There is no standard process for receiving, registering, and referring them... leading to congestion..." (P21, Head Nurse)*

**Technical and Infrastructural Challenges**

This subcategory explores the physical, software, and system barriers that limit hospitals' flexibility and capacity to respond to a surge in mass casualties. The failure to design hospital infrastructure with a crisis-oriented approach—where physical spaces such as emergency rooms, intensive care units, parking lots, and helipads accommodate necessary capacities for triage, temporary hospitalization, and logistical movement—has been identified as a major shortcoming. This physical limitation also heightens the risk of infection spread due to a lack of temporary isolation spaces. From a systems perspective, current hospital information systems designed for normal workloads slow down, crash, or fail when faced with exponentially increasing data volumes. This technical inadequacy presents a significant obstacle to real-time crisis assessment and data-driven decision-making, necessitating a reevaluation of architecture and the creation of flexible spaces with the ability to expand capacity temporarily.

*"...Our standard medical records are not suitable for crises. We need a simple, rapid format..." (P27, Nurse)*

*"...Internal and external communications within the hospital are severely disrupted during a crisis..." (P32, Support Personnel)*

*"...Our hospital information system slows down, crashes, or fails when faced with exponentially increasing data..." (P11, Hospital Manager)*

**Support and Logistics Challenges**

Logistical barriers significantly hindered service delivery. Under "Human Resource Supply," the analysis identified codes like "staff burnout," "lack of specialized backup staff," and "insufficient welfare facilities for personnel." As one nurse mentioned: "We are expected to work double shifts without even a place to rest for a few minutes, which leads to exhaustion and errors" (P22, Nurse). In the "Physical Space" sub-domain, codes such as "emergency department overcrowding" and "inflexible space

allocation" were highlighted as major obstacles to effective triage.

**Physical Space Constraints**

This subcategory focuses on the physical structure and architecture of hospitals, which not only demonstrate operational inefficiencies under normal conditions but also exhibit a complete inability to scale response during catastrophic events. The infrastructure design is based on standard patient volumes and lacks the flexibility required for crisis-oriented design. This creates physical bottlenecks at all stages of crisis management, from triage and isolation of casualties in the emergency department to short- and long-term hospitalization capacity. Furthermore, the absence of standardized spaces for isolating infectious cases during trauma events significantly increases the risk of infection transmission. Logistical constraints, including parking congestion and helipad non-compliance with emergency operational standards, directly contribute to delays in the evacuation and rapid transfer of critically ill patients.

*"…Our emergency department is small and lacks adequate space to isolate and triage casualties safely…" (P28, Nurse)*

*"…As a trauma hospital, we face a bed shortage even on normal days… patients endure conditions on stretchers…" (P10, Nursing Director)*

*"…We do not have sufficient and appropriate space in the hospital for patients needing isolation…" (P15, Hospital Safety Officer)*

*Challenges in Human Resource*

**Challenges in Human Resource Supply and Development**

High-casualty crises require maximum performance from human resources, but weaknesses in scenario-focused training and resilience maintenance undermine this potential. Managers express concern over the insufficient quantity of specialized personnel (especially emergency physicians and nurses) during normal conditions, which reaches a critical point during crises. Unmanageable workloads lead to excessive fatigue, directly impacting clinical decision-making accuracy and patient safety. From a skills development perspective, existing training lacks operational and simulation-based components for mass casualty management and advanced triage. Additionally, motivational factors such as job security, psychological support, and compensation negatively affect staff commitment to emergency shifts, making it challenging to implement preparedness plans effectively.

*"…Even under the best circumstances, we face a shortage of emergency physicians and nurses…" (P22, Specialist Physician)*

*"…Long shifts and psychosocial stress during a crisis cause excessive fatigue among medical staff…" (P29, Nurse)*

*"…Training is primarily theoretical and lacks practical aspects, such as working with crisis-specific equipment…" (P24, Head Nurse)*

**Supply Chain Weaknesses**

The supply chain is recognized as a key vulnerability in the health system during crises. Internal supply processes, particularly the requisitioning of goods from warehouses, become completely inefficient in emergencies due to bureaucratic delays and scheduling designed for normal demand. This bureaucratic inertia occurs while strategic reserves often lack sufficient quantities of essential items (drugs, serum, consumables). The absence of a defined out-of-hospital support roadmap hampers the rapid activation of backup warehouses or alternative distribution centers during internal stock depletion. Moreover, logistical challenges (transportation and movement of items within the hospital or between centers) are complicated by physical and traffic constraints.

*"…The demand for painkillers, serum, and bandages surges dramatically, but our stocks are limited…" (P33, Support Personnel)*

*"…Our warehouse requisition system is slow and bureaucratic… delaying the delivery of needed items…" (P12, Hospital Manager)*

*"…We do not know which central warehouse or distribution company to contact if we run out of stock…" (P13, Deputy of Clinical Affairs)*

*Lack of Psychosocial Support*

**Lack of Psychosocial Support**

The impact of mass casualties extends beyond physical and logistical challenges; the significant psychosocial burden on healthcare workers, victims, and their families requires structured attention. Current hospital structures lack specialized and organized psychosocial support teams capable of intervening in crisis environments. This absence directly affects the mental health of healthcare workers, increasing the risk of burnout, post-traumatic stress, and diminished

resilience. Neglecting psychological needs not only reduces service quality in the short term but also leads to attrition and a long-term reduction in human resources. Psychosocial support must be viewed as a vital component of crisis management alongside physical care.

*"…We do not have a team of psychologists or social workers experienced in crisis management…"* **(P4, Director of Medical Services at the University of Medical Sciences)**

*"…After a major incident, healthcare workers experience post-traumatic stress, but there is no formal mechanism to identify it…"* **(P30, Support Personnel)**

*"…Many injured individuals and their families require psychological support post-discharge, but hospitals do not provide it…"* **(P19, Member of the Hospital Disaster and Risk Management Committee)**

**Challenges in Clinical Service Delivery**

This domain focuses on the quality and flow of patient care. In the sub-domain of "Clinical Competencies," codes included "deficiency in triage skills," "unfamiliarity with disaster protocols," and "lack of specialized trauma care training." A physician remarked: "Some residents and staff are not proficient in rapid triage under pressure, which slows down the entire treatment process" (P11, Emergency Physician). Regarding "Patient Flow Management," participants pointed to "bottlenecks in radiology/lab services" and "delays in transferring stabilized patients to wards."

**Challenges in Patient Flow Management**

Managing patient flow during a mass casualty incident is a critical operational step in the emergency department, directly influencing survival rates and resource allocation efficiency. The current triage and patient routing system, often designed for normal capacities, quickly becomes ineffective. Overcrowding beyond the physical capacity of the emergency department, compounded by the arrival of non-injured individuals or companions without operational justification, results in chaos and disorder. The absence of an efficient referral system to other healthcare facilities forces hospitals to accept more patients than they can handle. Furthermore, the lack of trained law enforcement personnel to manage arrivals complicates order control.

*"…Our existing triage system would not be responsive… we would likely see long lines, leading to critical delays…" (P23, Specialist Physician)*

*"…Patient numbers surge to the point where corridors fill up, making it nearly impossible to provide standard services…" (P20, Head Nurse)*

*"…Without trained security personnel at the entrance, both companions and individuals without emergencies enter, causing chaos…" (P32, Support Personnel)*

*Care and Treatment Challenges*

**Care and Treatment Challenges**

Following successful triage, providing effective and quality treatment during a crisis faces numerous barriers. The most significant obstacles include an urgent shortage of clinical specialists (surgeons, internists, anesthesiologists), limited capacity for critical diagnostic equipment (such as CT scanners and ultrasounds), and insufficient continuous clinical monitoring. Overcrowding, severe staff fatigue, and the inability to monitor vital signs of inpatients and outpatients directly lead to higher rates of diagnostic and care errors. Additionally, coordination and unity of command among multidisciplinary teams (physicians, nurses, laboratory, radiology, and support staff) are low, undermining the overall clinical response.

*"…Our system lacks the capacity to simultaneously provide services from surgeons, internists, labs, and radiology…" (P22, Specialist Physician)*

*"…Our CT scanners and specialized equipment are insufficient to meet the high demand during a crisis…" (P31, Expert in Paraclinical Units)*

*"…With so many patients, closely monitoring each patient's condition and vital signs becomes virtually impossible…" (P25, Nurse)*

**Weakness in Clinical Capabilities and Competencies**

The clinical competencies of medical staff for effectively managing mass casualties do not align with current training. Many personnel lack the necessary skills to manage large volumes of patients with diverse injuries (trauma, extensive burns, chemical poisoning) simultaneously. Existing training is predominantly theoretical and rarely includes realistic practical maneuvers or multi-team clinical simulations. This lack of practical experience in high-pressure, unfamiliar scenarios (such as chemical accidents) sharply diminishes personnel confidence during real

crises. It significantly raises human error rates in critical decision-making.

*"...Many of our personnel lack the skills needed to efficiently and effectively manage casualties with traumatic injuries, extensive burns, or severe poisoning. Training is largely theoretical..." (P22, Specialist Physician)*

*"...A nurse or doctor may manage the situation when faced with 5 or 10 emergency patients. However, when confronted with 50 or 100 patients at once, they struggle to cope with the workload..." (P24, Head Nurse)*

*"...We do not have adequate practical training or clinical simulations for crisis management. A nurse who has not undergone specialized crisis training may make mistakes and poor decisions in stressful situations, leading to further patient harm and increased mortality..." (P21, Head Nurse)*

Table 1: Characteristics of Interview Participants

| Organizational Level | Organizational Positions | Number |
|---|---|---|
| **Macro Policymakers** | Deputy and Director of Medical Services at the University of Medical Sciences, Deputy of Pre-hospital Emergency Operations, Head of Hospital Emergency Supervision Unit | 4 |
| **Senior Hospital Managers** | Hospital President, Manager, Nursing Director, Deputy of Clinical Affairs, Supervisor | 11 |
| **Technical/Safety Specialists** | Disaster and Emergency Health Specialists, Secretary and Members of the Hospital Disaster and Risk Management Committee, Hospital Safety Officer | 6 |
| **Clinical Service Providers** | Specialist Physicians, Head Nurses, Nurses, Pre-hospital Emergency Technicians | 6 |
| **Support Staff** | Experts in Paraclinical Units and Support Personnel | 6 |
| **Total** | | 33 |

Table 2: Hospital Challenges in Facing Mass Casualties

| Main Domain | Sub-Domain |
|---|---|
| Management Challenges | **Weakness in Risk Management** |
| | **Weakness in Command and Control System** |
| | **Governance and Policymaking Challenges** |
| Organizational Communication Challenges | **Weakness in Intra- and Inter-Organizational Coordination** |
| | **Inadequacy in Information Management and Exchange** |
| | **Technical and Infrastructural Challenges** |
| Support and Logistics Challenges | **Physical Space Limitations** |
| | **Human Resource Supply and Development Challenges** |
| | **Weakness in Supply Chain** |
| | **Lack of Psycho-Social Support** |
| Clinical Service Delivery Challenges | **Challenges in Patient Flow Management** |
| | **Care and Treatment Challenges** |
| | **Weakness in Clinical Competencies and Capabilities** |

## Discussion

The effective MCIs in teaching hospitals, particularly in developing countries such as Iran, represent a complex challenge that transcends simple resource availability. Our findings indicate that hospital resilience is hindered by a multifaceted array of structural and functional barriers, ranging from macro-level policy gaps to clinical competency deficits. These challenges suggest that preparedness is not a static state but a dynamic organizational culture that requires evidence-based planning and systemic coherence. This aligns with international frameworks emphasizing that hospital readiness must move beyond "paper-based"

plans toward operational reality.

A central finding of this study was the inadequacy of scientific risk assessment and the absence of operational plans tailored to regional threats. Participants highlighted that hospitals often remain in a "reactive" mode, focusing on day-to-day management. This lack of risk-based planning is a common bottleneck in many low- and middle-income countries (LMICs). Studies in Pakistan and India have similarly identified that without scenario-based planning and a functional Hospital Incident Command System (HICS), decision-making during the "golden hour" of a crisis becomes fragmented and slow11,12. The "policy-practice gap" observed in our study—where plans exist but are not operationalized—reflects a broader systemic issue in the region where disaster management is often viewed as a secondary administrative requirement rather than a core clinical necessity.

The findings of the present study underscore that the absence of dedicated disaster funding and fragmented governance structures are the most critical impediments to hospital resilience. Our participants explicitly identified the lack of sustainable, earmarked financial lines for preparedness as a primary bottleneck. This finding directly mirrors the challenges documented in other LMICs, such as Brazil and Egypt13,14. This fiscal vulnerability is not merely a local issue but reflects a systemic global neglect; as evidenced by a systematic review of 27 studies across 11 countries, the 'Financing' building block remains the least researched aspect of health system resilience, with no primary studies focusing on its institutionalization15.

Furthermore, our study revealed that fragmented oversight between the Ministry of Health, medical universities, and local entities fosters a 'siloed' response environment. This lack of inter-organizational synergy leads to significant role confusion at the operational level. The international literature reinforces this observation, highlighting that even in high-resource settings, weaknesses in the initial command structure can paralyze hospital capacity during the 'golden hour' of a crisis16.

The alignment between our results and the broader global context suggests that current hospital preparedness in LMICs remains largely reactive and observational, often collecting data years after events rather than establishing proactive frameworks. To mitigate these challenges, our study suggests a mandatory transition from general readiness to hazard-specific protocols and legally defined chains of command. Strengthening hospital resilience necessitates a paradigm shift: moving away from ad-hoc, fragmented management toward an integrated system where financial resources and command structures are institutionalized and functional long before a disaster occurs17.

The perceived ineffectiveness of current training and exercises was another critical finding. Participants noted that drills are often theoretical and detached from the actual stressors of an MCI, leading to a "simulation-reality gap." Research indicates that experiential learning and high-fidelity simulations are far more effective than classroom-based lectures in building resilience18. In resource-constrained settings, moving toward "In-situ simulations"—where exercises are conducted in the actual work environment—can be a cost-effective way to identify latent safety threats without the need for expensive virtual reality technology19.

Information management and communication systems also emerged as major vulnerabilities. Current Hospital Information Systems (HIS) are designed for steady-state flows and often collapse under sudden surges. This mirrors global experiences where hospitals reported significant information disruptions during crises. Our findings suggest that, for hospitals in the study context, the priority should be developing simplified, offline-accessible electronic or paper-based records to ensure data continuity 20. Additionally, the lack of real-time communication between ambulances and emergency departments, a challenge also reported in Turkey, often leaves hospitals in "information blindness," unable to prepare for the volume of incoming casualties21.

Finally, the challenges identified in this study position the Iranian healthcare system at a critical intersection between High-Income Countries (HICs) and Low-Income Countries (LICs). In HICs, hospital resilience is often challenged by over-reliance on complex digital infrastructures and hyper-specialization, which can lead to systemic paralysis during cyber-attacks or total grid failures 22,23. Conversely, LICs struggle with a fundamental lack of basic infrastructure and a heavy reliance on external international aid, which

undermines long-term institutional sustainability24,25 Our findings suggest that Iran, as an Upper-Middle-Income country, possesses the technical expertise and infrastructure—resembling HICs—yet remains hindered by 'siloed' governance and ad-hoc financing mechanisms typical of resource-constrained settings26. This 'middle-income trap' in disaster management implies that while theoretical knowledge exists, the transition to operational resilience is blocked by fragmented oversight25. Therefore, unlike LICs that require primary resource mobilization27, the priority for the study context is the integration of existing resources through legally defined command chains and earmarked disaster budgets.

## Conclusion

In Iran, the lack of oversight in implementing a comprehensive national plan for MCI management, coupled with coordination gaps between the Ministry of Health and the findings of this study, indicates that mass casualty incident management in Yazd teaching hospitals faces extensive structural and operational barriers. Key challenges include weak regional risk assessment and a lack of appropriate operational plans, insufficient coordination in the chain of command among relevant institutions, disruptions in hospital information systems during crises, a shortage of trained human resources compounded by burnout from continuous workloads, an absence of regular and scenario-based operational exercises, and poor coordination in the referral process with prehospital emergency services. Collectively, these factors undermine hospitals' preparedness for the sudden influx of large numbers of casualties, resulting in delays and errors in effective response. To address these challenges, macro-level policymaking should focus on strengthening infrastructure and operational processes. The Ministry of Health and universities of medical sciences must proactively monitor the implementation of national protocols for MCI management. Allocating dedicated funding for crisis preparedness, developing a crisis-specific electronic health record with offline accessibility, and upgrading information systems to secure cloud platforms are crucial infrastructure priorities. At the operational level, implementing local hazard-based simulation models with annual risk assessments, alongside regular scenario-based exercises, is essential. Strengthening human resources through ongoing training programs, integrating medical students into practical exercises, developing and implementing crisis incentives to enhance staff engagement, and conducting periodic psychological assessments of personnel can mitigate burnout and enhance team resilience. Finally, formalizing memoranda of understanding between hospitals, prehospital emergency services, and other relief organizations, alongside establishing digital coordination networks, will improve information flow and referral processes. The coordinated implementation of these policies will transition teaching hospitals from a reactive state to a dynamic and sustainable preparedness model, significantly enhancing their capacity to respond to MCIs. These measures will not only save lives but also fortify the health system against future crises.

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## Conflict of Interest Disclosures

The authors declare that they have no conflict of interest.

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## Authors' Contributions

Adel Eftekhari contributed to the conception and design of the study, data analysis, and drafting of the manuscript. Najmeh Baghian contributed to the study supervision, methodological guidance, and critical revision of the manuscript. Somayeh Bagheri contributed to data collection, interpretation of

findings, and manuscript editing. All authors read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

## Ethical Statement

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Research Ethics Committee of Shahid Sadoughi University of Medical Sciences, Yazd, Iran, with the approval code IR.SSU.SRH.REC.1404.019. Informed consent was obtained from all participants prior to their inclusion in the study. Participants were assured that their participation was voluntary, that they could withdraw from the study at any time without any consequences, and that the confidentiality and anonymity of their information would be strictly maintained.

## Declaration of Generative AI and AI-assisted technologies

During the preparation of this manuscript, generative AI tools were used only to assist in translating and rephrasing parts of the text. The authors carefully reviewed, edited, and approved all AI-assisted content and take full responsibility for the accuracy and integrity of the manuscript.

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