Review Article

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Pharmacological Preparedness for Flood Disasters: Lessons from the 2025 Hat Yai Floods

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Abstract:

Flood disasters threaten population health, continuity of care, and health-system resilience, particularly in climate-vulnerable settings. This narrative review examines pharmacological preparedness for flood emergencies, drawing lessons from the 2025 Hat Yai floods following Cyclone Senyar. Relevant literature, disaster-management guidance, and reports addressing flood-related health impacts, pharmaceutical services, and emergency medicine supply management were synthesized. A two-phase pharmacological preparedness framework was developed. The early phase (days 1–10) prioritizes medicines and supplies for acute injuries, gastrointestinal illness, wound and skin infections, leptospirosis prophylaxis, vaccination, and fluid replacement; selected items require substantial surge capacity. The late phase (>10 days) emphasizes continuity of treatment for noncommunicable diseases, mental health conditions, and prolonged infectious-disease therapy. Although the World Health Organization Interagency Emergency Health Kits and Thai Ministry of Public Health guidance provide essential baseline medicine lists, these frameworks should be adapted to local flood hazards, epidemiological patterns, health-service accessibility, population characteristics, and the anticipated severity and duration of disruption. In Southern Thailand, preparedness should include pre-monsoon stockpiling, decentralized emergency medicine depots, demand forecasting for early-phase surge medicines, medication-refill plans for patients with chronic diseases, and cold-chain capacity for temperature-sensitive products. Pharmacists have central roles in estimating medicine needs, procurement, distribution, storage, therapeutic substitution, medication reconciliation, patient screening, and safe dispensing. Context-specific, pharmacist-led pharmacological preparedness can strengthen continuity of care and healthcare-system resilience throughout all phases of flood response.

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Introduction

Flooding is a major climate-related hazard driven by extreme rainfall, tropical cyclones, river overflow, coastal inundation, inadequate drainage, and land-use change. Climate change is intensifying the hydrological cycle through increased atmospheric moisture, altered precipitation patterns, sea-level rise, and warmer oceans, thereby increasing the risk of extreme rainfall and coastal flooding[1,2].

In 2025, recurrent heavy rainfall, flooding, and tropical cyclones affected large parts of Asia. Monsoon-related floods in Pakistan, India, Nepal, and Bangladesh caused more than 1,000 deaths and damaged or destroyed over 229,000 homes, while typhoon-related flooding in Viet Nam between September and November resulted in at least 203 deaths. In November, Tropical Cyclone Senyar contributed to severe flooding in Thailand, Malaysia, and Indonesia. Hat Yai District, Songkhla Province, received 1,282 mm of rainfall from 19–26 November, including 370.2 mm on 21 November, while Thailand's highest daily total reached 624.2 mm on 22 November; 276 deaths were reported in Thailand[2-4]. Flooding can cause drowning, injuries, displacement, infectious diseases, mental health problems, and interruptions to healthcare, essential medicines, and chronic disease treatment. Damaged facilities, equipment, and supply chains, together with increased patient demand, can further overwhelm healthcare systems[5].

Effective flood response requires pharmacological preparedness, defined as the capacity to anticipate medication needs and ensure the safe, equitable, and continuous provision of medicines before, during, and after disasters. This preparedness should be integrated into hospital disaster plans and informed by essential medicines lists, as well as relevant World Health Organization (WHO) and Ministry of Public Health guidelines. Accordingly, this narrative review examines the role of essential medicines in early emergency response and continuity of care. By linking these frameworks to lessons from the 2025 Hat Yai floods, the review highlights practical strategies for strengthening medication preparedness and healthcare system resilience.

Health implications associated with flooding

The health impacts of flooding are temporally dependent. During the acute phase (within 10 days of exposure), the risk of dermatological conditions increases significantly due to the immersion of lower extremities in floodwaters. These skin disorders are categorized into three primary groups: inflammatory diseases (e.g., atopic or contact dermatitis), infectious diseases (e.g., superficial fungal infections and cellulitis), and traumatic injuries (e.g., abrasions or lacerations)[6-8]. Concomitant physical health issues, such as musculoskeletal injuries and myalgia, are also frequently observed, often attributed to the strenuous activities involved in navigating floodwaters for survival and the salvage of personal possessions. As the flood persists, the risk of infectious disease transmission escalates; overcrowded shelters facilitate the spread of waterborne pathogens and upper respiratory viruses, including pneumonia, while inadequate sanitation and compromised access to safe drinking water contribute to higher incidences of diarrhea and gastroenteritis[5,9,10]. Notably, a peak in conjunctivitis cases is often observed approximately 10 days post-exposure[11,12].

Beyond the initial 10-day period, infectious diseases emerge as the predominant health concern. Notable examples include outbreaks of leptospirosis, particularly following heavy precipitation[13-16], and an increased risk of vector-borne transmissions, such as dengue fever,

chikungunya, and malaria[17,18]. Furthermore, floodwaters dispersing contaminated soil and mud significantly drive melioidosis incidence[19]. As the flood impact persists, long-term health challenges arise, including the management of noncommunicable diseases (NCDs) and an escalating mental health burden[12,20,21]. Crucially, the necessity for rapid evacuation during such extreme events often results in inadequate preparedness regarding personal medication management. The subsequent loss or interruption of essential medication regimens can precipitate acute medical emergencies, including hypertensive urgency, psychotic disorders, or severe hyperglycemia[22].

Pharmacological preparedness during disasters: a two-phase approach

Pharmaceutical response measures vary across disaster stages, primarily depending on disease patterns and flooding-related impacts. The response can be divided into 2 phases: the early phase (1-10 days) and the late phase (after 10 days)[5,23].

Phase 1: Medication for the early phase. This phase requires significant stockpiling and immediate ordering to address urgent health issues and prevent early outbreaks related to the disaster. Medications help manage the disease in its initial stages, with demand or usage potentially 100-500% higher than usual[23].

Medication prophylaxis for leptospirosis outbreak: Doxycycline was the primary medication to prevent leptospirosis after a flood. A non-randomized trial demonstrated that a single 200 mg dose of doxycycline provides high protective efficacy, specifically 92.0% against leptospiral infection and 95.6% against leptospirosis among participants with lacerations. Notably, prolonged exposure to floodwaters—exceeding three hours per day—was significantly associated with an increased risk of infection[24]. However, the clinical application of doxycycline requires careful consideration of its safety profile; common adverse effects include gastrointestinal irritation and photosensitivity. Drug-drug and drug-food interactions with multivalent cations. Furthermore, it is contraindicated in pregnant women and children under eight years of age due to the risk of permanent tooth discoloration and bone growth inhibition.

As the severity of flooding intensifies, the demand for antimicrobial prophylaxis escalates accordingly. This necessitates the strategic stockpiling of medications for targeted distribution to high-risk populations, specifically those presenting with open wounds or undergoing prolonged water exposure. Furthermore, systematic screening of these high-risk individuals is essential for optimized medication management. Nevertheless, the most effective primary prevention strategy remains the avoidance of direct contact with contaminated water and soil through the use of personal protective equipment (PPE), such as waterproof gloves and boots[25].

Antipyretics and analgesics: primarily paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs) are frequently utilized for the management of fever and mild-to-moderate pain in outpatient settings, including during disaster response[26]. Nevertheless, paracetamol should be recommended as the first-line agent, especially for elderly patients and those with NCDs. The use of NSAIDs (e.g., ibuprofen) must be approached with caution in flood-affected populations, as dehydration and hemodynamic instability significantly increase the risk of adverse effects, such as acute kidney injury and gastrointestinal bleeding. Consequently, careful patient assessment is essential before prescribing NSAIDs to mitigate these clinical risks.

Gastrointestinal disorders: Oral Rehydration Salts (ORS) are the primary intervention for managing dehydration and electrolyte imbalances resulting from diarrhea, vomiting, or reduced oral intake. This need is particularly acute during severe flooding, when access to potable water and adequate nutrition is often compromised. To manage

nausea and vomiting—frequently caused by foodborne illnesses—antiemetic agents, including domperidone, metoclopramide, and ondansetron, are commonly employed. Additionally, symptomatic relief is provided through the use of antispasmodics and antacids[27].

Antibiotic and antifungal: Epidemiological data from a previous study in Thailand regarding skin and soft-tissue infections (SSTIs) post-flooding indicate that infectious agents comprise 50% of skin pathologies, characterized by a predominance of superficial fungal infections (38%) and bacterial infections (15%), the latter of which are largely driven by Gram-negative bacilli (GNB)[8]. This pattern aligns with observations following a tsunami disaster, where key GNB pathogens included *Aeromonas* spp., *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Proteus* spp. Notably, seawater-derived flooding may introduce *Vibrio* species, thereby shifting the infectious landscape from the baseline state. Gram-positive bacteria typically prevail as the primary causative organisms[28].

- Topical antifungal agents, including clotrimazole and ketoconazole creams, are in high demand among people affected by floods. However, Whitfield ointment (3% salicylic acid and 6% benzoic acid) was an alternative treatment[29,30].
- Oral antibiotic: Amoxicillin/clavulanic acid is commonly used for treating skin and soft-tissue infections (SSTIs) resulting from contaminated water exposure, as it covers *Escherichia coli, Klebsiella pneumoniae, and Proteus spp*. However, fluoroquinolones like ciprofloxacin and levofloxacin are more suitable for empirical therapy due to their ability to cover more prevalent pathogens in such settings, namely *Aeromonas spp.*, *Pseudomonas aeruginosa, and Vibrio species*. Additionally, both amoxicillin/clavulanic acid and levofloxacin are effective agents for the treatment of respiratory tract infections. In contrast, antibiotics used to treat Gram-positive bacteria, such as dicloxacillin, cephalexin, and cefazolin for *Staphylococcus aureus and Streptococcus spp.*, are expected to be less common in flood-related scenarios[28,31]. Additionally, Trimethoprim/Sulfamethoxazole (TMP/SMZ) is a first-line agent used during the 3-6 months eradication phase of melioidosis treatment. This extended regimen may sustain drug demand throughout the late post-flood phase.
- Intravenous antibiotic: Ceftriaxone usage may increase during empirical treatment of community-acquired infections; conversely, melioidosis outbreaks following floods are expected to drive sustained ceftazidime consumption, extending into the late recovery phase[19]. Additionally, carbapenems (e.g., meropenem, imipenem, or ertapenem) should be stockpiled to address potential multidrug-resistant (MDR) infections.
- Antiseptics such as povidone-iodine, chlorhexidine, and normal saline are essential for proper wound care and dressing[32].

Vaccine:

- Tetanus vaccines were important for post-exposure prophylaxis (PEP) during flood emergencies. While environmental concentrations of *Clostridium tetani* spores may not necessarily increase during flood events, the clinical risk of tetanus is significantly elevated. This increased risk is driven by the high incidence of traumatic, contaminated wounds and the widespread exposure of skin abrasions to soil-laden, debris-heavy floodwaters[33,34]. Effective management requires a systematic assessment of the patient's vaccination history and the nature of the wound. Clinicians should assess completion of the primary tetanus vaccination series (≥3 doses) and the interval since the last tetanus-toxoid–containing vaccine dose. For patients who completed the primary series, a booster is indicated if the last dose was ≥10 years ago for clean, minor wounds or ≥5 years ago for dirty or major wounds. For patients with an unknown or incomplete vaccination history, tetanus vaccination is indicated for all wounds; tetanus immune

globulin (TIG) should additionally be administered for dirty or major wounds to provide immediate passive protection[35].

- Rabies vaccine: there have been reports of dog and cat bites among rescue teams assisting animals, including evacuating individuals and moving animals, which can increase the risk of animal bites and rabies transmission[36]. All potential rabies exposures require immediate wound cleansing with soap and running water, followed by risk assessment based on WHO exposure category, animal status, and local rabies epidemiology. For previously unvaccinated individuals, Category II exposures (minor scratches or abrasions without bleeding) require rabies vaccination, whereas Category III exposures (transdermal bites or scratches, saliva on broken skin, or mucosal exposure) require both rabies vaccine and rabies immunoglobulin (RIG), infiltrated into and around the wound where feasible. Previously vaccinated individuals require wound care and an abbreviated vaccine regimen but should not receive RIG.
- Influenza vaccine: While influenza is not a waterborne pathogen, the socio-environmental disruptions inherent in flood-disaster settings significantly alter the epidemiology of respiratory viruses. The risk of influenza transmission is elevated when displaced populations are concentrated in crowded, poorly ventilated evacuation centers, which facilitates rapid droplet-borne spread. Clinical management should include robust surveillance for influenza-like illness to enable early detection of clusters. To mitigate the threat of secondary respiratory outbreaks, vaccination should be prioritized for high-risk populations, specifically the elderly, young children, and individuals with underlying chronic comorbidities[37,38].

Miscellaneous: Intravenous fluids are crucial for maintaining adequate hydration, including normal saline, Ringer's lactate, and 5% dextrose solution. Additionally, using normal saline for wound irrigation can increase demand for appropriate wound dressings. Moreover, the prevalence of conjunctivitis, including both bacterial and allergic forms, often rises following flooding events[11].

Phase 2: medication in the late phase (10 days)

As recovery efforts progress and the situation stabilizes, the final phase centers on managing noncommunicable diseases. Effective long-term medication management does not require overstocking; rather, it demands prompt assessment of the situation and swift ordering to ensure adequate supplies are maintained[23].

Medication in chronic disease: Post-disaster mental health problems—including Post-Traumatic Stress Disorder (PTSD), depression, anxiety, and psychological distress—are well documented, with pooled prevalence estimates of approximately 22–26% among flood-affected populations, based on meta-analytic and systematic review data[12,39]. For individuals presenting with clinically significant psychiatric symptoms following disaster exposure, a stepped-care approach is recommended, in which psychosocial support and non-pharmacological interventions are offered as first-line measures, with pharmacotherapy reserved for moderate-to-severe or persistent symptoms unresponsive to initial supportive care. When pharmacotherapy is indicated, selective serotonin reuptake inhibitors (SSRIs), such as fluoxetine, sertraline, and escitalopram, are the preferred first-line agents for depression, anxiety, and PTSD given their favorable safety profile. Benzodiazepines (e.g., lorazepam, diazepam, alprazolam) should be limited to short-term use at the lowest effective dose under close supervision, given the risks of dependence and misuse, particularly where follow-up capacity is constrained[39]. For patients with pre-existing psychotic disorders such as schizophrenia, antipsychotics (haloperidol, fluphenazine, risperidone) remain effective, with continuity of prior regimens prioritized where feasible[40].

Pooled prevalence estimates from meta-analyses of disaster-exposed populations report diabetes and

hypertension at approximately 13.5% and 47.3%, respectively[21]. While the magnitude of disruption to chronic disease management varies with local demographics, healthcare infrastructure, and disaster severity, these estimates provide a reasonable basis for anticipating increased demand for antihypertensive and antidiabetic medications during flood emergencies. Medication loss during evacuation is a key driver of this demand, with disaster-affected populations reportedly requiring refills at rates 10–20% above baseline.

For practical preparedness, chronic medications can be stratified by clinical urgency. Life-saving or immediately critical medications—whose interruption risks rapid deterioration—include insulin and antidiabetic agents (diabetic ketoacidosis), antihypertensives (hypertensive crisis, stroke), anticoagulants (thromboembolism or bleeding), antiretroviral therapy (viral rebound, resistance), and anti-tuberculosis therapy (treatment failure, resistance). Important but lower-priority medications, whose short-term interruption poses less immediate risk, include antiplatelet agents, lipid-lowering agents, thyroid hormone, cholinesterase inhibitors, oral chemotherapy, and hepatitis B antiviral therapy.

This stratification enables disaster response teams to prioritize limited pharmaceutical resources toward medications carrying the highest risk of acute harm upon discontinuation, while maintaining continuity plans for lower-priority therapies as resources permit.

The recommended medication lists should serve as a context-specific framework, not a universal formulary. Medication priorities should reflect the type of flood and its associated hazards. Local disease patterns, climate, healthcare capacity, and national treatment guidelines should also guide preparedness planning. Therefore, Table 1 categorizes medicines by therapeutic class rather than specific products, allowing health services to select suitable alternatives according to local availability, institutional protocols, and national guidelines while maintaining appropriate clinical care.

Table 1 Overview of medication list preparedness for flood disasters

Early phase (<10 days)	Late phase (>10 days)
Leptospirosis prophylaxis: doxycycline	**Antidepressants/SSRIs:** fluoxetine, sertraline, escitalopram
Antibiotic: ciprofloxacin, levofloxacin, amoxicillin/clavulanic, trimethoprim–sulfamethoxazole, cephalexin, clindamycin, cefazolin, ceftriaxone and ceftazidime	**Anxiolytic medicines:** lorazepam, diazepam, alprazolam
Antipyretic and analgesic: paracetamol, ibuprofen, and other NSAIDs	**Antipsychotic:** haloperidol, fluphenazine, and risperidone
Oral rehydration and gastrointestinal medicines: ORS, domperidone, metoclopramide, hyoscine	**Hypertensive agents:** amlodipine, enalapril, losartan, carvedilol
Topical antifungal: clotrimazole cream, ketoconazole cream, Whitfield's ointment	**Glucose-lowering agents:** insulin, metformin, glipizide
Antiseptics and wound-care products: povidone-iodine, Chlorhexidine, Sodium chloride 0.9% for wound irrigation	**Anticoagulants:** warfarin, apixaban, rivaroxaban
Vaccines and post-exposure prophylaxis: tetanus vaccine, tetanus immune globulin, Rabies vaccine, Rabies immunoglobulin, Influenza vaccine	**Antiplatelet medicines**: aspirin, clopidogrel
Ophthalmic treatment for conjunctivitis: antibiotic eye drops, antihistamine eye drops	
Intravenous fluids: sodium chloride 0.9%, Ringer's lactate, 5% dextrose solution	

*The medications listed serve as representative examples within each therapeutic class only. Alternative agents within the same class may be substituted depending on local drug availability, institutional protocols, clinical practice, or country-specific treatment guidelines.
ORS=oral rehydration salts, SSRIs=selective serotonin reuptake inhibitors

Antimicrobial stewardship considerations:

During floods, antimicrobial stewardship is necessary to ensure timely treatment of suspected bacterial infections while minimizing unnecessary antibiotic use and antimicrobial resistance. Empiric antibiotic selection should reflect the clinical syndrome, anticipated flood-associated pathogens, local epidemiology, and susceptibility data. Where feasible, microbiological specimens should be collected before treatment, without delaying urgent care[41]. Prophylactic antibiotics should be limited to defined, guideline-supported high-risk groups, rather than routinely given to all flood-exposed persons. Doxycycline prophylaxis for leptospirosis, for example, may be considered after substantial exposure to potentially contaminated floodwater or soil[24]. For water-exposed wounds, prompt irrigation, debridement when required, regular assessment, and appropriate dressings are first-line measures; antibiotics are reserved for clinical infection, deep wounds, or systemic illness[32]. Most upper respiratory tract infections and acute diarrhea are viral or self-limiting and should not routinely receive antibiotics. When indicated, the narrowest effective agent should be prescribed at the appropriate dose and for the shortest effective duration, with review and de-escalation as clinical or microbiological information becomes available[41-43].

Medication list management guidelines for public health emergency preparedness

WHO essential medication lists: Pharmacological preparedness in disaster response is commonly standardized through the WHO Interagency Emergency Health Kits (IEHKs). Designed to facilitate self-sufficiency during the acute phase of an emergency, the IEHK provides a tiered system of care consisting of a 14-item basic module for primary healthcare and a supplementary module for advanced clinical interventions, alongside a malaria unit and various pharmacological supplements categorized by therapeutic class (Table 2)[44]. However, as these kits are engineered for generalized emergency use, they may lack the clinical and logistical granularity required to address the unique epidemiological demands specific to flood-related disasters.

Thai Ministry of Public Health guidelines: The Department of Disease Control (DDC), Ministry of Public Health (MOPH), governs pharmacological preparedness for public health emergencies. These guidelines encompass a wide range of natural disasters, including floods, earthquakes, landslides, tsunamis, and storms. The prescribed medical supplies are categorized into two primary tiers: (i) relief medications, which consist of ten essential items, and (ii) hospital-support medicines designed for healthcare service units. The latter includes twelve categories of essential therapeutics, as well as critical supplies such as orphan drugs, life-saving medications, and vaccines, as shown in Table 3[45].

Discussion

Pharmacological preparedness is a dynamic capability rather than a static requirement. Although a two-phase framework provides a useful temporal structure, effective field operations depend substantially on regional context. The 2025 Hat Yai floods illustrate this need: extreme rainfall and the area's topography contributed to extensive inundation across urban and agricultural communities, affecting more than 300,000 people. Such flooding disrupts healthcare delivery, medicine supply chains, and population mobility. These consequences underscore the need for disaster preparedness in Thailand to move beyond generic global recommendations and incorporate local hydrological, epidemiological, and sociodemographic characteristics.

The WHO Essential Medicines Lists provide an important broad-based foundation for preparing for a range of disaster scenarios. Similarly, guidelines issued by the Thai Ministry of Public Health (MOPH) have increasingly addressed hazards relevant to the national context,

including floods, storms, and tsunamis. Nevertheless, these frameworks should be adapted rather than applied rigidly. The composition and quantity of pharmaceutical stockpiles should remain flexible and be guided by the likely health risks, population characteristics, geographic conditions, accessibility of health facilities, and anticipated duration and severity of disruption in each area.

Table 2 WHO Interagency Emergency Health Kits (IEHKs)

Basic module	Supplementary module
Albendazole	**Anesthetics:** ketamine, lidocaine
Amoxicillin	**Analgesic:** morphine
Benzyl benzoate	**Antiallergics:** hydrocortisone, prednisolone
Chlorhexidine digluconate, solution 5%	**Anticonvulsants/antiepileptics:** diazepam, midazolam, carbamazepine, magnesium sulfate
Ferrous sulfate+folic acid	**Antidotes:** calcium gluconate, naloxone
Ibuprofen	**Anti-infective medicines:** cefalexin, ceftriaxone, penicillin G, clotrimazole, doxycycline, metronidazole, nystatin
Miconazole	**Cardiovascular medicines:** ASA 81 mg, amlodipine, bisoprolol, enalapril, glyceryl trinitrate (SL), hydralazine, methyldopa
Omeprazole	**Dermatological medicines:** silver sulfadiazine
ORS (oral rehydration salts) powder for dilution	**Disinfectants and antiseptics:** sodium dichloroisocyanurate
Paracetamol	**Diuretics:** furosemide, hydrochlorothiazide
Povidone-iodine, solution 10%	**Gastrointestinal medicines:** atropine
Tetracycline, eye ointment 1%	**Endocrine medicines:** intermediate-acting insulin, Soluble insulin
Zinc sulfate	**Medicines affecting the blood:** heparin sodium, folic acid
Malaria: artemether+lumefantrine	**Mental health medicines:** diazepam, biperiden, fluoxetine, haloperidol, carbamazepine
	Respiratory tract: salbutamol inhaler, adrenaline, beclomethasone inhaler
	Water, electrolytes, and acid-base disturbances: ringer's lactate, glucose 5%, glucose 50% and water for injection
	Vitamins: ascorbic acid, vitamin A
	Oxytocics: misoprostol, oxytocin
	Malaria: artesunate

Table 3 Pharmacological preparedness for public health emergencies in Thailand

Relief medications	Hospital-support medicines
Medicated balm Condoms Paracetamol Chlorpheniramine Oral rehydration salts (ORS) Alum milk Povidone-iodine Triamcinolone acetonide (TA) cream Surgical masks Disposable latex	**Essential medicine:** oseltamivir, chloramphenicol eye drops, doxycycline, clotrimazole cream, ORS, dicloxacillin, norfloxacin, ceftriaxone, chlorpheniramine, dexamethasone, and topical analgesics **Life-saving medications**: adrenaline, lidocaine, magnesium sulfate, dopamine, dexamethasone, amiodarone, diazepam, atropine, calcium gluconate, digoxin, 50% glucose for injection, sodium bicarbonate 8.4% w/v **Vaccine:** flu, rabies, dT, oral cholera vaccine, serum hematotoxin, serum neurotoxin, MMR **Orphan drugs:** tetanus antitoxin 1,500 IU, ERIG immunoglobulin, HRIG immunoglobulin, botulinum antitoxin, diphtheria antitoxin 10,000 IU

Given the recurrent flooding in Southern Thailand, proactive stockpiling of essential medicines before the monsoon season is essential. To reduce the risk of supply interruption when transport routes become inaccessible, health systems should establish decentralized emergency medicine depots at strategically selected locations in the Songkhla area. Establishing several regional depots, informed by local risk and accessibility assessments, would help ensure that subdistricts retain access to essential supplies when major transportation routes are disrupted. In situations of severe infrastructure damage, emergency supplies may be mobilized through interprovincial resource sharing and, where appropriate, quality-assured humanitarian donations. Medicines delivered from external areas may require air transport, followed by distribution to affected communities using high-clearance vehicles or watercraft.

In addition to identifying essential medicines, preparedness planning requires an assessment of event severity to forecast the volume and timing of pharmaceutical demand. During the acute phase of a flood, demand for selected medicines may increase sharply. For example, the need for doxycycline for leptospirosis prophylaxis among high-risk populations may increase more than tenfold during the first 10 days of an event. Increased demand may also occur for topical antifungal agents and oral rehydration salts (ORS). By contrast, medicines for noncommunicable diseases (NCDs) may require sustained replenishment during the later phase of response, when displaced individuals and patients with interrupted treatment require continuing access to long-term therapies. Early forecasting and timely procurement are therefore necessary to prevent avoidable interruptions in treatment.

Several strategic challenges should be addressed in Thailand. First, medication-refill systems should be strengthened during the monsoon season. Dispensing a one- to two-month supply of essential long-term medicines to clinically appropriate patients before periods of elevated flood risk may reduce treatment interruption and minimize losses when medicines are damaged or swept away by floodwaters. This strategy should be accompanied by patient counseling on safe storage, particularly for medicines that are vulnerable to heat, humidity, or water exposure. Second, maintaining the cold chain for temperature-sensitive products, including vaccines and insulin, remains a major logistical challenge. Strengthening cold-chain capacity during proactive outreach activities at evacuation shelters or temporary displacement centers would support continuity of care, enable the safe provision of essential services in the field, and reduce the burden on hospitals.

Pharmacists are essential members of disaster-response teams and contribute to medication management throughout the continuum of care, from procurement and inventory management to direct patient care. Their responsibilities include estimating medication requirements, coordinating procurement and distribution, and maintaining appropriate storage conditions to protect medicines from heat, humidity, and contamination. When pharmaceutical resources are limited, pharmacists can recommend therapeutically appropriate alternatives and adapt dispensing practices to preserve access to essential treatment. Such adaptations may include preparing unit-dose or appropriately repackaged medicines, providing suitable measuring devices, such as dosing spoons or oral syringes, and giving clear instructions to promote medication safety and adherence. In addition, pharmacists provide important clinical support by screening high-risk patients, conducting medication reconciliation, and assisting in the identification of unlabeled or unknown medicines. These activities support accurate clinical decision-making and reduce the risk of medication-related harm. Through interprofessional collaboration and the provision

of evidence-based recommendations, pharmacists play a central role in ensuring the safe, effective, and continuous use of medicines throughout all phases of flood-disaster response.

Several limitations should be noted. As a narrative review, this study may be subject to selection bias compared to a systematic review. The findings rely on synthesized literature and secondary reports rather than original primary data from the 2025 Hat Yai floods, potentially limiting real-time clinical granularity. Furthermore, the results are highly context-specific to Southern Thailand, which may limit generalizability to other regions or disaster types, and are ultimately subject to the inherent limitations and quality of the source materials used.

Conclusion

Pharmacological preparedness for flood disasters should be flexible, context-specific, and integrated into emergency health planning. Lessons from the 2025 Hat Yai floods support a two-phase approach: the early phase should prioritize medicines and supplies for acute conditions, whereas the later phase should ensure continuity of treatment for chronic diseases and prolonged infectious conditions. In Southern Thailand, preparedness should include pre-monsoon stockpiling, decentralized medicine depots, demand forecasting, chronic-medication refill plans, and cold-chain capacity. Antibiotic use should follow stewardship principles. Pharmacists are central to medicine forecasting, procurement, storage, distribution, reconciliation, and safe dispensing. Future research should assess medicine demand, supply chains, and pharmacist-led interventions during floods.

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