RESEARCH REPORT

# Hospital Disasters Preparedness for Mass-Casualty Incidents at Emergency Units in Northwest of Ethiopia: A Cross-Sectional Study

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**Abbreviations:**
CSH: comprehensive specialized hospital
ICG: incident command group
ICS: incident command system
MCI: mass-casualty incident
MCM: mass-casualty management
WHO: World Health Organization

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## Abstract

**Background:** Ethiopian policy and strategy aim to make health care systems capable of dealing with emergencies. However, Ethiopian health care still lacks a comprehensive "all-hazard" approach and a disaster preparedness program. Thus, this study aimed to assess the level of disaster preparedness in selected public hospitals for mass-casualty incidents (MCIs) in Amhara Regional State, Northwest Ethiopia.

**Methods:** A descriptive cross-sectional study was conducted at general and comprehensive specialized hospitals (CSHs) in Amhara Regional State, Ethiopia using a World Health Organization (WHO) hospital emergency response checklist that included a domain on mass-casualty management (MCM) adapted from a literature review.

**Results:** Seventeen (17) hospitals were evaluated (response rate: 81%). Five (29.4%) were teaching hospitals (tertiary health care) and 12 (70.5%) were non-teaching (secondary health care) hospitals. With an average mean of 97.3 (SD = 33.68; range 31-160), most hospitals under WHO required an Acceptable level of preparedness. Two were at an Unacceptable (0-67) level of preparedness, 12 (70.5%) hospitals were at an Insufficient (68-134) state, while the other three had an Acceptable (135-192) level of preparedness.

**Conclusion:** The preparedness level of hospitals is Insufficient for potential MCIs in this region and needs prior attention in implementing existing strategic guidelines to develop and activate hospital disaster plans if and when needed.

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## Introduction

Mass-casualty incidents (MCIs) are any single event that negatively impacts a community, causing several casualties that outstrip that community's ability to respond normally. The point at which a community becomes overwhelmed is highly variable and entirely dependent on the size of the prehospital workforce, the available emergency room(s), the number of responders, and available supplies.[1]

The ability of a hospital to cope with disasters and mass-causality events is built on preparedness elements such as the availability of qualified medical personnel, appropriate space, and essential equipment. However, previous instances, on the other hand, have revealed failures in hospitals' resilience, preparedness, and performance after disasters.[2] The Sendai Framework for Disaster Risk Reduction 2015-2030 also recognizes the importance and safety of health care facilities during disasters. This can be accomplished by implementing emergency and disaster preparedness plans to ensure a comprehensive and effective disaster response.[3]

The incidences of disasters are on the rise across the world. The occurrence of catastrophic events will result in a large number of deaths, physical injuries, and social and

| Hospital Category | Number of Hospitals | Affiliation | |
|---|---|---|---|
| | | Teaching | Non-Teaching |
| General | 10 | 0 | 10 |
| Comprehensive Specialized | 7 | 5 | 2 |



**Table 1.** Background Information of Assessed Hospital (n = 17) in the Amhara Regional State Northwest of Ethiopia, 2021

economic damages. During disasters and MCIs, health facilities provide their communities with prehospital and in-hospital care. To improve health facilities' response capacity and preparedness to cope with the challenges at the time of a disaster, hospitals need to be prepared to commence their mass-casualty management (MCM).[4,5]

Africa suffers double the effects of disasters because of its small economies and increased health burden. Furthermore, communicable diseases affect African countries more than any other region. This creates a vicious cycle of disaster and emergency events for Ethiopia and the African continent.[6] Despite Ethiopia's double-digit economic growth over the last ten years, urban disasters, such as fire and other incidents, are rising due to urbanization.[7] Unlike in the past, besides drought, the risk of other disasters like floods, landslides, human epidemics, crop pests, forest and bushfires frequency, scale, and intensity of such disasters have been increasing due to different factors, including climate change. This above situation, in general, depicts that the country is vulnerable to multiple hazards and associated disasters.[8]

Only some studies are carried out in some parts of Ethiopia. However, empirical studies have yet to be conducted in the Amhara Regional State to assess hospitals' disaster preparedness for MCIs using the World Health Organization (WHO; Geneva, Switzerland) standardized toolkit and checklist.[8] Taking this into account, the study will serve as a valuable reference for improving the implementation and performance of Emergency Medical Services and contributing to enhancing the quality of services for planning for and responding to MCIs. This study aimed to assess the level of disaster preparedness in public hospitals in the case of MCIs in Amhara Regional State, Northwest Ethiopia.

## Methods

An institutional-based, cross-sectional descriptive study was carried out to assess the hospital disaster preparedness level for MCIs in the emergency department of public hospitals of Amhara Regional State, Ethiopia from April through July 2021. The region has 82 hospitals (eight comprehensive specialized hospitals [CSHs], 13 general hospitals, and 62 primary hospitals); 866 health centers; and 3,573 health posts.[5]

Twenty-one (21) hospitals were purposively selected and invited to participate in this study. Ten general hospitals and seven CSHs responded to the study. The study was limited to hospitals at the secondary and tertiary levels, based on their capacity, the number of people they serve, and representativeness to the selected zone. Primary hospitals, military hospitals, and private hospitals were excluded from the study.

### *Survey Checklist*

Primary data were collected from general hospitals and CSHs with a self-administered questionnaire using a quantitative data collection method. The data were collected by sending a validated evaluation tool developed by the WHO to the emergency care unit head via email, telegram, and in-person by site coordinators, as needed. The emergency department head of each hospital completed the survey. Due to time, financial, and security challenges, site visits by the principal investigator were not done.

The survey was adapted from the WHO Hospital Emergency Response Checklist. It is composed of 92 priority action items grouped into nine key components, such as command and control, communication, safety and security, triage, surge capacity, continuity of essential services, human resources, logistics and supply management, post-disaster recovery, and four questions containing MCM were adapted from a literature review.[4] The checklist has three options (pending review, in progress, and completed) and assigns zero for "pending review," one for "in progress," and two for "completed" so each hospital was evaluated out of 192 points (96 priority action items×2) and eight points regarding MCM; this classification was adopted from disaster preparedness evaluation by WHO toolkit in Italy.[2] If the hospital performs less than 35% (67 points), it is in an "Unacceptable" level of preparation; if it is 35% to 70% (68-134 points), it is in an "Insufficient" level of preparation; and if it is more than 70% (>135 points), it is in an "Acceptable" level of preparation.

### *Statistical Analysis*

Data from the questionnaire were coded and then analyzed using descriptive statistics (mean and standard deviation [SD]) with Statistical Package for the Social Sciences (SPSS, version 27; IBM Corp.; Armonk, New York USA), and frequencies and percentages were used for summarizing and presenting data using Microsoft Excel spreadsheet, version 365 (Microsoft Corporation; Redmond, Washington USA).

### *Ethical Considerations*

The ethical review board of Amhara Public Health Institute (APHI; Bahirdar, Ethiopia) has approved an ethical approval request with the protocol code H/R/T/T/D/4/1 and June 2021. A permission letter was gained from the respective hospital's Director and Chief Executive Officer. Informed consent was taken from the emergency department head of each hospital after the purpose and objectives of the study had been informed.

## Results

Twenty-one (21) hospitals were invited and approached and 17 participated in the study, with a response rate of 81%. Seven of the participating institutions were CSHs, while ten were general hospitals. Of which, five of the facilities (29.4%) were teaching hospitals while 12 (70.5 %) were non-teaching hospitals (Table 1).

With an average mean of 97.3 (SD = 33.68; range 31-160), the majority of hospitals under WHO required an Acceptable level of preparedness. Out of 17 hospitals, two (11.7%) were at an Unacceptable (0-67) level of preparedness, 12 hospitals (70.5%) were at an Insufficient (68-134) state, while the other three (17.6%) had an Acceptable (135-192) level of preparedness



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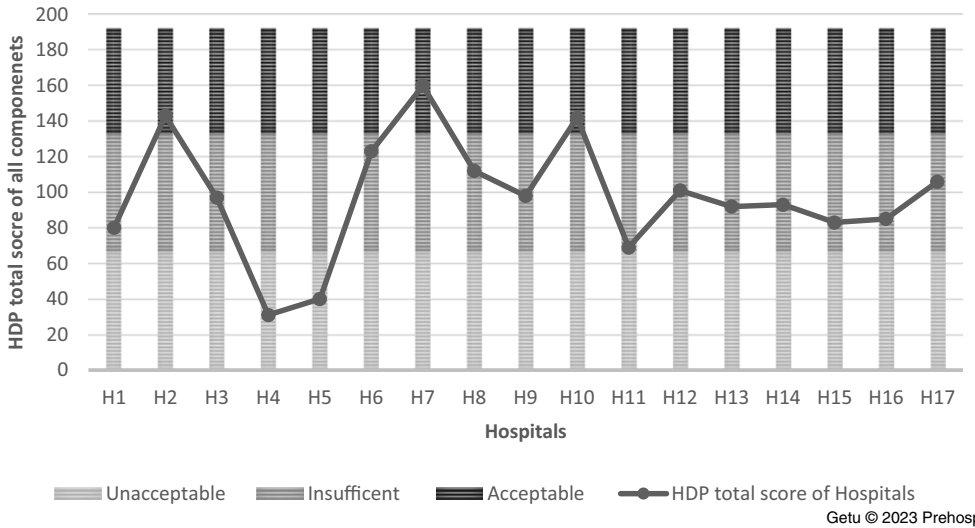




**Figure 1.** The Average Level of Disaster Preparedness of Hospitals in the Amhara Regional State Northwest of Ethiopia, 2021. Abbreviation: HDP, hospital disaster preparedness.

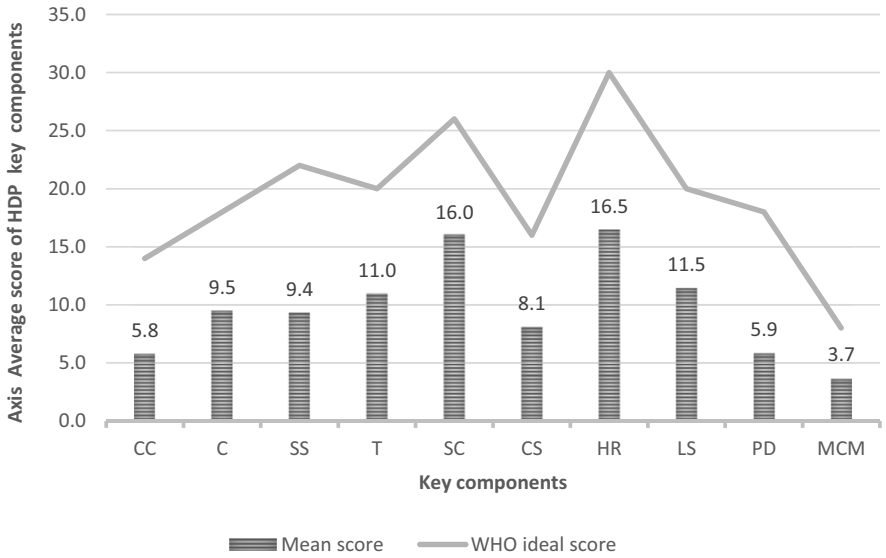




**Figure 2.** Average Score of HDP Key Components in the Hospitals in the Amhara Regional State Northwest of Ethiopia, 2021. Abbreviations: HDP, hospital disaster preparedness; CC; command and control; C, communications; SS, safety and security; SC, surge capacity; T, triage; CS, continuity of essential services; HR, human resources; LS, logistics and supply management; PD, post-disaster recovery; MCM, mass-casualty management; WHO, World Health Organization.

(Figure 1). In terms of key components of hospital disaster preparedness assessed in this study, many were found at an Insufficient level, while "post-disaster recovery" was the lowest score, an Unacceptable state (Figure 2). General hospitals' versus CSHs' key component scores are presented in Figure 3, and general hospitals' versus CSHs' level of disaster preparedness are presented in Table 2.

The evaluation results related to each key component are thematically summarized and presented under the following ten sub-headings.

*Command and Control*

Of the 17 hospitals, four (24%) had an active or ad-hoc incident command group (ICG) and a designated place to meet and coordinate emergency activities in the facility. Only one (12%) of the study hospitals' ICG members had received proper training on the structure and functions of the incident command system (ICS), and that other hospital personnel and community networks were aware of their ICS roles.

*Communication*

Fifty-nine percent (59%) of hospitals (four CSHs and six general hospitals) had appointed a public information spokesperson. Only six hospitals (35%) reported that streamlined mechanisms were in place for exchanging information between hospital administration, department heads, and hospital staff. In most health facilities, the procedure for briefing staff on their roles and responsibilities in the plan was not reported.



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| Level of HDP | Type of Hospitals | | |
|---|---|---|---|
| | General Hospital | Comprehensive Specialized Hospital | All Hospitals (N = 17) |
| Acceptable | 1 (5.8%) | 2 (11.7%) | 3 (17.6%) |
| Insufficient | 9 (52.9) | 3 (17.6%) | 12 (70.5%) |
| Unacceptable | 0 (0.0%) | 2 (11.7%) | 2 (11.7%) |
| Average Score | 100.7 | 92.5 | 97.3 |



**Table 2.** General versus Comprehensive Specialized Hospital Level of Disaster Preparedness in the Amhara Regional State Northwest of Ethiopia, 2021
Abbreviation: HDP, hospital disaster preparedness.

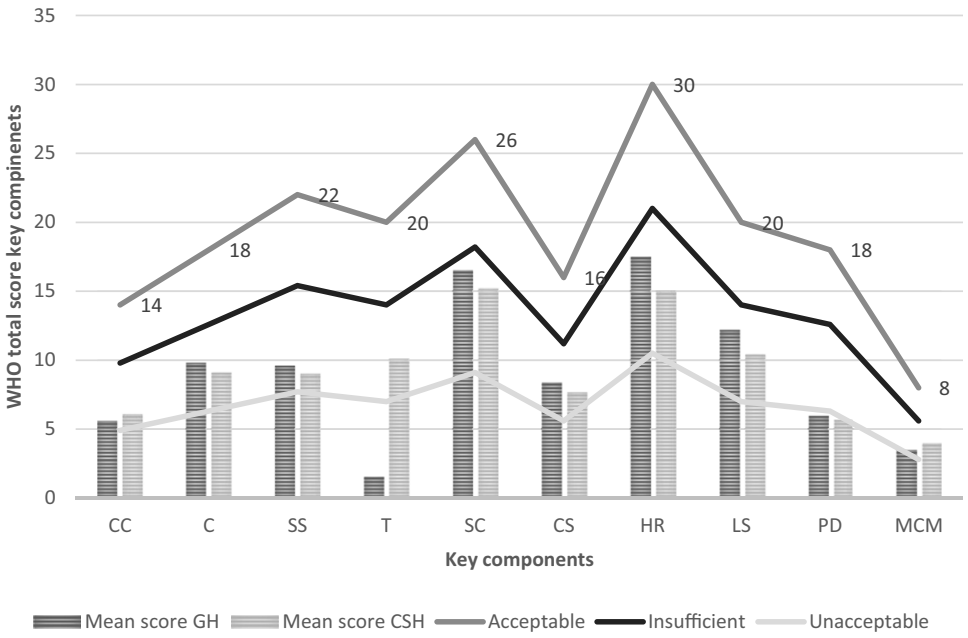




**Figure 3.** General versus Comprehensive Specialized Hospitals Key Component Scores in the Amhara Regional State Northwest of Ethiopia, 2021.
Abbreviations: GH, general hospital; CSH, comprehensive specialized hospital; CC; command and control; C, communications; SS, safety and security; SC, surge capacity; T, triage; CS, continuity of essential services; HR, human resources; LS, logistics and supply management; PD, post-disaster recovery; MCM, mass-casualty management; WHO, World Health Organization.

*Safety and Security*
Seven hospitals (41%) included the appointment of a security team in the plan. However, only two hospitals (12%) had adequate security measures for safe and efficient evacuation. Nine facilities (53%) had established designated areas for radioactive, biological, and chemical decontamination and isolation. Reliable procedures for identification of authorized hospital staff, patients, and visitors and escorting emergency medical personnel and their families to patient care areas had the lowest scores in this component.

*Triage*
Twelve (12) hospitals (71%) had appointed experienced triage officers to oversee triage operations in this component. Clearly identified entrance and exit routes to the triage were reported by six (35 %) facilities. Under this WHO-recommended action, almost all hospitals except one (12%) did not have a contingency site for receipt and triage of mass causalities, and only five facilities (29%) had a triage protocol that followed internationally accepted principles and guidelines.

*Surge Capacity*
Three facilities (18%) had a system to identify ways of expanding hospital in-patient capacity, whereas other hospitals' status was either pending review or in progress. Including designated care areas for patient overflow in the institution's plan was reported only in three hospitals (18%). Systems to verify the availability of vehicles and resources needed for patient transportation and to identify additional sites that could be turned into patient care facilities in collaboration with local authorities were in place in 12 (71%) and five (29%) of the studied hospitals, respectively. Eleven (11) facilities (65%) cancelled nonessential services, as needed.

*Continuity of Essential Services*
Seven hospitals (41%) had a list of all hospital services ranked in order of priority. Under this key component, the lowest score



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reported was the existence of a systematic and deployable evacuation plan. Four hospitals (24%) reported the availability of appropriate backup arrangements for water, power, and oxygen, and seven (41%) had a contingency mechanism for collecting and disposing of human, hazardous, and other waste.

*Human Resources*

Of 17 hospitals, nine (53%) of them practiced updating their staff contact list. To ensure enough staff capacity and expertise, nine (53%) facilities provided training and exercises in areas of potential increased clinical demand, such as emergency and intensive care. Seven facilities (41%) ensured adequate shift rotation and self-care for medical staff to support the morale and minimize medical errors. Providing appropriate vaccination for staff dealing with epidemic-prone respiratory illness was less common in numerous hospitals.

*Logistic and Supply Management*

Less than one-half (47%) of the hospitals had developed and maintained an updated inventory of all equipment, supplies, and pharmaceuticals. Only three of the studied hospitals (18%) had established a system to provide essential medications and supplies during MCI continuously. Ten facilities (59%) followed national guidelines while stockpiling necessary supplies and pharmaceuticals.

*Post-Disaster Recovery*

In this component, four of facilities' (24%) plans included those in charge of recovery operations, and three (18%) had a system to determine essential criteria and processes for incident demobilization and system recovery. Most (10; 59%) hospitals were in progress for including professional debriefing for staff within 24-72 hours after the occurrence of an MCI in their plan. If evacuation was required, determining the time and resources needed to complete repairs and replacements before the facility can be reopened, 12 hospitals (71%) were in progress and five (29%) were pending review from this component.

*Mass-Casualty Management*

This domain was the most important for responding to possible MCIs efficiently. Seven facilities (41%) had a MCM plan. Twelve (12) hospitals (71%) were in progress of conducting training on MCM, and only two had a database of staff trained in emergency management. Moreover, six (35%) had performed drills for a mass-casualty event in the last two years.

## Discussion

This multi-zonal study found that the overall disaster preparedness level of hospitals in all key components was Insufficient and Unacceptable, with an average calculated total score of 97.3. A study conducted in government hospitals in Addis Ababa City showed that all hospitals' average total preparedness score was 44.2%.[9] However, compared to other similar studies conducted in Italy and Iran, the result was lower than the current study.[2,10]

The majority of hospitals in the region (70.5%; n = 12) were found to be Insufficient, and 11.7% (n = 2) were in an Unacceptable level of preparedness. This result was in line with the findings of an Italian study that found hospital preparedness levels Insufficient.[2] In contrast to this study, similar research conducted in South Yemen had reported 80% of the studied hospitals were found at Unacceptable preparedness levels.[11]

Triage systems, one of the basic principles of accident management, appear to be vital for prioritizing patients, providing them with suitable care, and maximizing medical centers' resources and facilities after accidents.[12]

Most of the study hospitals in Northwest Ethiopia had a triage officer overseeing all triage operations. The majority of hospitals, on the other hand, lack a mass-casualty triage strategy that adheres to internationally accepted principles and guidelines and contingency sites for MCI management. Furthermore, only three hospitals had identified entrance and exit routes to and from the triage area.

Surge capacity is a critical key component that enables facilities to respond to large-scale disasters. In this study, surge capacity, human resources, and logistics and supply management were at an Insufficient level in all hospitals. Health systems need to act to develop and maintain surge capacity, and all other patients must continue to receive medical care.[13]

Studies conducted in different countries showed that proper safety and security measures play a significant role in effective response to MCIs.[11] Only seven hospitals included the appointment of a hospital security team in their plan. Moreover, the study revealed that adequate security measures were not in place for safe and efficient hospital evacuation. In comparison to previous studies conducted in Yemen, where hospitals were at Unacceptable levels of preparedness, and in Italy, where few of the evaluated hospitals met safety and security criteria, the majority of hospitals in the Amhara Regional State were at an Unsatisfactory level of preparedness in this key component.[2]

The hospital's recovery planning and post-event recovery activities should ideally be focused on a continuum of community needs, from short-term early recovery needs to long-term healthy community goals. If properly designed and managed, this latter aim can benefit communities in recovering from MCIs and addressing chronic community health issues such as access to health care services.[14] However, this study revealed that all facilities had an Unacceptable preparedness level in post-disaster recovery key components with a calculated mean score of 5.8, far from the WHO ideal score of 18, which was inconsistent with the findings from Yemen.

During emergencies, hospitals' primary focus is MCM. A standardized and well-prepared incident management system, as well as standard operation strategies, are fundamental for linking site operations to hospital-based care during the event of a disaster.

Seven hospitals had MCM plans in this study; however, all hospitals never conducted training on MCM, which was the lowest score in this domain. In contrast to this study, in research conducted in Central Saudi Arabia, two facilities had workshops to provide orientations for their staff,[15] while some hospitals in Italy demonstrated a formal training program such as drills, simulations, and cross-training for their staff.[2] Furthermore, only two had a database of trained staff in emergency management. Six hospitals (three general hospitals and three CSHs) had drills for MCIs in the last two years. This domain had a better preparedness level than similar studies conducted in Saudi Arabia.[15]

The National Disaster Health Preparedness and Response Guideline in Ethiopia outlines the arrangements and coordination for the preparation of a health-related disaster and the provision of the necessary responses during the disaster. Regions and city administrations must develop their health disaster plans and act accordingly during emergencies. The way forward in implementing sound preparedness is to, first and foremost, build strong ties to education to establish new perspectives on hazards, vulnerabilities, risks, and the value of responding to emergencies.[16]



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### Limitations

The results of this study could not be generalized to all hospitals in Ethiopia, as military, primary, and private hospitals were not included. Since the study was conducted during the COVID-19 pandemic, some hospital emergency departments were overwhelmed and did not return the survey, resulting in a potential non-response bias.

Moreover, all the questions in the checklist are restricted to pending review, in progress, and completed answers, although clearly, more explanations on this response were not given.

### Conclusions

The disaster preparedness level of the hospitals found in Northwest Ethiopia is Insufficient, apart from three hospitals with an Acceptable level of preparedness. The main key components were Insufficient, such as command and control, safety and security, post-disaster recovery, and MCM. Moreover, most key components were in the "due for review" and "in progress" stage.

Most hospitals are familiar with MCI and disaster preparedness concepts. However, there need to be more measures in place to ensure that hospital staff members know about MCI and disaster preparedness plan based on the "all-hazard" approach.

Furthermore, the findings of this study demonstrated that CSHs had a slightly better level of preparation than general hospitals. So, it needs attention to fulfilling the required human resource and logistics in health care facilities to improve preparedness levels that meet international and national guidelines.

### Author Contributions

SBG, PAG, and RCD designed the study. SBG and FWT collected and analyzed data. SBG, PAG, and RCD collected the resources; SBG, PAG, and RCD validated data; SBG wrote original draft; and SBG, FWT, PAG, and RCD reviewed and edited final manuscript.

All authors contributed to the interpretation of results and critical revisions of the manuscript for intellectual content and have given final approval of the version to be published.

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