

# Analysis of the Hospital Preparedness Index in Responding to Disasters Based on the Hospital Safety Index and Its Influencing Factors at RSUD Haji Makassar

Análisis del índice de preparación hospitalaria para responder a desastres basado en el índice de seguridad hospitalaria y sus factores influyentes en RSUD Haji Makassar

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## SUMMARY

**Aims:** This study aimed to assess the disaster preparedness of RSUD Haji Makassar using the Hospital Safety Index (HSI) framework. **Materials and Methods:** A mixed-methods approach with a sequential explanatory design was employed. Quantitative data were obtained using the HSI questionnaire, which focused on hospital facilities and infrastructure, while qualitative data were collected through purposive sampling involving in-depth interviews with key informants. Four key informants participated in this study, comprising Occupational Health and Safety (OHS) staff and Non-Medical

Facilities Maintenance Installation staff, with the OHS Committee serving as a triangulation. **Results:** The hospital's structural preparedness scored 0.65 on the HSI, signifying a moderate level of resilience. In-depth interviews revealed that budget constraints and the hospital's prioritization of improving health services were the main barriers to enhancing structural preparedness. **Conclusion:** Despite a moderate level of preparedness, further improvements are required in safety standards, emergency response capacity, and disaster management. Strengthening these aspects will enhance the hospital's resilience in managing future disasters.

**Keywords:** Hospital Safety Index (HSI), Disaster preparedness, Hospital resilience, Disaster management, RSUD Haji Makassar.

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## RESUMEN

**Objetivos:** Este estudio tuvo como objetivo evaluar la preparación de la RSUD Haji Makassar ante desastres, utilizando el marco del Índice de Seguridad Hospitalaria (HSI). **Materiales y métodos:** Se empleó un enfoque mixto de métodos con un diseño explicativo secuencial. Los datos cuantitativos se obtuvieron mediante el cuestionario HSI, centrado en las instalaciones e infraestructura del hospital, mientras que los datos cualitativos se recopilaron mediante un muestreo intencional que incluyó entrevistas en profundidad con informantes clave. Cuatro informantes clave participaron en este estudio: personal de Salud y Seguridad Ocupacional (OHS) y personal de Instalación y Mantenimiento de Instalaciones No Médicas, con el Comité de OHS sirviendo como triangulación. **Resultados:** La preparación estructural del hospital obtuvo una puntuación de 0,65 en el HSI, lo que indica un nivel moderado de resiliencia. Las entrevistas en profundidad revelaron que las limitaciones presupuestarias y la priorización del hospital para mejorar los servicios de salud fueron las principales barreras para avanzar en la preparación estructural. **Conclusión:** A pesar de un nivel moderado de preparación, se requieren mejoras adicionales en los estándares de seguridad, en la capacidad de respuesta ante emergencias y en la gestión de desastres. El fortalecimiento de estos aspectos aumentará la resiliencia del hospital para gestionar futuros desastres.

**Palabras clave:** Índice de Seguridad Hospitalaria (ISH), Preparación ante desastres, Resiliencia hospitalaria, Gestión de desastres, RSUD Haji Makassar.

## INTRODUCTION

Indonesia is among the countries with the highest disaster vulnerability in the world, due to its geological and climatic characteristics. The high frequency of disasters directly affects the continuity of healthcare services, including damage to facilities and disruption of their operations. Summary data for 2023 indicate that 1 929 disasters occurred in Indonesia between January 1 and July 13, 2023, resulting in damage to 39 healthcare facilities. This figure highlights the urgency of strengthening hospital preparedness as a critical component of public service infrastructure (1).

The World Health Organization (WHO) emphasizes the importance of hospital preparedness for disaster response to ensure hospitals can continue providing services to affected populations. Hospitals are often directly affected by disasters, which can cause both structural and non-structural damage (2). Therefore, maintaining building safety and implementing pre-disaster policies are essential to minimize the risk of damage and loss of life while ensuring preparedness for disaster response and post-disaster recovery planning (3).

The Hospital Safety Index (HSI), developed by the WHO and the Pan American Health Organization (PAHO), is a rapid, relatively low-cost diagnostic tool used to assess the likelihood that a hospital will remain functional during a disaster. The HSI evaluates three key components—structural safety, non-structural safety, and emergency and disaster management—and produces a composite classification (A/B/C) to guide intervention priorities. The strength of the HSI lies in its systematic, comprehensive, and operational approach: it assesses not only the integrity of buildings and critical utilities but also organizational readiness, chain of command, logistics, communications, and clinical surge capacity (4).

In the context of Indonesia's exposure to multiple hazards—such as earthquakes, tsunamis, floods, volcanic eruptions, and extreme climate events—the application of the HSI serves as an evidence-based strategy for identifying the weak points that most affect the continuity of hospital services. These include the security of essential equipment, the reliability of utility systems (electricity, water, and medical gas), evacuation routes, communication redundancy, and the preparedness of the Hospital Disaster Plan (HDP) as well as its coordination with referral networks and regional emergency commands (World Health Organization, 2019). This approach also aligns with the development of Health Emergency and Disaster Risk Management (Health-EDRM), which calls for integrating preparedness into clinical governance and daily hospital operations (5).

In previous studies on the application of the HSI in hospitals, most participants reported choosing it because it is a comprehensive tool

published by the WHO. They noted that the tool is highly specific and enables researchers to identify detailed conditions within hospitals (6). HSI is a user-friendly, all-inclusive instrument provided by a reputable organization and should be used regularly to evaluate the internal preparedness of different hospitals for disasters (7).

The HSI assesses several aspects, including structural safety, non-structural safety, and functional capacity. The studies indicated that each tool used to measure hospital disaster preparedness in HSI has strengths and weaknesses within the assessed domains. Although some tools have been recommended for evaluating hospital disaster preparedness, assessing each tool's validity and reliability remains critical and requires further investigation (8).

Examples of HSI application across several hospitals in Iran provide an international comparison and show that many hospitals fall into Category B ("fairly safe"). Improving hospital safety and resilience; strengthening the safety of medical equipment, enhancing managers' knowledge and skills in the scientific development of preparedness, emergency response, and recovery programs; increasing funding and support for crisis programs; and strengthening attention to safety, pollution control, and evacuation programs are among the solutions for improving hospital disaster preparedness (9).

Therefore, research on hospital disaster preparedness using the HSI is both scientifically and practically relevant. Scientifically, this study operationalizes the theory of healthcare organizational resilience within the Sendai Framework by linking hazard exposure, non-structural vulnerability, and managerial capacity to the probability of service continuity. Practically, the HSI assessment results provide a foundation for prioritizing cost-effective and regulation-aligned interventions—based on the Ministry of Health guidelines and the Hospital Accreditation Commission (KARS) standards—such as strengthening critical utilities, securing equipment, enhancing the competence of incident command teams, ensuring emergency stockpiles, and designing and testing surge scenarios (10).

Finally, the focus on regional hospitals, specifically RSUD Haji Makassar, a regional government-owned healthcare facility, is strategic given its role as a disaster referral hospital for high-risk communities. This study is expected to produce an accurate HSI profile, identify the weakest modules, and formulate realistic and measurable recommendations for gradual improvement. This will not only enhance the HSI score but, more importantly, ensure the continuity of essential clinical functions, the safety of patients and healthcare workers, and the fulfillment of public service mandates during a crisis.

## MATERIALS AND METHODS

This study employed a mixed-methods approach with a sequential explanatory design, combining quantitative and qualitative methods. In the first stage, the study used a descriptive quantitative method to determine the stability of HSI implementation in hospitals. In the second stage, a qualitative method was used to deepen understanding of the factors influencing implementation. The study was carried out at RSUD Haji Makassar in Makassar, South Sulawesi, Indonesia.

The study population consisted of all employees of RSUD Haji Makassar in Makassar, South Sulawesi, Indonesia. The quantitative sample was determined based on the divisions included in the HSI questionnaire. The sample consisted of the items on the HSI assessment checklist, namely, employees responsible for hospital facilities and infrastructure. Meanwhile, the qualitative sample was determined using a purposive sampling technique. The research informants consisted of four individuals: Occupational Health and Safety (OHS) staff and Non-Medical Facilities Maintenance Installation staff, with the OHS Committee serving as triangulation.

The tools used for data collection in this study were interview guidelines and observation sheets derived from the second edition of the Safe Hospital Index Checklist published by the WHO and PAHO in 2015.

## Data Analysis

The data analysis used was univariate, with manual calculations. The value of each module was summed and divided by three, after which the hospital was classified to describe its level of preparedness for natural disasters into three categories: C (not prepared, 0–0.35), B (partially prepared, 0.36–0.65), and A (well-prepared, 0.66–1). The classification results were based on the Safe Hospital Index Checklist and relevant quotations from in-depth interviews. For qualitative data, the researchers used data-source triangulation techniques to ensure the validity and accuracy of the data. For primary data, this was carried out by comparing the checklist results with interview and observation findings.

## Ethical Approval

This study, titled “Analysis of the Hospital Preparedness Index in Responding to Disasters Based on the Hospital Safety Index and Its Influencing Factors at RSUD Haji Makassar,” received ethical clearance from the Ethics Committee of the Faculty of Public Health, Universitas Hasanuddin, Indonesia (Approval Number: 1685/UN4.14.1/TP.01.02/2025). The approval is valid from September 4, 2025, to September 4, 2026.

## RESULTS

### Quantitative Analysis

The Safety Index assessment was conducted using the second edition of the HSI module. The HSI consists of 151 questions divided into four modules: Module 1 (Hazard/Disaster Risk Mitigation), Module 2 (Structural Safety), Module 3 (Non-Structural Safety), and Module 4 (Emergency and Disaster Management). Each module is assessed on a low, medium, and high scoring scale.

The HSI recognizes relative levels of functionality, with the following weightings: impossible to function—25 %, possible to function—50 %, and very likely to function—100 %. The minimum safety level is 25 %, while the maximum level is 100 %. The safer the hospital, the lower its vulnerability (4).

The overall HSI classification is divided into three categories, namely: (1) Category C (HSI score range 0 %-35 %), indicating that health facilities and their contents have a very high safety risk when facing a disaster situation (2); Category B (HSI score range 36 %-65 %), indicating that health facilities may be able to function, but essential services and equipment remain at risk during a disaster; and (3) Category A (HSI score range 66 %-100 %), indicating that health facilities have a level of safety that can protect people and continue to operate even in a disaster situation (4).

Table 1. Automatic Tabulation Results of the Safety and Vulnerability Index for RSUD Haji Makassar

Module	Safety Index	Vulnerability Index	Health Facility Status
Structural Safety (Module 2)	0.61	0.39	B
Non-Structural Safety (Module 3)	0.55	0.45	B
Emergency and Disaster Management (Module 4)	0.79	0.21	A
Total	0.65	0.35	B

Table 1 showed that the analysis of structural elements indicated a disaster preparedness level in the medium category, with a score of 0.61. Non-structural elements also fell within the medium preparedness category, with a score of 0.55. Functional elements fell within the high preparedness category, with a score of 0.79.

Thus, RSUD Haji Makassar was considered to have a moderate level of disaster preparedness, with an overall HIS score of 0.65. This finding indicated that the hospital could continue to function effectively under disaster conditions.

Table 2. Sub-component Values of Disaster Management Preparedness at RSUD Haji Makassar, 2025

<b>Component</b>	<b>Weight (%)</b>
<b><i>Disaster Management Coordination Activities</i></b>	
Disaster Committee at the hospital	3
Members of the committees	1.05
Coordinator for disaster management	1.2
Disaster preparedness program	3.75
Disaster incident management system	1.2
Availability of an Emergency Operations Center	1.8
Good coordination with local disaster management agencies	1.5
Planned coordination with health service networks	1.5
<b>Score</b>	<b>15.00</b>
<b><i>Hospital Disaster Response and Recovery Planning</i></b>	
Disaster response planning	6.3
Sub-planning for specific hazards in hospitals	5.4
Activation and deactivation procedures	1.26
Training for the correction, evaluation, and implementation of disaster response planning	3.6
Post-disaster hospital recovery planning	1.44
<b>Mark</b>	<b>18.00</b>
<b><i>Communication and Information Management</i></b>	
Internal and external communication during disasters	2.8
Directory of external stakeholders	1.75
Public and media communication procedures	1.4
Patient information management	1.05
<b>Score</b>	<b>7.00</b>
<b><i>Human Resources</i></b>	
Contact list of all staff	3
Staff availability	8
Staff recruitment and mobilization during disasters	3
Assignment of staff tasks during disasters	5
Staff welfare during disasters	1
<b>Score</b>	<b>20.00</b>
<b><i>Finance and Logistics</i></b>	
Agreements with suppliers and vendors during disasters	2
Availability of transportation during disasters	2
Availability of food & beverages during disasters	1.6
Financial allocations during disasters	2.4
<b>Score</b>	<b>8.00</b>
<b><i>Patient Care and Support Services</i></b>	
Continuity of critical care services during emergencies	5
Continuity of essential clinical services	3.75
Expansion of special rooms for mass casualties	2.5
Major disaster triage procedures	3
Availability of triage tags	0.75
Patient referral, admission, and transfer system	2.5
Infection surveillance, prevention, and control	3.75
Psychosocial services	2.5
Post-mortem	1.25
<b>Score</b>	<b>25.00</b>
<b><i>Safety, Evacuation, and Decontamination</i></b>	
Evacuation planning	3.5
Decontamination against biological and chemical hazards	1.05
Use of personal protective equipment and isolation for infectious and epidemic diseases	0.35
Safety procedures during disasters	1.75
Security of computer network systems	0.35
<b>Score</b>	<b>7.00</b>
<b>HSI Module 4 Average Score</b>	<b>84</b>

Table 2 shows that the subcomponent scores for disaster management preparedness at RSUD Haji Makassar were 84 v% for Module 4 (Emergency and Disaster Management), indicating that the hospital's disaster management system was well established. However, several aspects still require improvement to achieve optimal preparedness.

The Disaster Management Coordination Activities sub-component, with a weighting of 15 %, showed that the hospital had established a committee, a coordinator, and both internal and external coordination mechanisms. The Hospital Disaster Response and Recovery Planning sub-component, with a weighting of 18 %, showed that the response planning documents, activation and deactivation procedures, and recovery plans were fully developed. The Communication and Information Management sub-component, with a weighting of 7 %, showed that the hospital established communication procedures with both internal and external stakeholders, including the media and patients.

The Human Resources sub-component, with a weighting of 20 %, showed that staff allocation and availability were adequately planned. The Finance and Logistics sub-component, with a weighting of 8 %, showed that the hospital had basic logistical support and maintained cooperation with suppliers to ensure resource availability during disasters.

Meanwhile, the Patient Care and Support Services subcomponent, which contributed the highest weighting of 25 %, demonstrated the hospital's ability to maintain essential and critical services, including disaster triage, isolation rooms, and infection control. Finally, the Safety, Evacuation, and Decontamination sub-component, with a weighting of 7 %, showed that the hospital had an evacuation plan, a decontamination room, and basic personal protective equipment (PPE).

Overall, disaster management at RSUD Haji Makassar had adequate structures, documentation, and basic facilities. However, preparedness was not yet optimal because regular training, simulations, document updates, and logistical reinforcement had not been conducted. In other words, the system was in place but not yet fully ready to be tested in a real disaster situation.

### Qualitative Analysis

Based on in-depth interviews with research informants at RSUD Haji Makassar, the main obstacle to implementing structural preparedness was budgetary limitations. This was evidenced in the following interview excerpts:

*“The challenge in implementing structural preparedness is budgetary. For minor renovations, there is an annual budget. However, major renovations are carried out on a rolling basis.”* (Inf-1)

RSUD Haji Makassar was also constructing a new building located in front of the hospital. This project required significant funding because the building must comply with current safety standards.

*“The problem lies in the budget. For example, constructing a new building now requires a large amount of funding.”* (Inf-2)

*“Well, the obstacle is the adequacy of the available budget. For example, right now there are several construction projects at our hospital, including the new building in front and renovations to the building next to the mosque. The main issue is the budget.”* (Inf-3)

From the interview excerpts, it can be concluded that budget constraints were the primary factor hindering improvements in structural preparedness at RSUD Haji Makassar. Building upgrades and infrastructure maintenance were implemented gradually as funding became available, so strengthening preparedness required more planned, sustainable financial support. In addition to new building construction, maintenance of existing facilities was also being carried out to enhance structural preparedness.

Based on the results of the Focus Group Discussion (FGD), several elements in emergency and disaster management (Module 4) at RSUD Haji Makassar required attention and improvement. Although the hospital already had documents, standard operating procedures (SOPs), designated rooms, and basic equipment for emergency and disaster management, these were not supported by regular document updates, routine training, or periodic plan testing. Most components received a score of 0.5 because,

while planning documents were available, access, updates, training, and simulations were not conducted regularly. This indicated that disaster management preparedness had been established but still needed to be strengthened through continuous training, procedural updates, and enhanced resource capacity.

## DISCUSSION

The structural preparedness index of RSUD Haji Makassar was at a partially prepared level, with a score of 0.65. Overall, the hospital was approaching the well-prepared category in terms of building infrastructure. This was also supported by the ongoing construction of a new building and the renovation of several existing facilities. This finding was consistent with the study by Sunindijo et al. (2019), which assessed disaster preparedness levels in 10 hospitals in West Java and 5 in Yogyakarta. The study showed that most hospitals were in Category B, indicating that improvements were still needed in several components to strengthen hospital safety and disaster preparedness (11).

In addition, a similar finding was reported by Lamine (2022), who showed that 7 of 9 university hospitals were classified in the 'B' safety category, with an overall safety index ranging from 0.37 to 0.62. Furthermore, four of the nine hospitals had a safety score below 0.20 in the emergency and disaster management component (12). Control measures of preparedness should be considered, such as improvements in equipment and facilities, hospital emergency and disaster response and recovery planning, communication and information management, training, and relevant stakeholder awareness (13,14).

Urgent intervention measures are therefore needed, as hospitals may not be able to function effectively during and after emergencies or disasters. The current levels of safety, emergency, and disaster management in hospitals remain inadequate to protect the lives of patients and hospital staff during and after such events. Essentially, structural preparedness consists of two groups of indices:

In 2019, renovations were carried out on several buildings, including the Non-Medical Facilities

Maintenance Installation (IPSNM), the hall, and the area around the mosque. Construction of Phase III of the Inpatient Installation began on September 20, 2019, and was funded by the 2019 State Budget.

Building construction and expansion serve to improve service efficiency and facilitate public access to medical care. Currently, several hospitals with older buildings are still operating, even though the age of the building does not directly affect the delivery of medical services. However, service continuity may be disrupted if structural components are damaged. Therefore, hospital renovation and construction require special attention (15).

Hospital renovation and expansion should be prioritized to improve disaster resilience and ensure operational continuity, not merely to increase capacity. Non-structural damage (ceilings, medical equipment) poses a significant threat and requires anchoring systems and shock-resistant installations. At the same time, structural resilience is enhanced through the application of dissipative bracing to reduce deformation and maintain post-disaster emergency services, considering that designs must meet current building safety standards (16,17).

Efforts to improve hospital resilience to disasters, particularly earthquakes, must be based on a comprehensive evaluation that goes beyond structural integrity alone. Studies in Indonesia showed that assessments of preparedness and resilience using the HSI indicated a need for short-term interventions to repair (renovate) at-risk facilities (18). Global reviews confirmed that mitigation strategies should include structural retrofitting (e.g., shear walls or base isolators) and non-structural measures (e.g., securing medical equipment and utilities) to ensure hospital functionality is maintained post-disaster (19,20). Specifically, seismic vulnerability analyses demonstrated that installing reinforcements, such as RC shear walls, could significantly improve the resilience of hospital buildings by reducing the probability of structural damage, thereby ensuring operational sustainability (20).

The buildings observed included the Emergency Department (ER), treatment rooms, the main building, the pharmacy, Non-Medical Facilities Maintenance Installation, and the

outpatient care unit. Observations revealed that several of these buildings had undergone renovations, such as repainting, to maintain their quality and preparedness.

According to the Indonesian Ministry of Health (2009), a hospital is a health service institution that provides comprehensive individual health services, including inpatient, outpatient, and emergency services (21). Furthermore, Regulation of the Minister of Health No. 24 of 2016 concerning Technical Requirements for Hospital Buildings and Infrastructure defines a hospital building as the result of construction work that is physical and integrated with its location and position, either partially or completely, above or below land/water, and used as a facility for hospital operations. This regulation aims to ensure that hospital buildings and infrastructure are functional and harmoniously integrated with their surroundings (22).

According to the Asian Disaster Reduction and Response Network (2009), hospital structural preparedness involves assessing the building's structural type, materials, and exposure to natural and other hazards (23). Poor structural design can result in severe damage during disasters, potentially leading to failure or collapse. Conversely, moderate structural design provides partial protection, though it still carries a risk of damage short of total collapse. Meanwhile, good structural design indicates that a building should remain intact even in the face of a disaster (24).

The risk of hospital losses, both financial and human (loss of life), can be minimized by strengthening structural preparedness, which is closely related to the condition of the hospital's physical infrastructure (25). In addition, the availability of planning documents and other documentation related to hospital infrastructure development can support the assessment of structural vulnerability (26).

Based on in-depth interviews, the main obstacle hospitals faced in implementing structural preparedness was budgetary constraints. These findings align with the study by Yenni and Windusari (2020), which reported that the main challenges hospitals face in implementing disaster preparedness include financial constraints and a focus on improving structural preparedness and health services (27).

Hospitals have a phased budget allocation to improve structural preparedness, particularly regarding building conditions. This budget is primarily sourced from the State Budget (APBN). However, the construction of new hospital buildings currently requires significantly greater funding, as they must comply with the technical standards specified in Regulation of the Minister of Health of the Republic of Indonesia No. 24 of 2016 concerning Technical Requirements for Hospital Buildings and Infrastructure.

## CONCLUSION

Based on the results of this study, it can be concluded that the structural preparedness index of RSUD Haji Makassar was at a partially prepared level (Category B), with an HSI score of 0.65. Overall, the hospital was approaching the well-prepared category in terms of its building infrastructure, supported by ongoing construction of a new building and renovations to several existing facilities. However, the hospital faced major obstacles in implementing structural preparedness, including budgetary limitations and a focus on improving health services.

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