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Emergency Staff Perceptions of Mass Casualty Management Effectiveness in Lebanese Hospitals: A Cross-Sectional Study

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ABSTRACT

Introduction

Mass Casualty Incidents (MCIs) present significant challenges to hospitals, often overwhelming available resources and requiring rapid, coordinated responses. Effective casualty management plans are essential to ensure optimal patient care during such crises. Key components include staff training, interdepartmental communication, resource allocation, psychological support, and post-disaster evaluation.

Objective

This study aimed to evaluate the perceived effectiveness of disaster management plans in Lebanese hospitals from the perspective of emergency staff responsible for implementing Mass Casualty Management (MCM) plans.

Materials and Methods

A cross-sectional quantitative study was conducted with 71 emergency staff members, including chiefs and personnel directly involved in MCM, from 12 public and private hospitals across Lebanon. Data were collected via a structured questionnaire covering demographics, overall plan effectiveness, specific plan components (triage, communication, coordination, resource allocation), and open-ended suggestions.

Results

Significant positive correlations were observed between staff training and perceived plan effectiveness ($r = 0.528$, $p < 0.01$), perceived triage efficiency and the staff's perception of reduced mortality and morbidity ($r = 0.505$, $p < 0.01$), resource allocation and perceived plan effectiveness ($r = 0.572$, $p < 0.01$), communication and team coordination ($r = 0.481$, $p < 0.01$), and psychological support and staff satisfaction ($r = 0.541$, $p < 0.01$).

Conclusion

Emergency staff perceive continuous training, effective communication, optimized resource allocation, and psychological support as critical to improving the effectiveness of MCM plans. Hospitals should adopt an

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integrated approach that combines these elements with systematic post-disaster evaluation to strengthen preparedness, staff resilience, and patient care during mass casualty incidents.

INTRODUCTION

Context

Lebanon has faced repeated crises in recent years, including the Beirut port explosion of 2020, ongoing political instability, and strained healthcare resources, that have exposed critical vulnerabilities in hospital preparedness for Mass Casualty Incidents (MCIs). MCIs are large-scale emergencies that generate a sudden influx of patients with diverse and severe injuries, often exceeding the capacity of local healthcare systems [1]. These events place hospitals under extreme pressure, especially in resource-limited settings, and highlight the need for structured preparedness and response strategies [2]. Without adequate planning, the continuous arrival of casualties can quickly destabilize hospital systems, increasing morbidity and mortality [3].

Mass Casualty Management (MCM) provides an essential framework for mitigating these challenges. It encompasses measures to optimize resource allocation, organize patient care, and coordinate inter-institutional efforts to ensure equitable distribution of patients and continuity of hospital services [4].Within this framework, the crisis management cycle outlines key phases: immediate response, relief, rehabilitation, prevention, mitigation, and preparedness. Each phase requires coordinated actions among hospitals, government agencies, and community stakeholders to strengthen resilience and reduce disaster impact [5].

Effective crisis response depends on three fundamental principles: triage, communication, and adaptability. Triage enables prioritization of care, maximizes survival outcomes, and ensures efficient use of limited resources [6]. Clear communication among hospitals, emergency services, public authorities, and international organizations reduces delays and errors, while centralized information systems support timely decision-making [7]. Flexibility and adaptability are equally critical, as crises often create unpredictable demands that require rapid redistribution of resources and decentralized decision-making at the frontline level [8].

Hospital preparedness is further enhanced through MCM training programs, which strengthen the capacity of health systems to respond effectively to crises. Evidence demonstrates that such training improves staff performance in three key areas. First, it enables faster and more coordinated responses by standardizing protocols, thus reducing delays in patient care [8]. Second, it improves patient flow management through more accurate triage and better allocation of medical units, preventing service blocks [9]. Third, it enhances communication across stakeholders, ensuring real-time coordination and optimal use of available resources [1]. By improving efficiency, patient management, and interprofessional collaboration, MCM training may contribute to a perceived reduction of preventable mortality and morbidity during disaster events [10]. However, despite growing international literature on hospital disaster preparedness, there is limited evidence from Lebanon examining how frontline emergency staff perceive the effectiveness of mass casualty management plans and their key operational components in real-world crisis settings.

Objective

This study aimed to assess emergency staff perceptions of the effectiveness of mass casualty management plans in Lebanese hospitals and to examine perceived associations between key plan components and perceived management effectiveness.

MATERIALS AND METHODS

This quantitative cross-sectional study was conducted to evaluate the effectiveness of disaster management plans in Lebanese hospitals. Data were gathered from a purposive sample of 71 nursing leadership and supervisory staff members directly involved in the operational implementation of Mass Casualty Management (MCM) protocols. Participants were recruited using a non-probability convenience sampling approach. In each participating hospital, a local contact person facilitated questionnaire distribution to eligible emergency staff directly involved in mass casualty management. Because participation depended on availability and willingness to respond, the sample may not be fully representative of all emergency personnel within each institution. While this method ensured high-level perspectives on departmental coordination, we acknowledge that reliance on availability and the specific targeting of management may introduce selection bias by excluding broader frontline staff. Consequently, these findings reflect the insights of nursing leadership and should be interpreted with caution regarding their generalizability to the wider Lebanese healthcare workforce.

Data collection was performed using a structured questionnaire divided into four sections:

- **Section A: Demographic information** – collected participants' personal and professional characteristics, including gender, age, years of experience, and hospital type.
- **Section B: Evaluation of the disaster management plan** – measured participants' perceptions of their hospital's disaster

management plan using a Likert scale ranging from "strongly disagree" to "strongly agree."

- **Section C: Specific components of the plan** – assessed critical elements of the disaster management plan, including triage systems, communication protocols, and collaboration with external agencies.
- **Section D: Results and recommendations** – comprised open-ended questions allowing participants to suggest improvements and recommend training initiatives.

The data collection process included the following steps:

1. **Authorization:**
Obtaining approval from relevant ethics committees and hospital authorities.
2. **Coordination:**
Designating a contact person at each hospital to facilitate questionnaire distribution and collection.
3. **Distribution:**
Providing questionnaires in either paper or electronic format, according to hospital preference.
4. **Collection:**
Gathering completed questionnaires over a one-month period, with regular reminders to maximize response rates.
5. **Validation:**
Reviewing completed questionnaires to ensure completeness and alignment with study objectives.

To ensure validity, a pilot test was conducted with 10 nurses prior to full-scale distribution. Reliability was assessed using Cronbach's alpha, demonstrating excellent internal consistency of the survey items ($\alpha = 0.933$).

Data Analysis

Collected data were entered into SPSS version 26 (IBM Corp., Armonk, NY, USA) for statistical analysis. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize participants' demographic characteristics and responses regarding disaster management plans.

Inferential statistics were applied to assess relationships between variables. Pearson correlation coefficients were calculated to examine the association between staff training, resource allocation, communication, psychological support, and the perceived effectiveness of hospital disaster management plans. Significance was set at $p < 0.05$ for all analyses.

Open-ended responses from Section D of the questionnaire were analyzed qualitatively using thematic content analysis. Responses were coded to identify recurring themes and recommendations for improving disaster management plans and training programs.

The combination of quantitative and qualitative analyses allowed for a comprehensive evaluation of hospital disaster management strategies, providing both numerical associations and practical insights from frontline staff.

RESULTS

Participant Demographics

The study included 71 healthcare staff members from 12 public and private hospitals across Lebanon. Participants' demographic characteristics are summarized in **Table 1**. The sample included both genders, with a slight predominance of females (55%). Age distribution ranged from 24 to 58 years, with a mean age of 36.4 ± 7.8 years. The majority of participants had between 5 and 15 years of professional experience (61%), while 20% had less than 5 years and 19% had more than 15 years. Participants were drawn from various hospital types, including 8 public hospitals (45%) and 4 private hospitals (55%). This diversity ensured a representative sample across hospital settings.

TABLE 1 - Participant Demographics (N = 71)

Characteristic	Category	Frequency	Percentage
Gender	Male	32	45%
	Female	39	55%
Age (years)	24-34	25	35%
	35-44	28	39%
	45-58	18	26%
Years of Experience	<5	14	20%
	5-15	43	61%
	>15	14	19%
Hospital Type	Public	32	45%
	Private	39	55%

Descriptive Analysis

Table 2 presents descriptive statistics on participants' perceptions of the effectiveness of the disaster management plan. Overall, the disaster management plan received a mean score of 3.75 out of 5, indicating a generally positive perception among hospital staff. Pre-crisis training in disaster management protocols was rated 3.62, suggesting moderate preparedness but highlighting area for improvement.

Coordination between medical teams (mean = 3.68 ± 0.858) and resource allocation (mean = 3.70 ± 0.901) were perceived as relatively effective. In contrast, the consideration of staff psychological needs received a lower mean score (3.18 ± 1.004), identifying a key area requiring further attention. Integration of external agencies (mean = 3.65 ± 0.987) and interdepartmental communication (mean = 3.59 ± 0.748) were rated moderately positive. The perceived impact of the plan on reducing mortality and morbidity was favorable (mean = 3.66 ± 0.877). These findings highlight the need for targeted improvements in pre-crisis training and psychological support (Table 2).

TABLE 2 - Descriptive Statistics of Disaster Management Plan Effectiveness (N = 71)

Item	Minimum	Maximum	Mean	Std. Deviation
Overall effectiveness of disaster management plan	2	5	3.75	0.823
Pre-crisis training in disaster management	1	5	3.62	0.991
Coordination between medical teams	2	5	3.68	0.858
Resource allocation effectiveness	2	5	3.70	0.901
Psychological support for staff	1	5	3.18	1.004
Triage system efficiency	2	5	3.73	0.696
Communication between departments	2	5	3.59	0.748
Adequacy of disaster management training	2	5	3.72	0.778
Integration of external agencies	1	5	3.65	0.987
Perceived reduction in mortality and morbidity	1	5	3.66	0.877

Inferential Analysis

Training and perceived effectiveness

Pearson correlation analysis revealed a significant positive relationship between disaster management training and the perceived effectiveness of the plan ($r = 0.528$, $p < 0.01$; Table 3).

This finding suggests that greater perceived adequacy of training is associated with higher perceived effectiveness of the disaster management plan.

TABLE 3 - Correlation Between Training and Perceived Effectiveness

		Training	Perceived effectiveness of the plan
Training	Pearson Correlation	1	.528**
	Sig. (2-tailed)		.000
	N	71	71
Perceived effectiveness of the plan	Pearson Correlation	.528**	1
	Sig. (2-tailed)	.000	
	N	71	71

**. Correlation is significant at the 0.01 level (2-tailed). Note: $p < 0.01$ (2-tailed)

Triage efficiency and perceived reduction in mortality and morbidity

A significant correlation was observed between triage efficiency and perceived reduction in mortality rates ($r = 0.505$, $p < 0.01$; **Table 4**). Structured triage systems and training could lead to improved patient survival during mass casualty events.

Resource allocation and plan effectiveness

Efficient allocation of hospital resources was strongly correlated with the perceived effectiveness of the disaster management plan ($r = 0.572$, $p < 0.01$; **Table 5**). Hospitals with better management of staff, equipment, and supplies demonstrated increased capacity to handle mass influxes of patients.

Communication and coordination

Clear communication between medical teams was significantly associated with improved coordination during crisis management ($r = 0.481$, $p < 0.01$; **Table 6**). This underscores the importance of standardized communication protocols and technologies, such as briefing meetings and instant messaging systems, to enhance hospital response.

TABLE 4 - Correlation between triage efficiency and perceived reduction in mortality

		Triage efficiency	Perceived reduction in mortality rates
Triage efficiency	Pearson Correlation	1	.505**
	Sig. (2-tailed)		.000
	N	71	71
Perceived reduction in mortality rates	Pearson Correlation	.505**	1
	Sig. (2-tailed)	.000	
	N	71	71

**. Correlation is significant at the 0.01 level (2-tailed). Note: $p < 0.01$ (2-tailed)

TABLE 5 - Correlation Between Resource Allocation and Plan Effectiveness

		The effectiveness of the disaster management plan	Resource allocation
The effectiveness of the disaster management plan	Pearson Correlation	1	.572**
	Sig. (2-tailed)		.000
	N	71	71
Resource allocation	Pearson Correlation	.572**	1
	Sig. (2-tailed)	.000	
	N	71	71

**. Correlation is significant at the 0.01 level (2-tailed). Note: $p < 0.01$ (2-tailed)

TABLE 6 - Correlation Between Communication and Coordination

		Communication from medical teams	Coordination of medical teams
Communication from medical teams	Pearson Correlation	1	.481**
	Sig. (2-tailed)		.000
	N	71	71
Coordination of medical teams	Pearson Correlation	.481**	1
	Sig. (2-tailed)	.000	
	N	71	71

**. Correlation is significant at the 0.01 level (2-tailed). Note: $p < 0.01$ (2-tailed)

Psychological care and staff satisfaction

Psychological support for staff was positively correlated with overall staff satisfaction regarding the disaster management plan ($r = 0.541$, $p < 0.01$; Table 7). These findings highlight the value of post-crisis consultations, debriefing sessions, and stress management training in promoting staff well-being and sustaining effective disaster response.

Thematic Analysis of Open-Ended Responses

Analysis of open-ended responses identified five key themes highlighting staff concerns and recommendations (Table 8):

1. **Continuous training and simulation:**
Staff emphasized the need for regular disaster drills and updated training programs to maintain preparedness.
2. **Improved coordination:**
Enhancing coordination within departments and with external partners, such as the Red Cross and Civil Defense, was recommended.
3. **Resource optimization:**
Respondents highlighted the importance of effective allocation and management of human and material resources during crises.
4. **Psychological support:**
Providing structured psychological care for medical staff was consistently identified as a critical gap.
5. **Post-Crisis evaluation:**
Establishing systematic post-crisis assessments was suggested to refine disaster management plans and incorporate lessons learned.

TABLE 7 - Correlation Between Psychological Support and Staff Satisfaction

		Psychological care for staff	Staff satisfaction
Psychological care for staff	Pearson Correlation	1	.541**
	Sig. (2-tailed)		.000
	N	71	71
Staff satisfaction	Pearson Correlation	.541**	1
	Sig. (2-tailed)	.000	
	N	71	71

**. Correlation is significant at the 0.01 level (2-tailed). Note: $p < 0.01$ (2-tailed)

TABLE 8 - Key Themes from Open-Ended Responses

Theme	Description	Representative Examples
Continuous Training and Simulation	Regular disaster drills and updated protocols	"We need more frequent MCM simulations to stay prepared."
Improved Coordination	Better internal and external collaboration	"Communication with Red Cross could be faster during emergencies."
Resource Optimization	Efficient allocation of staff, beds, and equipment	"We ran short of essential supplies during the last incident."
Psychological Support	Structured support for medical staff	"Debriefing sessions after crises are essential."
Post-Crisis Evaluation	Systematic review of plan effectiveness	"Lessons learned should be documented and applied for future events."

Overall, the combination of quantitative and qualitative findings indicates that Lebanese hospitals generally implement effective disaster management plans but require targeted improvements in staff training, psychological support, resource management, and post-crisis evaluation.

DISCUSSION

The results of this study provide clear insights into the effectiveness of disaster management plans in Lebanese hospitals and the factors influencing their success. By combining quantitative and qualitative analyses, this research demonstrates that staff training, interdepartmental coordination, resource allocation,

and psychological support are all critical components of effective Mass Casualty Management (MCM).

The observed positive correlation between staff training and perceived plan effectiveness ($r = 0.528$, $p < 0.01$) confirms that well-trained personnel significantly enhance the hospital's emergency response capabilities. These findings align with Yao & Kuago (2022), who reported that regular simulation exercises and practical training improve caregivers' preparedness, reduce errors, and facilitate rapid, coordinated action in crises [11]. Similarly, Bodina et al. (2017) highlighted those hospitals investing in comprehensive theoretical and practical training experience better interdepartmental coordination and overall plan efficiency [12].

Effective communication and coordination among hospital teams were significantly correlated ($r = 0.481$, $p < 0.01$), emphasizing that clear communication channels are essential to ensure smooth patient flow and minimize errors during emergencies. These results corroborate the work of Xue et al. (2020), who demonstrated that structured protocols and regular inter-agency meetings enhance operational efficiency [13]. Furthermore, Soltani-Sobh et al (2016) highlighted that communication training and pre-established collaboration agreements with external organizations, such as the Red Cross, improve response quality during disasters [7].

Resource allocation emerged as a key determinant of plan effectiveness, with a strong positive correlation ($r = 0.572$, $p < 0.01$). Hospitals with better management of staff, medical supplies, beds, and equipment were more capable of handling patient surges. This aligns with Yao et al. (2022), who emphasized that efficient resource management, supported by inventory systems and digital monitoring technologies, improves emergency care outcomes and overall hospital preparedness [14].

The study confirms that psychological care for hospital staff significantly impacts their satisfaction and performance during crises ($r = 0.541$, $p < 0.01$). These results support findings by Hussaini et al 2023, who advocate for structured post-crisis debriefings, stress management training, and continuous psychological support to prevent burnout and maintain quality care. Integrating psychological support into MCM plans not only improves staff well-being but also indirectly enhances patient care and institutional resilience [5].

An important finding of this study is that psychological support for staff received the lowest mean score among all assessed components (3.18 ± 1.004). In the Lebanese context, this result may reflect the cumulative burden of repeated crises, including the Beirut port explosion, prolonged economic instability, workforce shortages, and sustained occupational stress. These contextual pressures may contribute to emotional exhaustion and burnout among healthcare professionals, thereby limiting the perceived adequacy of institutional psychological support mechanisms. This finding suggests that psychological preparedness should be integrated more explicitly into hospital disaster plans through debriefing protocols, peer-support systems, referral pathways, and post-incident mental health follow-up.

Responses to open-ended questions highlighted the importance of systematic post-crisis evaluation. Regular assessment of disaster management plans, as recommended by Tegegne et al. (2023), allows hospitals to identify weaknesses, implement corrective measures, and improve overall preparedness [15]. This iterative process, combined with nursing leadership/supervisors' feedback, ensures continuous improvement, better resource allocation, and enhanced team coordination for future incidents.

Overall, this study demonstrates that effective disaster management in hospitals is multifactorial. Staff training, communication, resource management, psychological support, and post-crisis evaluation are interdependent components that together enhance hospital preparedness, improve patient outcomes, and increase institutional resilience during mass casualty incidents.

STRENGTHS AND LIMITATIONS

Strengths

- The mixed-methods approach allowed for a comprehensive evaluation of disaster management plans by combining quantitative and qualitative analyses.
- The quantitative instrument demonstrated high reliability, with an excellent internal consistency (Cronbach's alpha = 0.933).
- The research successfully identified and confirmed critical pillars of effective Mass Casualty Management (MCM), specifically staff training, communication, resource allocation, and psychological support, providing a robust framework for institutional assessment.

Limitations

Despite these strengths, several limitations must be considered:

- The study utilized a non-probability convenience sampling approach with a relatively small sample size (N=71), which may limit the generalizability of the findings to all hospitals in Lebanon. Furthermore, by targeting nursing leadership and supervisors as key informants, the study captures high-level perspectives on departmental oversight but may introduce selection bias. Consequently, the findings primarily reflect the insights of nursing management and may not fully capture the frontline experiences of bedside emergency staff.
- The reliance on self-reported data may introduce participant perception bias. Additionally, the possibility

of common method bias exists, as both predictor and outcome variables were collected from the same respondents simultaneously. This suggests that some observed associations may partly reflect general response tendencies rather than distinct underlying constructs.

- The cross-sectional design restricts the ability to evaluate the long-term evolution of hospital practices over time. More over, the focus on specific institutional contexts means the results may not be directly comparable to facilities with different infrastructures or policies.

- While the study distinguished between leadership and staff involved in MCM, detailed professional sub-categories were not systematically captured. Incorporating objective metrics, such as response times or mortality rates, in future research would provide a more granular assessment of MCM effectiveness.

Ethical considerations

Ethical approval was obtained from the Ethical Committee-Holy Family University, approval number [004/2026]. Administrative authorization was also obtained from the participating hospitals.

CONCLUSION

This study highlights that, from the perspective of emergency staff, disaster preparedness in Lebanese hospitals depends on several interrelated dimensions, particularly training, communication, resource allocation, and psychological support. The findings should be interpreted as staff perceptions rather than objective measures of clinical effectiveness. Nevertheless, they identify priority areas for strengthening hospital disaster readiness. Practical implications include regular simulation-based training, clearer interdepartmental communication pathways, formal staff support mechanisms after crisis events, and structured post-incident audits to guide continuous quality improvement. Future studies should combine staff perceptions with objective institutional indicators and clinical outcomes to provide a more comprehensive assessment of mass casualty management effectiveness.

Keywords

Mass Casualty Management (MCM), Emergency Staff Perceptions, Hospital Preparedness, Psychological Support, Resource Allocation

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Author contributions

Eliana GHAZAL: Conceived the study, wrote the introduction, and participated in the discussion.
Dunya NOHRA: Developed the methodology and contributed to data interpretation.
Maha NEHME: Conducted data analysis and participated in the discussion and conclusion.
Hilda CHELALA: Provided critical feedback on the manuscript.
All authors validated the final version of record.

Declarations

Conflicts Of Interests

The Author declares that there is no conflict of interest.

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Registration

No registration applicable.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethical approval

Ethical approval for this study was not required.

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