

ANALYSIS OF THE READINESS OF TELAGA BUNDA HOSPITAL BIREUEN INRESPONDING TO FLOODS AND EARTHQUAKE DISASTERS: THE HOSPITAL SAFETY INDEX (HSI) APPROACH

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Abstract

Acute Respiratory Infections, post-disaster epidemics, and infrastructure damage following hydrometeorological and seismic disasters in Aceh during 2025-2026 have placed enormous pressure on health facilities. Hospitals in disaster-prone regions such as Bireuen District must be assessed for their preparedness using validated instruments. This study aims to analyze the disaster preparedness level of Telaga Bunda Hospital Bireuen in facing flood and earthquake disasters using the Hospital Safety Index (HSI) approach developed by WHO/PAHO. The research employed a descriptive evaluative design using mixed methods, combining HSI self-assessment of 145 items across three modules (structural safety, non-structural safety, and emergency and disaster management) with structured observation, document review, and focus group discussions involving the hospital disaster team. Results indicated that Telaga Bunda Hospital Bireuen achieved a Safety Index of 0.78, categorized as Class A (the hospital is likely to function during and after a disaster). Module 2 (structural safety) scored 0.81, Module 3 (non-structural safety) scored 0.79, and Module 4 (emergency management) scored 0.74. The majority of indicators were rated as high safety level, particularly for structural integrity, electrical backup systems, and clinical staff readiness. Recommendations focus on strengthening disaster simulation drills, improving evacuation signage, and enhancing inter-agency coordination with BPBD Bireuen and Health Service.

Keywords: Bireuen ; disaster preparedness; flood; Hospital Safety Index; Telaga Bunda Hospital

INTRODUCTION

Indonesia is a very vulnerable country to various type disaster , good disaster hydrometeorology and geology , so that often called as a " laboratory" world disaster ". Throughout 2025 , flood recorded as disaster the most dominant nature in Indonesia with percentage reached 37.09% of the total incidents disaster , driven by rainfall Rain extreme , conditions drainage that is not adequate , and land use change (GoodStats , 2026). Aceh Province , including Regency Bireuen , is one of the most affected areas disaster hydrometeorology by the end of 2025 to early 2026, where the Aceh Government stated Bireuen " almost paralyzed " as a result flood big hit (Berta Merdeka, 2025) . In context this facility service health , in particular House sick , holding role central as the vanguard handling of disaster victims . Based on BNPB data, up to end of January 2026 recorded 215 facilities health experience damage consequence disaster hydrometeorology in Aceh and Sumatra (NU Online, 2026). Conditions This confirm importance House Sick No only endure in a way structural , but also remains functioning give service medical during and after disaster happened . The concept of "Safe Hospital" which has been promoted by WHO and PAHO since 2008 became global reference in evaluate preparedness House Sick to disaster .

Regency Bireuen in a way geographical located on the coast north of Aceh with level threat double , namely flood consequence overflow rivers and threats earthquake Because is located on the Sumatran Fault line . During period November 2025 to April 2026, Bireuen recorded as one of the regency affected flood the worst in Aceh, with 4,888 people or 1,395 families took refuge at 59 points refugee camps (NU Online, 2026). Government Regency Bireuen has set three decision regent regarding emergency status and recovery disaster , including Decree Number 300.2.2/9 of 2026 concerning transitional status emergency to recovery period 7 January–6 April 2026 (Waspada , 2026). Telaga Bunda Hospital, located at Jl. Peutua Banta No. 7, Gampong Bireuen Meunasah Blang, Kota Juang District, and Telaga Bunda 2 Hospital in Cot Gapu (officially operating on April 6, 2025), is a type C private hospital that has received full accreditation and is one of the main referrals for the people of Bireuen and its surroundings (Kabar Bireuen, 2025). As a strategic health facility, Telaga Bunda Hospital's preparedness in facing floods and

earthquakes is crucial for the continuity of health services for the people of Bireuen. The Hospital Safety Index (HSI) is an assessment instrument developed by WHO and PAHO to measure the likelihood of hospitals remaining operational in emergencies and disasters (WHO, 2015). The HSI consists of four modules: hazard identification, structural safety, non-structural safety, and functional capacity, with a total of 145 indicators in Modules 2-4 used to calculate the safety index. This study aims to analyze the level of preparedness of Telaga Bunda Bireuen Hospital in facing floods and earthquakes using the HSI approach, as a basis for formulating recommendations for improving disaster response capacity in hospitals.

LITERATURE REVIEW

The Hospital Safety Index (HSI) is an instrument designed by the Pan American Health Organization (PAHO) and the World Health Organization (WHO) to assess the likelihood of a hospital remaining operational during emergencies and disasters (WHO, 2015). The HSI is designed as a comprehensive diagnostic tool that considers not only the structural strength of a building but also its functional capacity and non-structural elements, which often determine the continuity of medical services after a disaster. Since its global introduction in 2008 and revision in 2015, the HSI has been adopted as the standard for assessing hospital safety in more than 100 countries.

The HSI structure consists of four modules. Module 1 identifies hazards that could impact hospital safety and includes 38 assessment items, but is not included in the safety index calculation. Module 2 (Structural Safety) evaluates the structure type, building materials, and previous exposure to natural hazards. Module 3 (Non-Structural Safety) assesses elements that are not part of the load-bearing structure but are crucial to hospital function, such as electrical, telecommunications, water systems, medical gases, and equipment. Module 4 (Emergency and Disaster Management) assesses coordination, planning, human resources, logistics, patient care, evacuation, and decontamination. Modules 2-4 contain a total of 145 indicators, each with a relative weight (Endradita, 2021).

The HSI assessment results produce three classification categories: A (score 0.66-1.00, the hospital is likely to be able to function during and after a disaster), B (score 0.36-0.65, functional capacity is at risk, short-term intervention is needed), and C (score 0.00-0.35, the hospital's ability to function in an emergency is high risk, urgent intervention is needed). This classification provides practical guidance for decision-makers to prioritize capacity-building investments (Pan American Health Organization, 2015).

The implementation of HSI in Indonesia remains limited, despite the country being dubbed a "disaster laboratory." A study by Gulo et al. (2022) at Dr. Soetarto DKT Hospital in Yogyakarta found a B classification with a safety index of 0.65 by independent evaluators and 0.43 by hospital self-assessment, indicating a common perception gap. A previous study at Hospital X DKI Jakarta in 2019 noted score preparedness structural 0.86, non-structural 0.96, and management emergency 0.73, with Classification A (University of Indonesia, 2019). Findings This show that module management emergency in a way consistent become an area in need strengthening compared to aspect structural .

Context Bireuen strengthen urgency HSI research . BMKG issued warning standby disaster hydrometeorology for Aceh including Bireuen in the period 11-15 and 16-20 April 2026 (Masakini , 2026). In addition , Aceh historical located in a seismic zone active Sumatran Fault, with risk earthquake powerful medium until big . This multi-hazard condition demand House sick in Bireuen For own preparedness comprehensive research This fill in gap literature with give specific HSI analysis for Telaga Bunda Bireuen Hospital , which so far search researchers Not yet Once done in a way systematic previously .

Review literature on research This in a way special study four aspect the main thing that becomes runway theoretical and empirical HSI assessment at Telaga Bunda Bireuen Hospital :

- The concept of "Safe Hospital" and the Hospital Safety Index (HSI) framework developed by WHO/PAHO as global assessment standards preparedness House sick , with four module evaluation that includes identification danger , security structural , non- structural safety , and capacity functional management emergency .
- Characteristics disaster hydrometeorology and seismic in the Aceh region, in particular Regency Bireuen , as context threat multiple (multi-hazard) demands preparedness comprehensive facility health , including the latest data flood Aceh November 2025–April 2026 and position Bireuen on the Sumatran Fault line .
- Studies HSI implementation at home sick Indonesia as comparator methodological and results , including Gulo et al.'s (2022) research at Dr. Soetarto DKT Hospital Yogyakarta and the University of Indonesia study (2019) at X Hospital DKI Jakarta, which provided description range home HSI score sick Indonesia.
- Profile of Telaga Bunda Hospital Bireuen as a unit of analysis , including accreditation status plenary , typology House sick (type C), and the role strategic as references main public Bireuen post Inauguration of Telaga Bunda 2 Hospital in Cot Gapu in April 2025.

METHOD

Study This use design descriptive evaluative with mixed methods approach (quantitative and qualitative) for describe level Readiness of Telaga Bunda Bireuen Hospital in face disaster floods and earthquakes . Approach quantitative implemented through Hospital Safety Index (HSI) assessment of 145 items indicators in Module 2 (Security Structural), Module 3 (Non- Structural Safety), and Module 4 (Management Emergency and Disaster). Approach qualitative done through Focus Group Discussion (FGD) with team management disaster House illness and observation field For validate quantitative data .

Study carried out at Telaga Bunda Hospital which consists of from two units (Telaga Bunda 1 Hospital on Jl. Peutua Banta No. 7 Bireuen Meunasah Blang and Telaga Bunda 2 Hospital in Cot Gapu , Kota Juang District) during the period February until April 2026. Subject study covering structure physique buildings , equipment medical and non - medical documents planning disaster House sick , and team management disasters consisting of from director , head part general , head of emergency room, head maintenance means , representatives committee safety , and K3RS coordinator .

Instrument study main is the 2015 WHO/PAHO version of the HSI form which has been translated Translated into Indonesian by the Indonesian Ministry of Health. Each indicator item is assessed in three categories: low safety level (score 0), medium (score 0.5), or high (score 1). The total score is calculated using the relative weighting formula for each indicator in the module, then combined into an aggregate safety index (Safety Index). The final classification follows the PAHO standard: Category A (0.66-1.00), B (0.36-0.65), or C (0.00-0.35).

Data collection was conducted in four stages. First, a self-assessment by the hospital team using the HSI checklist. Second, a structured observation by the research team of the structural and non-structural aspects of the building, with photographic documentation. Third, a review of supporting documents, including the Hospital Disaster Plan (HDP), evacuation SOPs, emergency contact lists, and disaster simulation records. Fourth, a focus group discussion (FGD) with seven members of the disaster management team was conducted to clarify findings and explore the operational context. Triangulation of data from these four sources ensured the validity of the HSI assessment results.

Data analysis was conducted in two stages. Quantitative analysis calculated scores for each module and an aggregate safety index using the official PAHO HSI calculator. Qualitative analysis used framework analysis to categorize FGD findings into themes according to the HSI modules. This study has obtained ethical approval from the UMMAH Health Research Ethics Committee and official approval from the Board of Directors of Telaga Bunda Bireuen Hospital. The results of the aggregate assessment of the three HSI modules of Telaga Bunda Bireuen Hospital are presented in Table 1, while the details of the indicators per module will be described in the Results and Discussion section.

Table 1. Results of the Hospital Safety Index Assessment of Telaga Bunda Bireuen Hospital

HSI Module	Score	Category
Module 2 (Structural)	0.81	A
Module 3 (Non- Structural)	0.79	A
Module 4 (Management) Disaster)	0.74	A

Based on Table 1, the aggregate Safety Index of Telaga Bunda Bireuen Hospital of 0.78, which is calculated through weighting relatively third module as arranged in WHO/PAHO 2015 HSI guidelines . This value including in Category Aggregate score This will explained more detailed in the Results and Discussion section , including distribution capacity high / medium / low on each module .

RESULTS AND DISCUSSION

Research result show that Telaga Bunda Bireuen Hospital obtain the aggregate Safety Index of 0.78 and is categorized in Category A. This is meaningful that House Sick possibility big can still functioning give service

medical during and after disaster flood and earthquake , with Details of Module 2 (Structural) score 0.81, Module 3 (Non- Structural) score 0.79, and Module 4 (Management) score 0.81. Emergency) score 0.74. The majority indicators on the three module get evaluation level security high , reflecting commitment management House Sick to preparedness disaster especially after experience COVID-19 pandemic and its series disaster hydrometeorology 2025-2026 in Aceh.

Characteristics FGD respondents consisted of of 7 (seven) members team management Telaga Bunda Hospital disaster includes Medical Director , Head of Emergency Room, Head of General Affairs, Head of Maintenance of Facilities and Infrastructure , K3RS Coordinator , representatives Committee Safety Patients , and one doctor specialist who becomes coordinator team response fast . The majority (71%) have experience work from home Sick more from 5 years and ever involved in response disaster victim management flood Bireuen period November 2025-January 2026. This real-world experience provides a significant learning base and is reflected in the positive scores of several indicators in Module 4.

HSI Module 2: Hospital Structural Safety

HSI Module 2 assessed the structural safety of Telaga Bunda Bireuen Hospital and obtained a score of 0.81 (Category A). The main building of Telaga Bunda 1 Hospital on Jl. Peutua Banta is a two-story reinforced concrete structure with foundations that meet SNI 1726:2019 standards for areas with a medium seismic coefficient zone. The Telaga Bunda 2 Hospital building in Cot Gapu , which was inaugurated in April 2025, was designed with standard construction stand earthquake latest , using K-300 concrete material and BJTD-40 steel reinforcement , as well has passed inspection structure from the Bireuen PUPR Service as prerequisite permission operational .

Aspect exposure flood get attention special remember Bireuen including areas that are " almost paralyzed "in the flood end of 2025. Observation results show that The location of Telaga Bunda 1 Hospital is at a relatively high elevation . safe with sufficient distance from Krueng Peudada, while Telaga Bunda 2 Hospital is in Cot Gapu own channel good drainage and yard high . During November 2025 flood , both housing units Sick No experience puddle significant and permanent operate full For serve patient references from The affected health centers . Indicators that are still can improved is availability of flood barriers portable in parking areas and doors enter the basement.

HSI Module 3 and Module 4: Non-Structural and Emergency Management

Module 3 (Non-Structural Safety) scored 0.79 with Category A. The strongest aspect is the electrical system: Telaga Bunda Hospital has two backup generators with a total capacity of 250 kVA that automatically activate in less than 10 seconds when the PLN power is cut off. The clean water system is supported by three drilled wells with a 30,000 liter reserve tank that guarantees a minimum of 72 hours of water supply. The medical gas system (central oxygen) has a reserve cylinder for 5 days of operation at peak load. Aspects that still need improvement are the installation of more photoluminescent evacuation signs (signage) in the hallways, as well as securing drug and medical equipment storage racks against earthquake vibrations.

Module 4 (Emergency and Disaster Management) received a score of 0.74 (Category A), the lowest-scoring module among the three modules. Notable positive aspects include the Hospital Disaster Plan (HDP) updated in January 2026 following the flood experience, a clear disaster management team structure, and strong collaboration with the Bireuen Regional Disaster Management Agency (BPBD) and the Health Office. During the Bireuen floods from November 2025 to January 2026, Telaga Bunda Hospital successfully activated its extended triage protocol and received referrals from four affected Community Health Centers (Puskesmas) without significant disruption to routine services.

However, several areas require strengthening in Module 4. First, scheduled disaster simulations are still conducted once a year, lower than the WHO recommendation of twice per year for hospitals in multi-hazard areas. Second, documentation and analysis of post-disaster after-action reviews have not been fully standardized. Third, formal coordination with the regional hospital network in Aceh for mass casualty incident referral scenarios is still ad-hoc, not yet outlined in a written Memorandum of Understanding. Strengthening these four aspects is projected to push the Module 4 score above 0.80, as achieved at several major referral hospitals in Indonesia. When compared to previous studies, the results of Telaga Bunda Bireuen Hospital are relatively equivalent to Hospital X DKI Jakarta which recorded a structural score of 0.86, non-structural 0.96, and emergency management 0.73 in a study by the University of Indonesia (2019). The striking difference lies in Module 3, where Hospital X Jakarta has the advantage of access to premium non-structural technology due to its status as a national type A hospital. For Telaga Bunda Hospital which has type C status, a score of 0.79 in Module 3 is an excellent achievement and demonstrates the management's serious commitment to the "Safe Hospital" concept.

CONCLUSION

Based on the results of the Hospital Safety Index analysis, Telaga Bunda Bireuen Hospital has a good level of preparedness in facing floods and earthquakes, with an aggregate Safety Index of 0.78 which is included in Category A. This means that the hospital is likely to be able to continue to function to provide medical services during and after a disaster occurs. The scores for Module 2 (Structural) of 0.81, Module 3 (Non-Structural) of 0.79, and Module 4 (Emergency Management) of 0.74 indicate that the majority of preparedness aspects have met WHO/PAHO standards, with advantages in the structural integrity of the building, backup electrical systems, and the availability of a trained disaster management team.

This study recommends four strategies for improving preparedness. First, increasing the frequency of disaster simulations from once to twice per year using scenarios that reflect the real threats in Bireuen (river floods and Sumatran Fault earthquakes). Second, installing portable flood barriers and photoluminescent evacuation signs in critical areas. Third, formalizing a Memorandum of Understanding (MoU) with the Aceh regional hospital network and Bireuen community health centers (Puskesmas) for mass casualty referral scenarios. Fourth, strengthening post-disaster after-action review documentation as a basis for continuous learning. Further research is recommended using a longitudinal design to monitor the evolution of HSI scores as recommendations are implemented, and expanding coverage to all health facilities in Bireuen, including community health centers and private clinics, to build an integrated district preparedness network.

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