

Hospital Evacuation:

*A Five-Phase Framework for
Detection, Response, and Recovery*

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EXECUTIVE SUMMARY

Hospitals occupy a paradoxical position in disaster response: they are simultaneously expected to absorb a surge of casualties from the community and, in a growing number of cases, to evacuate their own patients when a hurricane, flood, fire, earthquake, power failure, or technological hazard threatens the facility itself. Because hospitalized patients are frequently unable to self-evacuate and depend on continuous clinical support, life-support equipment, and specialized staff, hospital evacuation is widely regarded as one of the most operationally demanding and highest-risk undertakings in emergency management.

This white paper synthesizes the academic and practice literature on hospital evacuation into a five-phase framework: (1) incident detection, (2) evacuation decision, (3) preparation for evacuation, (4) movement through the evacuation network, and (5) return to the hospital. The paper examines the operational content of each phase, the models and tools that have been developed to support decision-makers, and the lessons emerging from well-documented case studies, including Memorial Medical Center during Hurricane Katrina (2005), NYU Langone Medical Center during Hurricane Sandy (2012), and Memorial Health University Medical Center's routine hurricane evacuation planning in coastal Georgia. It closes with lessons from the case studies and a set of recommendations for hospital administrators, emergency managers, and policymakers.

Three themes recur throughout the analysis. First, evacuation decisions are made under deep uncertainty, and the cost of both false positives (unnecessary evacuation) and false negatives (delayed evacuation) can be severe. Second, the transportation network connecting a hospital to receiving facilities is frequently a binding constraint on evacuation speed and safety, not the willingness of staff to act. Third, return and recovery are not simply the reverse of evacuation; they involve distinct technical, regulatory, and psychological demands that are often under-resourced in planning documents.

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1. INTRODUCTION

Healthcare facilities are disproportionately exposed to disaster risk. Many hospitals were built decades ago in locations now recognized as flood-prone, seismically active, or otherwise hazardous, and a substantial share of these facilities were not designed to modern resilient building standards (Field et al., 2012). At the same time, the frequency and intensity of many natural disasters (e.g., hurricanes, wildfires, storm surges, and heavy rains) are projected to increase, while technological and human-made hazards such as power failures, chemical releases, cyberattacks on hospital systems, and structural fires remain persistent threats (AghaKouchak, et al., 2020). Recent natural disasters or human-made hazards requiring hospital evacuations include wildfires in the Spokane, WA area forced the evacuation of a VA hospital in 2026 (Gooch & Kuchno, 2026), hurricane Milton in 2024 caused the largest healthcare evacuation in Florida's history with more than 400 healthcare facilities evacuated (Southwick, 2024), and in 2023, a transformer fire led the evacuation and a 17-month closure of a hospital in Massachusetts (Margain, 2024).

Unlike most building occupants, hospital patients cannot generally self-evacuate. Many are attached to monitors, ventilators, or other life-sustaining equipment; some are recovering from surgery or under sedation; neonates and intensive-care patients may require continuous life support during transport itself. Evacuating a hospital therefore differs qualitatively from evacuating an office building or a residential neighborhood: it is a clinical operation as much as a logistical one, and it must be executed by professionals who are simultaneously responsible for ongoing patient care.

The following two well-documented events illustrate the scale of the problem. During Hurricane Katrina in 2005, Memorial Medical Center in New Orleans was left without power, running water, or effective external rescue for several days after floodwaters isolated the facility; by the time the last patients and staff were evacuated, 45 bodies were recovered from the hospital, and the events triggered a state investigation into whether some patient deaths resulted from decisions made during the evacuation (Fink, 2013). Seven years later, Hurricane Sandy forced NYU Langone Medical Center to evacuate more than 200 patients, including 21 neonates from its neonatal intensive care unit, after floodwater disabled the hospital's primary and backup power systems (Espiritu et al., 2014). The evacuation was completed over several hours using stairwells because elevators were unusable.

This paper adopts a five-phase framework — incident detection, evacuation decision, preparation for evacuation, movement through the evacuation network, and return to the hospital — to organize the discussion (Yazdani et al, 2021). Table 1 summarizes the central question, personnel, and key outputs associated with each phase; the sections that follow examine each phase in turn.

Table 1. Overview of the five-phase hospital evacuation framework.

Phase	Central Question	Personnel	Key Outputs
1. Incident Detection	Has an internal or external hazard emerged that threatens the facility?	Facility engineering, security, clinical staff, external warning agencies	Situational awareness; activation of emergency operations plan
2. Evacuation Decision	Should the hospital evacuate, partially evacuate, or shelter in place?	Incident commander, hospital administration, medical staff leadership, external authorities	Formal evacuation order; scope and urgency classification
3. Preparation for Evacuation	How are patients, records, and resources readied for safe transport?	Unit leaders, nursing staff, pharmacy, biomedical engineering	Triage lists; packaged records/medications; staged patients
4. Movement Through the Evacuation Network	How are patients moved from units to receiving facilities?	Transport teams, EMS, receiving hospitals, logistics coordinators	Patients relocated; tracking of location and status
5. Return to the Hospital	When and how can the facility safely resume operations?	Facilities, administration, regulators, clinical leadership, logistics coordinators	Building clearance; phased re-occupation; restored services

Source: Adapted from Yazdani et al. (2021).

2. PHASE 1 – INCIDENT DETECTION

The first phase in any evacuation is the recognition that a hazard exists and may threaten the facility. Disasters are inherently associated with uncertainty about the precise timing and eventual severity of their consequences. This uncertainty shapes everything that follows: a hospital that detects a slow-onset hazard, such as an approaching hurricane, may have days to prepare, while a hospital confronting a sudden-onset hazard, such as a structural fire or an earthquake, may have only minutes (Yu & Lai, 2011).

2.1 Sources of Detection

Incident detection draws on both external warning systems and internal monitoring. External sources include national meteorological services, seismic networks, public health surveillance systems, and civil authorities who issue watches, warnings, or evacuation orders for a geographic area. Internal sources include building management systems, fire and smoke detection, generator and utility monitoring, security personnel, and the clinical staff who are often the first to notice a deteriorating situation, such as rising water in a basement mechanical room or the failure of backup power.

Considerable investment has gone into improving external warning systems to provide longer lead times before hazard impact, and evacuation planning generally has improved as a result (Samansiri et al., 2022). At the same time, post-event reviews of major disasters have repeatedly identified failures within warning systems themselves, including forecasts that underestimated storm surge or warnings that were issued but not effectively communicated to facility decision-makers (Morrow & Lazo, 2014). These issues highlight that improved detection technology does not eliminate the underlying uncertainty decision-makers must manage.

2.2 Hazard Diversity and the Detection Problem

Hospitals face a wide range of hazard types, and the detection problem differs meaningfully across them. Slow-onset natural hazards such as hurricanes and prolonged flooding are typically preceded by days of forecasting, allowing staged preparation. Sudden-onset hazards such as earthquakes, structural fires, or chemical releases offer little or no lead time and require the incident to be recognized essentially as it unfolds. A third category — technological or infrastructure failures, such as the near-simultaneous failure of primary and backup power at NYU Langone during Hurricane Sandy — may be triggered by an external hazard (the storm) but is functionally detected as an internal systems failure rather than as the storm itself. A fourth category, exemplified by the radiological hazard following the Fukushima Daiichi nuclear accident in 2011, combines an external triggering event with a detection and monitoring problem—exposure levels and evacuation radii—that evolves over subsequent days (Kumasaki & King, 2020).

Because detection modality varies so widely across hazard types, hospitals should develop emergency response plans around an all-hazards approach: rather than maintaining a separate detection and response protocol for every conceivable hazard, plans specify generic triggers (e.g., loss of utilities, structural compromise, external evacuation order) that map onto specific hazard scenarios (World Health Organization, 2022).

2.3 From Detection to Assessment

Detection alone does not establish that evacuation is necessary; it establishes that a formal assessment process should begin. Guidance developed for U.S. hospitals conceptualizes this assessment as involving three possible post-event conditions: (1) no meaningful threat to the safety of patients or staff, allowing normal operations to continue; (2) a threat that can be effectively managed by remaining in place through sheltering in place; and (3) a threat that cannot be adequately mitigated without evacuating the facility (Zane et al., 2010b; U.S. Department of Health and Human Services, n.d.). Moving from detection into this assessment promptly, having pre-defined decision maker roles for the assessment, and documenting the observations that triggered the assessment are necessary to reduce operational bottlenecks (Zane et al., 2010b).

3. PHASE 2 – EVACUATION DECISION

The decision to evacuate a hospital, partially evacuate specific units, or shelter in place is widely regarded as the single most critical and highest-stakes decision in the entire process (McGinty et al., 2016). Evacuating unnecessarily exposes critically ill patients to the risks of transport for no compensating benefit and imposes very high direct and opportunity costs on the institution; failing to evacuate when conditions in fact warrant it can be catastrophic, as the Memorial Medical Center experience during Katrina illustrated (Fink, 2013).

3.1 Who Decides

Depending on the governance structures in place, the evacuation decision-maker may be a single individual (such as a chief executive, incident commander, or medical director) or a formal decision team spanning administration, medical staff leadership, facilities/engineering, and emergency management. Guidance developed collaboratively by U.S. hospital systems and disaster-medicine experts recommends establishing a decision team, and clarifying its authority, well in advance of any specific incident — a recommendation motivated in part by events such as Katrina, where the state's mandatory evacuation order for the city of New Orleans did not explicitly include hospitals, leaving the evacuation decision for healthcare facilities ambiguous at exactly the moment clarity was needed (Zane et al., 2010b).

3.2 Decision Criteria

Formal decision guides typically direct decision-makers to evaluate: structural integrity of the building; status of life-safety systems, including power, water, medical gas, and climate control; anticipated duration of any service disruption; census and acuity mix of current patients; availability of transportation and receiving-facility capacity; and the external environment, including road conditions, weather, and the status of any civil evacuation order. Because these inputs rarely all point in the same direction, decision guides generally present the choice as a structured flowchart rather than a single rule, walking decision-makers from an initial hazard assessment through a small number of discrete decision points toward a recommendation (Zane et al., 2010b; U.S. Department of Health and Human Services, n.d.).

3.3 Timing and the Cost of Delay

Before an evacuation decision is made, the full severity of a threat is often uncertain, requiring decision-makers to rely on probabilistic forecasts. For an approaching hurricane, for example, the likelihood that a storm will strike a particular hospital may still appear relatively modest when an evacuation must begin, given the several days required to relocate large numbers of patients safely. As a result, officials face a persistent risk of initiating a costly "false alarm" evacuation even when acting appropriately on the best available information. Waiting for greater certainty, however, may leave insufficient time to complete a safe and orderly evacuation. This fundamental tradeoff has been identified as a key factor contributing to evacuation reluctance and has, in several past disasters, led hospitals to shelter in place before later reassessing that decision as conditions worsened (Zane et al., 2010b).

Once an evacuation decision is made, the remaining phases of the process are comparatively linear and primarily executional. Consequently, disaster medicine literature places particular emphasis on the decision phase because errors introduced at this stage cascade through preparation, patient movement, and eventual return (Schultz et al., 2003). In contrast, the subsequent phases focus largely on implementing the chosen course of action.

4. PHASE 3 – PREPARATION FOR EVACUATION

Once an evacuation order is issued, hospitals must rapidly transition from routine clinical operations to preparing every inpatient, along with the records, medications, and equipment required to sustain their care, for transport. This preparation is typically organized at the level of individual clinical units and coordinated by a designated unit leader—often a resource nurse or other clinical lead—whose responsibilities begin with assembling each patient's documentation,

medications, and essential equipment and conclude once the patient has been staged and is ready for transport (Schultz et al., 2003).

4.1 Patient Prioritization and Triage

Because transportation assets and staffing are invariably limited relative to the number of patients requiring movement, preparation necessarily involves an explicit or implicit process of prioritization. Hospital evacuation guidance generally describes two complementary approaches: geographic and resource-based (Schultz et al., 2003; Zane et al., 2010b).

- A geographic approach prioritizes evacuation from the areas at greatest risk or moves entire clinical units in sequence, making it most appropriate for hazards that provide substantial advance warning.
- A resource-based approach instead aligns patient movement with the availability of scarce transportation assets. For example, evacuating intensive care patients as appropriately equipped ambulances become available rather than according to their physical location within the hospital.

In practice, most hospital evacuations combine elements of both approaches, sequencing units while coordinating transport resources to distribute demand on emergency medical services more evenly over time.

4.2 Records, Medications, and Equipment

Every patient evacuated from a hospital must travel with a minimum set of clinical and administrative information — including patient identity, diagnosis, current medications, allergies, code status, and the designated receiving facility — as well as sufficient medications and essential medical equipment to support care during transport and the initial period after arrival. Historically, and in many hospitals still today, this information is carried on paper because electronic health record systems may become unavailable during power outages or other infrastructure failures. After-action reports have repeatedly identified manual patient tracking and documentation as major sources of confusion, both during the evacuation itself and later when families attempt to locate relocated patients (Gray & Hebert, 2007). Consequently, many hospitals now incorporate preassembled "go-kits" or standardized transfer packets into routine preparedness planning, ensuring that critical documentation and supplies are available before an evacuation occurs rather than assembled under emergency conditions (Massachusetts Department of Public Health, 2014).

4.3 Staff Roles and Staged Timelines

Well-developed hospital evacuation plans assign clear staff roles and organize preparation around a staged timeline rather than relying on ad hoc coordination. The U.S. Department of Homeland Security's *Planning Considerations: Evacuation and Shelter-in-Place* (2019) emphasizes the importance of pre-defined roles, phased planning, and early activation of evacuation procedures when hazards permit. For hurricanes, hospital evacuation plans may initiate preparatory activities as early as 120 hours (five days) before the anticipated arrival of tropical-storm-force winds. Such extended timelines reflect the reality that safely evacuating a large hospital requires several days of coordinated preparation. By contrast, hazards that provide little or no warning compress preparation and patient movement into a single phase. During Hurricane Sandy, for example, NYU Langone's evacuation decision followed the near-simultaneous failure of primary and backup power, leaving staff to prepare and evacuate patients simultaneously. In these circumstances, successful evacuation depends heavily on prior training and rehearsed low-technology contingencies, including manually ventilating patients with resuscitation bags and using evacuation sleds to move patients down stairwells when elevators are unavailable (Teperman, 2013; Wu et al., 2024).

4.4 Special Populations

Certain patient populations require preparation protocols beyond those used for the general inpatient population, including neonatal and pediatric intensive care patients, individuals dependent on mechanical ventilation, bariatric patients whose size complicates manual transport, behavioral health patients, and patients requiring isolation for infectious diseases (Schultz et al., 2003). Among these groups, neonatal intensive care patients are widely regarded as among the most challenging to evacuate because of their physiological vulnerability and dependence on specialized equipment. The evacuation of NYU Langone's neonatal intensive care unit during Hurricane Sandy — in which 21 neonates, several requiring battery-powered respiratory support, were prepared and transferred to receiving hospitals across New York City in approximately four and a half hours — is frequently cited in the literature, both as an example of successful neonatal evacuation under extreme conditions and because published evidence on disaster evacuation of neonatal populations remains comparatively limited (Espiritu et al., 2014).

5. PHASE 4 – MOVEMENT THROUGH THE EVACUATION NETWORK

Movement is the phase in which patients physically leave their units and travel, first within the hospital, then through a transportation network, and ultimately to a receiving facility. It is also the phase most constrained by factors outside of the hospital's control, including the availability of transportation (e.g., ambulances and aircraft), road conditions and congestion, weather, and the capacity of receiving hospitals.

5.1 Intra-Facility Movement

Before reaching a transport vehicle, patients must typically be moved horizontally within their clinical units and vertically between floors, often to a designated Assembly Point or Discharge Site located near the hospital's transport access area. The optimal sequence for vertical evacuation remains a subject of debate. A commonly cited approach recommends evacuating the upper floors first when elevators are available and the lower floors first when evacuation must occur primarily by stairwell (Massachusetts Department of Public Health, 2014). This strategy reflects the practical advantages of clearing lower levels more quickly on foot and reducing congestion for patients and staff evacuating from higher floors. Empirical research using observed hospital evacuation drills — including unannounced fire-drill studies in outpatient areas of a New Zealand hospital — has provided some of the limited real-world behavioral data available on pre-evacuation response times and movement speeds (Rahouti et al., 2020). These findings are important for validating the assumptions used in hospital evacuation simulation models.

5.2 Transportation Network Allocation

A limited number of operations-research studies examine how scarce transportation resources — including ambulances, buses, and helicopters — can be allocated among patients and receiving facilities to minimize overall evacuation time or operational costs. Mixed-integer programming models have been used to identify optimal assignments of patients across receiving hospitals based on acuity levels and the available vehicle fleet (Tayfur & Taaffe, 2009a; Bish et al., 2014; Kim et al., 2020). To address the greater complexity of real-world evacuations, researchers have also developed simulation-based approaches that incorporate factors such as staging areas, multiple transportation modalities, and staffing requirements for high-acuity patients (Taaffe et al., 2006; Tayfur & Taaffe, 2009b; Chen et al., 2015). More recent studies have expanded these models to stochastic and dynamic environments, including hospital evacuation frameworks that account for evolving hurricane forecasts and real-time optimization systems to adjust ambulance routing dynamically as conditions change during an evacuation (Rabbani et al., 2018; Rambha et al., 2021).

This literature has also identified a persistent limitation: most articles assume evacuation by ground ambulance or bus, even though many real-world disasters require alternative transportation modes. Large-scale hazards such as major hurricanes may necessitate the use of aircraft; flood events — such as the evacuation of Memorial Medical Center during Hurricane Katrina — may require boats to access the facility before ground or air transportation can begin. Moreover, disaster-related disruptions to transportation networks, including damaged roadways and storm-induced congestion, introduce dynamic changes in travel times that further complicate routing decisions and are an active area of research.

5.3 Receiving-Facility Capacity and Coordination

Movement is only successful when an appropriate receiving facility with sufficient capacity and clinical capability has been identified for each patient before or during transport. Achieving this requires real-time coordination, including physician-to-physician and nurse-to-nurse handoffs, verification of available beds, and often system-wide collaboration across a regional healthcare network rather than coordination between only a single sending and receiving facility (Schultz et al., 2003; Zane et al., 2010b). More than 1,800 hospitals participate in the *National Disaster Medical System Bed Availability Report*, a system where hospitals report their available bed (within 4 hours) and the maximum number of beds, by seven categories, available within 24 to 72 hours (Federal Emergency Management Agency, 2025). During Hurricane Sandy, for example, NYU Langone's approximately 200 evacuated patients were dispersed among multiple receiving hospitals throughout New York City, requiring simultaneous coordination and negotiation with several institutions under significant time constraints (Teperman, 2013).

5.4 Case Illustration: Contrasting Outcomes

The movement phase is the stage in which the consequences of earlier decisions and preparation become most apparent. At Memorial Medical Center during Hurricane Katrina, patient movement was severely constrained by floodwaters that isolated the facility, the absence of a pre-existing evacuation arrangement for a co-located long-term acute care unit housing highly immobile ventilator-dependent patients, and reliance on improvised boat and helicopter transport (Fink, 2013). The resulting evacuation took several days to complete, during which conditions inside the hospital deteriorated substantially. By contrast, NYU Langone's evacuation during Hurricane Sandy demonstrated how prior preparation can enable a more controlled movement phase. The neonatal intensive care unit evacuation—completed in approximately four and a half hours—was supported by a rehearsed evacuation plan, a sufficient supply of nearby ambulances, and low-technology contingencies such as evacuation sleds for stairwell transport when elevators were unavailable (Espiritu et al., 2014). Together, these cases demonstrate that the success of the movement phase depends not only on the transportation logistics executed during the event but

also on the conditions established during earlier phases of hazard detection, decision-making, and preparation.

6. PHASE 5 – RETURN TO THE HOSPITAL

Although return receives comparatively less attention in the planning literature than in the earlier phases, it is neither simple nor quick. Returning a hospital to full operation requires authorization from external authorities, a technical assessment of the building and its systems, a staged reintroduction of patients and staff, and — often overlooked in planning documents — attention to the psychological impacts experienced by staff who lived through the event (Farokhzadian et al., 2024; Gustavsson et al., 2022).

6.1 Authorization and Phased Re-Entry

Re-entry into an evacuated facility is generally subject to approval from local, county, and state authorities, including relevant regulatory or licensing agencies. Hospitals are typically expected to coordinate with police, fire, emergency management, and other partner agencies before resuming operations. Return is rarely an immediate process; instead, it is usually conducted through a phased approach in which administrative and facilities personnel may first re-enter to assess conditions, followed by the gradual restoration of clinical services and staged repopulation of patients (Zane et al., 2010b). Full operational capacity may take days or even weeks to achieve as individual systems, departments, and care areas are inspected, validated, and brought back online. Federal guidance on evacuee return more broadly describes this as "phased re-entry," in which access to an affected site is granted incrementally according to defined access levels tied to safety conditions and recovery priorities (Federal Emergency Management Agency, 2025).

6.2 Facility Assessment

Before any patient returns following a full or partial evacuation of a healthcare facility, the facility must pass an assessment. The Agency for Healthcare Research and Quality developed guidelines for hospital recovery, organizing the assessment into discrete functional domains – administration, facilities, security and fire safety, information technology and communications, biomedical engineering, medical services, ancillary services, materials management, building and grounds maintenance/environmental services, and support services – each assigned a dedicated assessment team (Zane et al., 2010a). The guidelines reflect the reality that a hospital functions as a tightly coupled system: repopulation depends not simply on reopening the building, but on independently verifying the integrity and functionality of critical infrastructure,

including electrical power, water supply, medical gas systems, life-safety systems, and information technology, before clinical services can safely resume.

6.3 Staged Repopulation and Special Considerations

Because returning evacuated patients requires renewed coordination with emergency medical services and because clinical capabilities are typically restored incrementally, hospital repopulation is generally conducted in stages. Patients return as transportation resources and clinical capacity become available, while specialty units — such as obstetrics, surgery, and intensive care — are reactivated sequentially as staffing, equipment, and supporting infrastructure are verified (Hertelendy et al, 2025). NYU Langone's reopening following Hurricane Sandy illustrates this phased approach. Although the medical center reopened approximately two months after the storm, key services such as the emergency department, maternity unit, and pediatrics resumed on a rolling schedule as infrastructure was repaired and validated, following an estimated \$1 billion in storm-related damage (Johnson, 2012).

6.4 Economic and Psychological Dimensions of Return

The return phase also carries substantial direct and indirect costs that are often underestimated in evacuation planning. A case study of hurricane evacuation planning at a mid-sized coastal Georgia hospital estimated that a single evacuation cycle can cost several million dollars even when the storm ultimately does not make landfall. These costs include evacuation logistics, lost inpatient and outpatient revenue during the closure, and the expense associated with transferring patients back to the facility once operations resume; costs increase substantially if the hospital sustains structural damage or an extended closure (Desai et al., 2019). Beyond these financial impacts, research has documented significant and, in some cases, lasting psychological effects among healthcare workers involved in hospital evacuations (Farokhzadian et al., 2024; Gustavsson et al., 2022). Consequently, the literature increasingly emphasizes that recovery planning should incorporate structured mental health support, including psychological first aid, access to behavioral health professionals, and other staff support services, alongside the technical assessment and restoration of the facility itself.

7. LESSONS FROM CASE STUDIES

The two case studies referenced throughout this paper — Memorial Medical Center during Hurricane Katrina and NYU Langone Medical Center during Hurricane Sandy — are useful precisely because they differ so substantially in outcome despite sharing a common hazard type (storm-driven flooding) and a common general challenge (complete loss of facility power). Comparing them across the five-phase framework highlights several lessons.

- Detection and decision ambiguity compounds risk. At Memorial, the state's evacuation order for the city did not explicitly address hospitals, and pre-storm planning had failed to establish clear coordination with the separately administered long-term acute care facility co-located within the hospital. As conditions deteriorated, this lack of coordination left dozens of highly medically fragile, ventilator-dependent patients without an integrated evacuation plan, illustrating how ambiguity during the detection and decision phases can cascade into serious operational consequences during the evacuation itself.
- Rehearsed, low-technology contingencies matter as much as high-technology infrastructure. NYU Langone's ability to complete a large, multi-unit evacuation in a matter of hours depended in part on simple measures — evacuation sleds, manual ventilation — that did not depend on the systems (power, elevators) that failed.
- Transportation-network capacity, not staff willingness, is frequently the binding constraint. Both cases show that the availability of ambulances, aircraft, or boats, and the willingness and capacity of receiving hospitals to accept patients determined the pace of the movement phase far more than any decision made inside the sending hospital.
- Return is a distinct operational phase with its own costs. Even the comparatively successful evacuation of NYU Langone was followed by approximately two months of closure, an estimated \$1 billion in damage, and a phased reopening, highlighting that a well-executed evacuation does not by itself resolve the disruption to the institution or the community it serves.

8. RECOMMENDATIONS

Drawing on the phase-by-phase analysis above, the following recommendations are offered for hospital administrators, emergency managers, and the policymakers and regulators who oversee healthcare facility preparedness.

8.1 Incident Detection

- Maintain integrated monitoring of both external hazard warnings and internal facility systems (power, water, structural sensors), with clearly assigned responsibility for escalating observations into a formal assessment.
- Adopt an all-hazards detection and escalation protocol so that the same assessment pathway can be triggered regardless of the initiating event.

8.2 Evacuation Decision

- Establish a named evacuation decision team, with explicit backup authority, well before any specific incident, and formally coordinate this authority with any co-located but separately administered units (long-term acute care, behavioral health, etc.).
- Use a structured decision guide or flowchart rather than ad hoc judgment, explicitly weighing the multi-day lead time required for large-scale evacuation against the probabilistic nature of most hazard forecasts.

8.3 Preparation

- Pre-position standardized patient transfer packets ("go-kits") containing the minimum data set needed for safe handoff, rather than assembling documentation at the time of the event.
- Define staged, time-anchored preparation checklists (e.g., activities beginning at 120, 72, and 24 hours before anticipated impact for slow-onset hazards) and rehearse compressed-timeline versions of the same checklist for sudden-onset hazards.
- Develop and drill specific protocols for high-vulnerability populations — neonatal and pediatric intensive care, ventilator-dependent, and bariatric patients — rather than relying solely on general evacuation procedures.
- Pre-position evacuation equipment and tools – flashlights, batteries, transport sleds, walkie-talkies, satellite phones, manual ventilators, lifting straps – rather than relying on a central storage for these items.

8.4 Movement

- Establish mutual-aid and receiving-capacity agreements with multiple partner hospitals in advance and maintain real-time bed-tracking arrangements that can be activated during an evacuation.
- Plan for multiple transport modalities (ground ambulance, air, and, where geographically relevant, water) rather than assuming ground transport will always be available.
- Invest in low-technology movement contingencies (stairwell evacuation sleds, manual ventilation training) that remain usable when elevators and powered equipment are unavailable.

8.5 Return

- Adopt a structured, multi-domain facility assessment protocol covering administration, engineering, safety, information systems, biomedical equipment, and clinical services before authorizing any re-entry.
- Plan explicitly for staged service-by-service repopulation rather than a single reopening date, and communicate this staged timeline to staff, patients, and families in advance where possible.
- Budget for the direct and indirect financial costs of evacuation and closure as part of routine disaster preparedness, not solely as a post-event surprise.
- Integrate structured psychological support — psychological first aid training, access to mental health professionals, and structured debriefing — into recovery planning alongside technical facility recovery.

9. CONCLUSION

Hospital evacuation is not a single event but a sequence of distinct operational challenges, each with its own decision-makers, information requirements, and failure modes. Framing the process as five phases — incident detection, evacuation decision, preparation for evacuation, movement through the evacuation network, and return to the hospital — makes it possible to identify where existing plans are strong, where they are underdeveloped, and where the published evidence base itself remains thin. The literature reviewed here shows meaningful progress in decision-support tools, transportation-network optimization, and behavioral data on patient and staff movement, alongside persistent gaps: limited data on evacuation under multi-hazard and non-ground-transport conditions, comparatively underdeveloped guidance for the return phase, and insufficient integration of the psychological dimensions of evacuation into formal planning. As natural disasters, infrastructure failures, and other complex hazards increasingly threaten healthcare facilities, addressing these shortcomings through stronger evidence, more comprehensive planning, regular training and exercises, and sustained investment in recovery capabilities will be essential to ensure that hospitals can continue to protect the patients and communities they serve.

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