

The Critical Role of Medical Air Transport in Disaster Response: A Comprehensive Analysis of the November 2025 Hat Yai Mega Flood

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Abstract:

Major disasters, particularly large-scale flooding, frequently paralyze urban infrastructure and isolate critical healthcare facilities, necessitating rapid, complex decision-making for hospital evacuation. This review examines the role of aeromedical evacuation as a logistical lifeline during internal hospital disasters, utilizing the November 2025 Hat Yai mega-flood in Southern Thailand as a case study. This study employs a retrospective case study approach combined with a narrative review. Data were derived from the academic literature, official operational reports, and relevant information from press releases between January 2016 and May 2026, as appropriate. Analysis followed a thematic framework aligned with the Hospital Incident Command System, focusing on strategic planning, operational decision schemes, and system elements. The November 2025 Hat Yai flood—the most intense precipitation event in 300 years—resulted in the inundation of critical medical facilities and compromised vital infrastructure. The study highlights the successful, phased evacuation of critically ill patients from Hatyai Hospital using governmental aviation assets, demonstrating the efficacy of the Thai Sky Doctor Service. However, the response also revealed significant systemic gaps, including delayed evacuation orders due to municipal communication failures and an over-reliance on premium aviation assets. Aeromedical transport serves as a critical force multiplier in disaster medicine, providing an essential vertical lifeline when ground infrastructure fails.

Keywords: aeromedical evacuation, disaster medicine, Hat Yai flood

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Introduction

When a major disaster strikes, it inevitably causes profound devastation to human life, property, infrastructure, the economy, and the environment, with a particularly severe impact on healthcare systems. This systemic disruption manifests through the structural compromise of medical facilities, loss of ancillary and support services, adverse effects on healthcare personnel, the widespread failure of essential utilities, and the paralysis of medical transportation networks, known as internal crises or internal disasters^{1,2}.

Effective crisis management necessitates a comprehensive Internal Disaster Management Plan integrated with the Hospital Incident Command System (HICS) to ensure a coordinated response. Furthermore, achieving operational resilience requires a robust business continuity plan to sustain critical functions, alongside strategic evacuation protocols designed to maximize overall outcomes under severe time and resource constraints^{1,2}.

Frequent flooding events in the urban basin of Hat Yai, Southern Thailand^{3,4}, especially in November 2025, represent a tragic catastrophe that serves as a profound case study for internal hospital disasters. The intense monsoon rains periodically transform Hat Yai's low-lying commercial hub into deep, fast-flowing waterways, completely submerging key transport corridors, trapping residents, and isolating major local hospitals from ground-based Emergency Medical Services (EMS).

In such a scenario, medical air transport transforms from a premium, specialized healthcare service into an absolute logistical lifeline. Aeromedical evacuation (AE) serves as the bridge connecting waterlogged or destroyed disaster zones with definitive, functional medical care facilities by overcoming the constraints of time, terrain, and compromised infrastructure⁵. Consequently, the integration of robust, interoperable aviation protocols into national emergency frameworks is a requisite foundation

for achieving global disaster resilience and safeguarding public health security⁶.

This review examines the critical role of aeromedical transport in hospital evacuation, delineating strategic planning frameworks, operational decision schemes, and essential system elements.

Methodology study design

This paper is a hybrid descriptive article comprising a retrospective descriptive case study (or operational case report/case analysis) of the November 2025 Hat Yai Hospital evacuation and a narrative literature review that provides context and supports the discussion. The objective is to analyze the operational deployment of AE during the November 2025 Hat Yai mega flood and evaluate it against established internal disaster management frameworks.

Data sources and search strategy

Data collection was conducted through a dual-track search strategy to capture both foundational academic literature and event-specific operational data from January 2016 to May 2026, as appropriate:

Academic Literature: A systematic search was performed across major academic databases, including PubMed, Scopus, and Google Scholar. The search targeted literature published from January 2016 to May 2026, utilizing keywords such as: ("aeromedical evacuation" OR "medical air transport") AND ("hospital evacuation" OR "internal disaster") AND ("disaster response" OR "flood").

Event-Specific Data: To analyze the Hat Yai incident, secondary operational data were gathered from publicly available official reports, press releases, and bulletins. Key sources included the Ministry of Public Health (MOPH) Thailand, the National Institute for Emergency Medicine (NIEM), the Department of Disaster Prevention and Mitigation, and official situation reports from the affected local healthcare facilities.

For press releases and electronic bulletins, the author selected information online from well-known press agencies, either national or international, and owned digital media, which established chronological timelines and environmental contexts. The media content was cross-referenced for accuracy against official bulletins.

Selection criteria

Articles and reports were included if they provided substantive insights into: (1) aviation protocols during extreme weather events, (2) critical care transport logistics, or (3) documented timelines and outcomes of the Hat Yai flood response. Opinion pieces, unverified social media reports, and articles lacking peer review or official institutional backing were excluded in order to maintain the analytical integrity of this review.

Data synthesis and analytical framework

As a single-author review, the extracted data were systematically categorized and synthesized using a thematic

analysis approach. The findings were mapped against three core domains aligned with the HICS:

Strategic planning frameworks (policy integration and preparation)

Operational decision schemes (triage and dispatch criteria during the flood)

Essential system elements (aviation assets, landing zone logistics, and communication)

This framework allows for a structured evaluation of how theoretical disaster response protocols were translated into practical aeromedical lifelines during the Hat Yai crisis.

The Hat Yai mega flood of November 2025: event characteristics and impact

Geographic and climatic causes

Located on a low-lying floodplain surrounded by steep hillsides, Hat Yai is geographically predisposed to rapid water accumulation and recurrent seasonal flooding³, as shown in Figure1. This inherent topographical vulnerability, compounded by rapid urbanization, presents



Source: https://www.gistda.or.th/article_attach/Analysis%20of%20the%20Hat%20Yai%20Floods.jpg

Figure 1 Topographic map of Hat Yai basin and water drainage, Songkhla, Thailand

critical challenges for government authorities in the realms of urban planning, climatological forecasting, and comprehensive disaster management⁴.

During the third week of November 2025, an unusually intense monsoon trough, exacerbated by localized low-pressure systems and prevailing La Niña conditions, stalled over Southern Thailand, resulting in unprecedented precipitation⁷. Between November 19 and 23, the region experienced extreme rainfall, with Hat Yai recording an accumulated 635 millimeters over a three-day period, including a peak intensity of 335 millimeters on November 21 alone^{8,9}. This event represents the highest recorded single-day precipitation in 300 years, significantly surpassing the previous peak of 428 millimeters documented during the 2010 flood event¹⁰. Consequently, it triggered a rapid influx of floodwaters, distinct from the historical inundations characterized by gradual upstream runoff. The precipitation intensity far exceeded the hydraulic capacity of the existing flood mitigation infrastructure—a system previously regarded as the cornerstone of Hat Yai's flood management strategy, as shown in Figure 2.

Casualties, economic ruin, and environmental disruption

The humanitarian toll was staggering, affecting more than 465,000 residents across the region, trapping tens of thousands in their homes, and forcing mass evacuations to higher ground^{11,12}. Official fatality counts fluctuated as floodwaters receded, but regional death tolls swiftly climbed past 145, with eventual estimates suggesting up to 170 fatalities. The disaster disproportionately impacted vulnerable demographics, including bedridden patients, tourists, and the elderly, who were unable to navigate the rising waters before rescue teams could mobilize.

Economically, the inundation of Hat Yai—the primary commercial and tourism hub of Southern Thailand—triggered catastrophic financial losses. Immediate direct damage was estimated at 20 to 25 billion baht¹³, equivalent to hundreds of

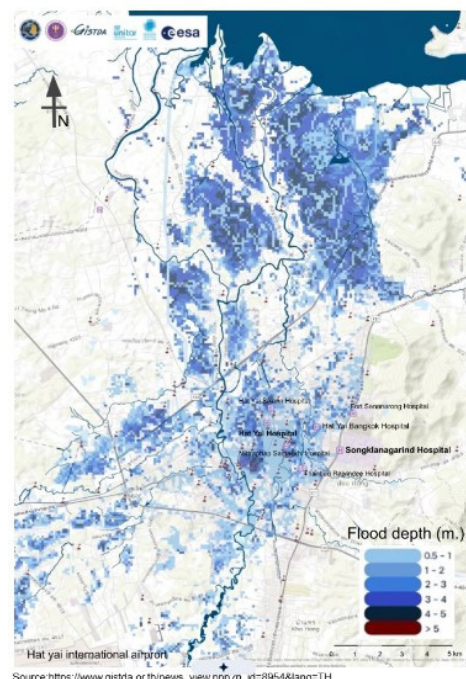


Figure 2 Flood death distribution in Hat Yai district, Songkhla province (November 25th, 2025)

millions of dollars. However, indirect losses stemming from the collapse of the “just-in-time” supply chain, sustained business closures, and long-term infrastructure degradation were projected to push total economic damages as high as 300 to 400 billion baht¹⁴.

Medical and public health impact

Flash floods trigger a dynamic public health crisis that evolves significantly from the onset of the disaster through the recovery phase. Initially, patient volumes at healthcare facilities paradoxically decrease as severed transport infrastructure renders hospitals geographically inaccessible. This isolation becomes life-threatening for critical patients who miss the “golden hour” for treatment due to severely delayed EMS or for vulnerable populations that cannot access medical facilities. Meanwhile, those who can access care typically present with disaster-specific conditions such as drowning, electrocution, venomous

bites, and waterborne diseases. Concurrently, public health systems must rigorously manage sanitation and infection control in evacuation shelters to prevent secondary disease outbreaks. The most severe challenge, however, occurs after floodwaters recede, triggering a massive “secondary surge” of patients. This sudden influx is primarily driven by individuals with chronic diseases suffering acute exacerbations from medication interruptions, necessitating that regional healthcare systems urgently implement robust surge capacity plans to accommodate the overwhelming demand¹⁵.

The recent hydraulic disaster caused a public health crisis. Local medical facilities, including the primary 600-bed Hatyai Hospital, found themselves engulfed by floodwaters. With the first floor of the hospital completely inundated, critical power systems and medical supply chains were compromised, creating a desperate scenario for the intensive care unit (ICU) patients relying on continuous mechanical ventilation and hemodynamic support^{16,17}. Furthermore, post-disaster infrastructure recovery requires massive financial investment and an extended timeframe to achieve long-term resilience¹⁸.

Hospital evacuation: indications and decisional dilemmas

The decision to evacuate a major healthcare facility during a disaster is among the most complex, high-risk, and ethically fraught determinations a hospital incident command team can make. Although Thai hospitals have established basic evacuation plans and committees, their preparedness remains inadequate due to a lack of specialized evacuation triage systems, unclear multiagency collaboration, and an inability to integrate alternative community resources during massive surges. Consequently, current protocols struggle with practical resource management and inter-organizational communication, compromising both patient and staff safety during actual crises¹⁹. Consequently, hospital administrators and emergency management officials rely on

rigorous decisional frameworks to navigate the “evacuate versus shelter-in-place” dilemma²⁰.

The shelter-in-place versus evacuate paradigm

Hospital evacuation during a disaster is a highly complex process fraught with ethical dilemmas regarding resource allocation, patient rights, and unclear decision-making authorities²⁰. As the most current guideline, the CHEST consensus statement emphasizes that ICU evacuation must be an absolute last resort; it strongly prioritizes shelter-in-place strategies whenever the facility’s infrastructure remains viable²¹ because moving critically ill patients, especially those in ICUs, poses extreme medical risks; for example, emergency evacuations during the Fukushima disaster increased patient mortality risk by 1.82 times, leading to numerous immediate and long-term fatalities among vulnerable patients^{22–23}. Additionally, infrastructural collapse and improper transport routes can further exacerbate infection spread and transit-related dangers^{24–25}. To navigate the critical “evacuate versus shelter-in-place” dilemma, incident commanders must rely on dynamic mathematical models and establish explicit risk thresholds²⁶. Ultimately, utilizing structured decision-making frameworks (such as those by the United States Agency for Healthcare Research and Quality) and enhancing flexible surge capacity through community collaboration are essential to minimize biases, balance risks, and ensure patient survival during crises²⁷.

The sequence of hospital evacuation

If the Shelter-in-Place strategy did not ensure an effective medical operation, evacuation would be a justifiable option²⁸. The authorization for evacuation is designated to the incident commander of the hospital disaster plan (HDP), necessitating continuous communication and collaboration with external organizations, including the higher command center, receiving health facilities, logistics, and support functions²⁹.

The stages of evacuation can be delineated as follows^{30,31}.

Triage: Fundamental to the evacuation process is systematic triage, which stratifies patients to dictate category-specific operational responses. These classification systems frequently utilize evacuation triage based on mobility status²⁹⁻³¹. For instance, the 2023 National Health Service (NHS) England guidelines advocate for a “reverse triage” strategy, where ambulatory individuals are prioritized for immediate relocation, while highly dependent, technologically supported patients are transitioned last. Every patient must undergo comprehensive assessment without exception; notably, any decision to defer a patient’s transfer necessitates a rigorous clinical evaluation by two medical professionals and a documented justification of the underlying rationale³¹.

Dispersal and coordination: Following triage, patients must be formally registered to accurately document their clinical status, specialized equipment requirements, and the logistical details of their designated transport. Robust inter-agency communication remains essential for ensuring a seamless evacuation process. Because absolute precision regarding patient transfer endpoints is vital, a centralized clearing station must be implemented. This facility functions as a critical logistical node, streamlining the systematic transfer of individuals to their definitive destinations—whether those are alternative healthcare institutions, temporary community shelters, or final discharge home²⁹⁻³¹.

Transport: Determining the appropriate mode of transportation requires a multifactorial approach that evaluates the distance to the destination, logistical obstacles, transit-related risks, and the clinical status of the patients. Ground transport is typically the preferred modality, as it facilitates the simultaneous evacuation of multiple patients and provides the flexibility to access additional resources en route. However, in the event of infrastructure disruptions—such as impassable roadways—alternative

methods, including maritime or aeromedical transport, must be considered in conjunction with robust inter-agency coordination³⁰.

Planning and response: multi-agency coordination

Effective disaster response requires seamless interoperability between civilian healthcare coalitions, local government bodies, and military assets. The response to the 2025 Hat Yai flood underscored the necessity of centralized command and the rapid deployment of specialized assets when local municipal capabilities were overwhelmed by the sheer scale of the inundation³²⁻⁴⁰.

The Thai aeromedical transport system

Thailand’s aeromedical transport network, formalized in 2009 by the NIEM, was developed to mitigate critical healthcare access disparities caused by complex topography and geographic isolation⁴⁰. Operating under the Thai Sky Doctor Service, the system functions as a public-private partnership that integrates military, governmental, and private aviation assets for both primary scene responses and secondary inter-facility transfers. In 2024, the MOPH mandated the “One Region, One Sky Doctor” policy to guarantee nationwide Helicopter Emergency Medical Services (HEMS) coverage by establishing standardized operational bases across all 13 national health regions⁴¹.

As part of its organizational management process under the “Directing” function of the POSDCORB (Planning, Organizing, Staffing, Directing, Coordinating, Reporting, and Budgeting) framework, the NIEM has established a dedicated command system for air emergency medical operations. This command system is structurally integrated into NIEM’s Health Information System, functioning alongside a data management system for operational compensation. The Narenthorn Center, operating under the Central Emergency Medical System Management Office,

serves as the central administrative body responsible for operational oversight, performance tracking, and outcome management of the dispatched missions. Functionally, these operations are classified into two distinct categories: primary missions, functioning as HEMS for pre-hospital care, and secondary missions, designated for interfacility transfers to institutions with advanced medical capabilities. Furthermore, the dispatch command process mandates rigorous authorization based on medical necessity criteria to ensure the efficient and appropriate transfer of critically ill patients. Consequently, statistical evidence indicates a sustained upward trajectory in both emergency medical notifications and overall dispatch commands, a progression substantially driven by the continuous expansion of operational coverage areas⁴².

The establishment of the Thai Sky Doctor Service has proven to be a highly successful initiative, yielding significantly positive outcomes for emergency healthcare. Operational reports analyzing 184 transported patients—primarily those suffering from severe trauma and acute cardiac events—highlight the system's life-saving impact, demonstrating remarkable post-transport survival rates of 98.9% at one day and 90.8% at three days. Crucially, the data indicate that the duration of the transport did not adversely affect patient outcomes, confirming the safety of the flights; rather, only the patient's pre-flight clinical severity significantly impacted three-day survival. Ultimately, the inception of this air medical service has delivered immense benefits by dramatically bridging the healthcare gap and improving accessibility for remote populations. By ensuring secure transit under the care of highly trained medical personnel, the Sky Doctor Service successfully empowers critically ill patients to receive specialized, life-saving interventions within their crucial golden periods⁴³.

Report on aero-hospital evacuation: successes and gaps

The successful evacuation of the Hatyai Hospital

ICU stands as a profound operational triumph of the 2025 response. It clinically validated the absolute necessity of incorporating reinforced, heavy-lift-capable rooftop helipads into the architectural design of all critical urban healthcare facilities. Without the ability to land S-76B helicopters directly on the hospital superstructure, the 50 mechanically ventilated patients trapped above the flooded ground floor would have faced catastrophic mortality rates during manual evacuation through deep, contaminated floodwaters. The flawless execution of this airlift prevented a mass-casualty event within the hospital walls^{44,45}.

However, the response also highlighted severe systemic bottlenecks and critical areas for improvement. Experts noted that localized political confusion and “mixed messages” from municipal authorities regarding the necessity of evacuation orders delayed the initial response by up to four days. This failure in public communication shifted the eventual operation from a controlled, pre-event relocation (where ground assets could have been utilized) to a highly dangerous, post-event emergency extraction relying entirely on premium aviation assets. Furthermore, the lack of sufficient state-owned, shallow-draft rescue boats in the municipal inventory early in the crisis placed an unsustainable, immediate burden on the limited national aviation fleet, forcing helicopters to perform tasks that should have been managed by marine units⁴⁶⁻⁴⁸.

Limitations

This review acknowledges several limitations. First, as a narrative analysis conducted by a single author, there is a risk of subjective interpretation; however, this was mitigated by adhering to a predefined search framework. Second, reliance on secondary official reports—while essential for capturing the specific context of the November 2025 Hat Yai flood—may lack granular clinical data regarding individual patient outcomes. Second, the clear chronological and operational description of the actual evacuation response involves sensitive and classified data.

The author was not a part of the emergency operating center headquarters; those issues were omitted. Lastly, the case-specific nature of this study means that the operational insights, while robust, may require adaptation when applied to different geographical or institutional disaster response landscapes. These constraints underscore the need for further multi-center, quantitative studies on aeromedical integration within hospital disaster management frameworks.

Further studies should investigate the clinical outcomes of the patients evacuated by aeromedical transport in this situation, as well as analyse the process and any obstacles during the operation.

Conclusion

Medical air transport has proven itself to be the ultimate force multiplier in the complex theater of modern disaster medicine. It transcends the physical destruction of the terrestrial environment, providing an exclusive, vertical lifeline that moves highly trained critical care expertise into the hot zone and rapidly transports highly vulnerable casualties out. The harrowing events of the November 2025 Hat Yai mega flood—characterized by record-shattering rainfall, burning hospitals, and fully submerged urban centers—prove unequivocally that when ground infrastructure fails, survival depends entirely on access to the sky.

However, aeromedical operations are not an infallible panacea: they are strictly bound by the unyielding laws of flight physiology, extreme financial procurement costs, and the limits of meteorological visibility. To truly harness this life-saving capability, governments must invest heavily in proactive policy. In an increasingly volatile global climate, where extreme weather events are becoming the baseline standard, developing and maintaining a robust, scalable aeromedical infrastructure is no longer a luxury of affluent health systems—it is an absolute, non-negotiable necessity for civilizational resilience.

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