CHAPTER 9

# Mass Casualty Evacuation and Patient Movement

Joanne E. McGovern

Patient transportation is a daily operational occurrence everywhere. It is a job done typically by local EMS, sometimes including air medical services. In an emergency, using mutual aid agreements or contingency contracts, local and state entities can muster assets from within the state and throughout their region. This chapter focuses on the planning and execution required in a catastrophic scenario when thousands are immediately at risk and local and state resources are inadequate. Two scenarios are examined: (1) responders are aware that an incident is imminent (a hurricane is used as an example); and (2) responders are not aware that an incident is imminent (the example is an earthquake).

## PLANNING CYCLE

There are three overlapping phases in a planning cycle (Figure 9.1): development of an estimate, using that information to generate a plan, and then executing the plan. These phases in planning for mass patient movement associated with catastrophic-level disasters are discussed below.

### Estimate

An estimate is developed to characterize the threat, geographic information, and demographic information about an area, and to define populations at greatest risk in order to identify requirements, including potential casualty volumes, and assist in developing courses of actions.

Topics covered in an estimate for patient evacuation include the following:

- Nature of threat and effects on patients and their ability to evacuate
  - Area characteristics
  - Weather
  - Terrain
  - Geology
  - Hydrology
- Transportation nodes, demands, and networks: ground, air, sea/waterway
  - Population density and demographics
  - Population at risk
  - Hospitals
  - Nursing homes
  - Special needs (medical)
  - Casualties—numbers and types
- Resources required to move patients
- Resources available to move patients

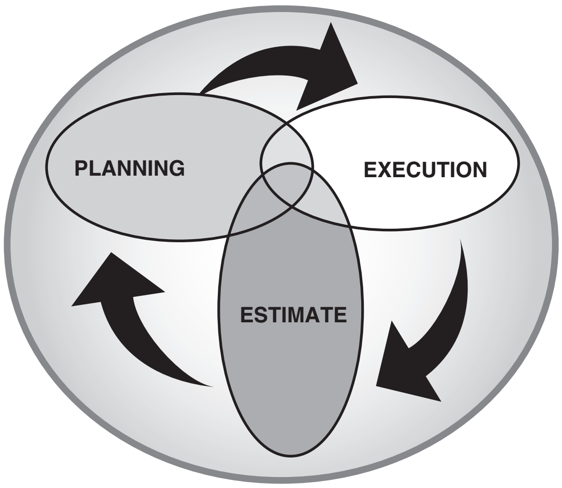


**FIGURE 9.1.** **Estimate, Planning, and Execution Cycle.**

## Threat

The threat can be analyzed by identifying the most likely and most dangerous hazards that may threaten a given community. In the case of states along the Gulf Coast, the most likely threats may be hurricanes; for states along the west coast and/or New Madrid faults, they may be earthquakes. Of all threats, which are most likely to occur and which are most dangerous? How often do these events happen? Are they predictable or do they occur without warning?

### Notice versus No-Notice Events

In a "notice" event, such as a hurricane, there is some warning of the impending incident before it occurs. This provides an opportunity to conduct pre-incident evacuation of vulnerable populations, including those in medical facilities, make preparations to shelter them in place if appropriate, and to pre-stage assets that will be needed during and after the event (e.g., landfall of the hurricane).

Like the decision to order evacuation of a political jurisdiction, the decision whether to evacuate medical institutions and custodial facilities before landfall is difficult and multifactorial. The decision maker(s) must weigh the risk of moving patients out of the stable hospital environment against the threats posed. Evaluation of the threat, in turn, considers the strength and direction of the storm, the survivability and sustainability of the facility, whether the facility is located in a known storm surge or flood zone, availability of supplies, and staffing. Hospitals are required to have plans in place for evacuation of their patients to safety in the event of an imminent threat or disaster.

A "no-notice" catastrophe occurs without warning. Its effects are immediate, causing instantaneous destruction, and usually generating large numbers of casualties. Examples include earthquakes or detonation of high-yield explosives. Although notice and no-notice events share many similarities, the defining difference is pre-incident time to implement specific

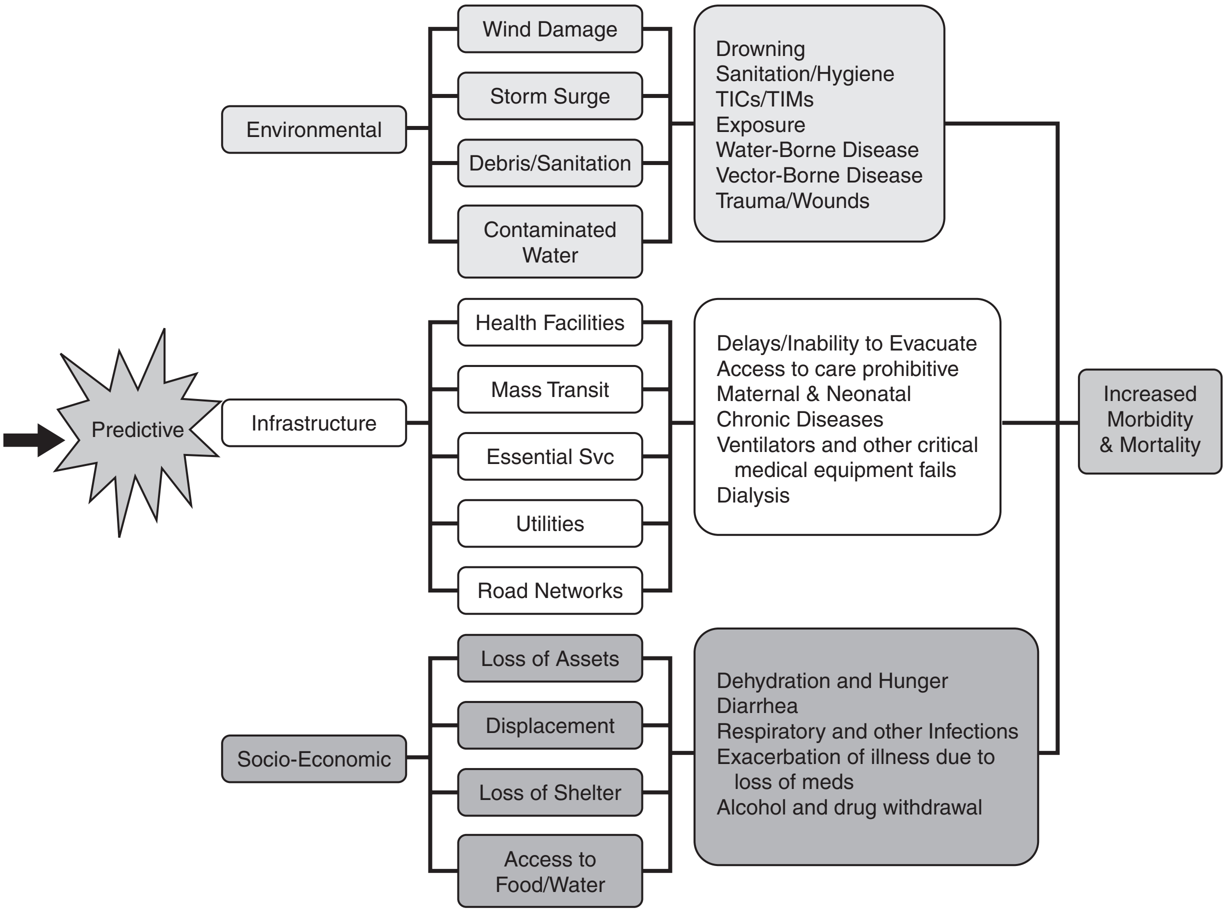


**FIGURE 9.2. Hurricane Threat and Possible Impacts on Health.** *Lieutenant Colonel William Darby, U.S. Army North. Hurricane Threat and Possible Impacts on Health, July 2008. Used with permission.*

mitigation and response strategies. For discussion of patient evacuation, notice events can involve mass patient movement both pre-event, where circumstances may be somewhat more controlled, and post-event. No-notice events may involve evacuation of large numbers of casualties as well as evacuation of medical facilities post-incident.

### 360-Degree Threat Assessment

One technique of evaluating the threat is looking at it from combined environmental, socioeconomic, and structural perspectives,[1] as outlined in Figure 9.2.

For example, a Category 3 hurricane will produce wind damage, storm surge, debris, and water contamination. The types of injuries and effects on the population's health can be predicted. High waters will generate drowning and exposure victims. Flying debris may produce blunt trauma injuries. In general, however, hurricanes do not typically generate the numbers of injuries that other threats might. As the storm impacts local infrastructure, utilities will be lost and transportation networks will be damaged or disrupted. Healthcare facilities that are not primarily damaged or flooded may be placed at risk due to lack of utilities, supplies, and staff who can no longer get to work.

Public health issues are also relevant to patient evacuation. Medically fragile populations living at home may need to be evacuated to facilities that can manage their conditions rather than typical school- or church-based shelters. After landfall, people who have been displaced may not have access to their medications or funds, thus exacerbating illnesses that existed before the storm. The lack of potable water can contribute to cases of dehydration, water-borne illnesses, and diarrhea. All of these circumstances can increase requirements for medical evacuation associated with hurricanes.

In an event such as an earthquake, the environmental factors of course are different. As shown in Figure 9.3,[2] seismically induced ground failure, landslides, liquefaction, and fault ruptures generate different types of casualties than do hurricanes.

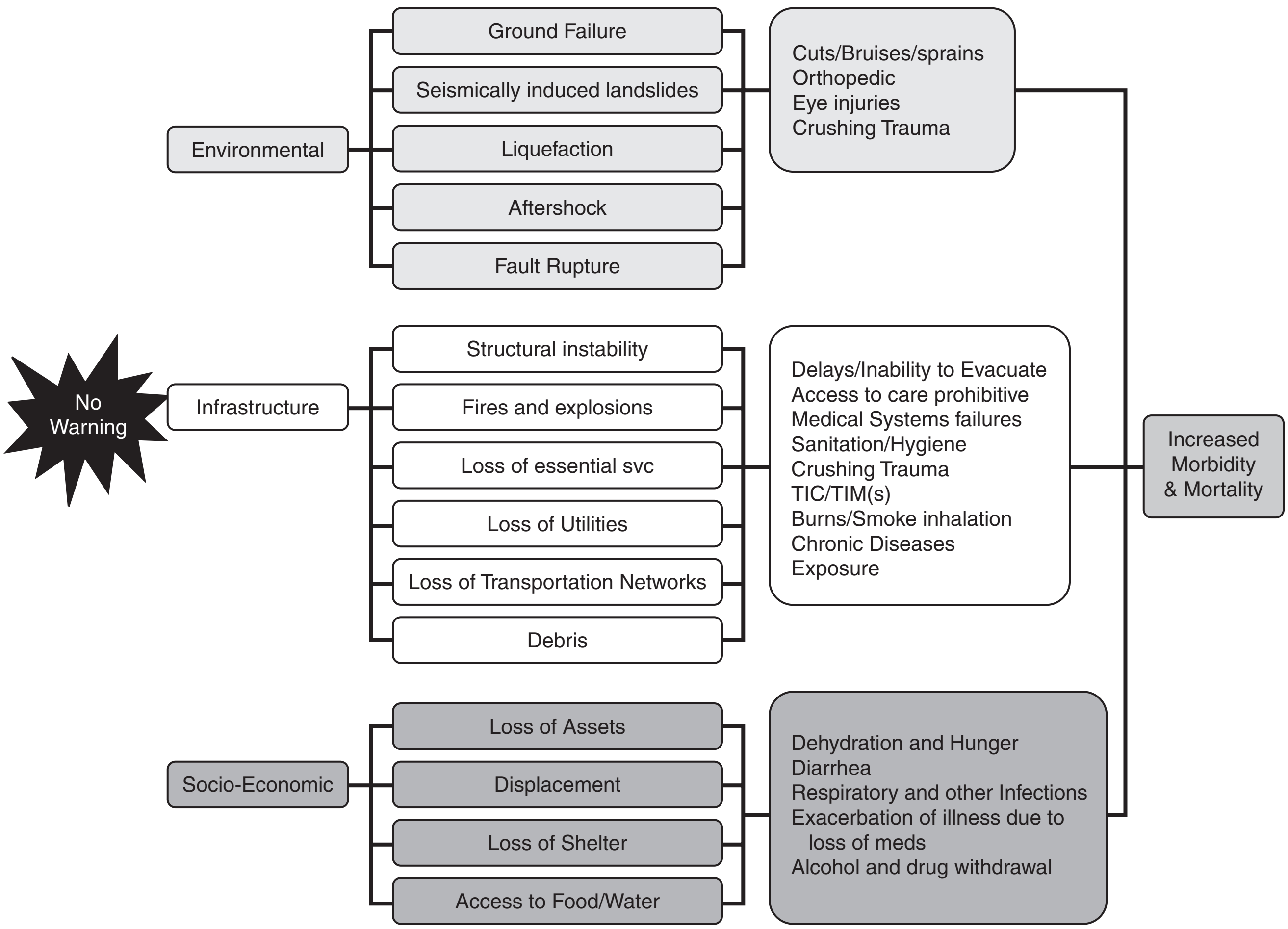


**FIGURE 9.3. Earthquake Threat and Possible Impacts on Health.** Lieutenant Colonel William Darby, U.S. Army North. Earthquake Threat and Possible Impacts on Health, July 2008. Used with permission.

Given that a catastrophic earthquake happens without warning, the population at risk may be significantly greater than in a hurricane, because in the latter instance people are able to evacuate or seek shelter before the storm. Structure collapse, falling debris, and in some cases, fire will result in large numbers of casualties.

Infrastructure damage could be severe, depending on the magnitude and duration of the quake. Transportation networks might well be destroyed due to collapse of bridges, buckling of roads, liquefaction of airfields, and breaks in rail lines. Medical facilities would be at risk not only due to the lack of utilities and staff, but also structural damage or failure.

Public health concerns are similar since in a disaster of this nature and magnitude populations would be displaced, property would be lost, and access to such basic needs such as food, water, and shelter would be difficult. After examining the threat and its possible impacts, the next step is to examine the community itself.

## CHARACTERISTICS OF THE AREA

In conducting the estimate, area characteristics need to be examined in relationship to the threat, the generation of casualties, and the impact on patients and medical evacuation.

### Terrain

What is the terrain like? Where are the low-lying areas? What parts of the terrain are most likely to be affected by a storm surge or to lowland flooding? Anything that places transportation networks or nodes underwater is going to hinder medical evacuation efforts. Areas prone to landslides are another hazard. In areas where the principal threat is from an earthquake, geology is key, including the location of fault lines, the types of soil and fill that exist in the area, and the location of bedrock, among other features. This information is critical because the amount of damage induced by an earthquake is somewhat predictable, and will be determined not only by the magnitude and location of the quake but also by the types of ground material under structures.

### Weather

Regional weather patterns are important since variances in temperatures and precipitation affect both emergency operations and human performance. High temperatures will contribute to patient dehydration and hyperthermia if patients cannot be sheltered from the environment. Weather can also affect evacuation operations, such as restricting flight operations or exacerbating flooding.

### Environmental Factors

How is the land being used? Is it urban or rural? What are the major industries in the area? Where are toxic industrial chemicals or materials likely to be used or stored? These are a few of the environmental factors that require attention as potential generators of casualties or hindrances to evacuation.

### Population Density and Demographics

Population densities and the demographics of the area are another significant characteristic to examine. U.S. Census Bureau databases can help provide a macro-level view of a community.[3] Additional considerations include locations of special populations such as the very old and the very young, since they are among the most fragile and may be more vulnerable to consequences of a disaster.

### Location of Medical Institutions

The location of medical institutions, including hospitals, nursing homes, long-term care facilities, and hospices, must be identified along with their proximity to known hazard areas. These overlay maps can be conveniently generated using a variety of geographic information systems (GIS) products. If a facility is below the height of a predicted storm surge or located in a flood zone, then it may need to be evacuated before landfall, in the setting of a hurricane.

### Structural Integrity of Medical Institutions

The question here is whether a structure can withstand the threat at hand, whether it be the winds of a hurricane or the shaking of an earthquake. It is useful to document which facilities have been surveyed or rated by engineers for ability to withstand relevant hazards. Many structures may have been "hardened" following previous disasters or in response to engineering surveys.

### Regional Transportation

Although most patient transport on a day-to-day basis is conducted by ground assets, in a mass medical evacuation, all alternatives must be examined since the demand will exceed available, standard medical-evacuation platforms. Further, ground transportation may be limited due to damage to networks and the convergence of responders trying to enter an area while victims are trying to leave.

Transportation must be examined from several aspects. First is the identification of transportation nodes. Transportation nodes are the primary locations that serve as access points, intermediary points, and destinations along the transportation network.[4] In the case of medical evacuation, the primary nodes would be hospitals and other types of medical institutions. During a disaster, other points, such as casualty collection points and ambulance exchange points, would also serve as nodes. For larger operations, critical nodes may include airports, rail stations, landing zones, ferry berths, and other ports of embarkation and debarkation.

Next, transportation networks need to be identified, including roads and highways, rails, airspace, waterways, and the infrastructure it takes to operate them. Post-disaster, determining which networks are intact and when the damaged ones may return to service is essential. In the event of a catastrophic disaster, all working transportation networks have to be evaluated as possible means for evacuation. Volume and demand will dictate that all viable means are used to move casualties and patients to safety.

After identifying the nodes and the networks, planners have to try to predict how a given disaster such as a hurricane or an earthquake will affect transportation systems and consider ways to either mitigate or work around the likely disruptions.

Finally, the demands that will be placed on the system have to be examined and the approach must be holistic. Responders, rescue workers, and various organizations and supplies will likely be coming into the impacted area as victims are trying to evacuate the area. Who has priority? What networks will be used by whom? What demands will be placed on the system by medical evacuation? These questions have to be addressed in the estimate and in plans at all levels (local, state, and federal) in order for the system to work, but the analysis must begin in the local community.

## ESTIMATING REQUIREMENTS FOR MEDICAL EVACUATION

Prior to a disaster, patients are already present within the following elements of the medical system:

- Hospitals
- Nursing homes
- Hospices
- Long-term care facilities
- Psychiatric care facilities
- Prisons

There is also a home-care/medically fragile part of any community's population. The challenge regarding this particular group is to identify individuals as well as their residences. Typically the majority are elders living with family members.

A catastrophic incident itself will generate casualties that must also be absorbed by the medical system. This rate will vary depending on the type of incident, its magnitude, the time of day, and the population density where it occurs.

Workloads generated from a disaster for medical evacuation will be outcomes of the following variables:

- Compromised medical facilities
- Incident-related injuries or illnesses
- Pre-existing conditions, including those of patients residing in medical facilities
- Exacerbated problems resulting from the disruption of care or services
- Special populations such as the:
  - Very young
  - Very old
  - Mentally disabled
  - Physically disabled

By knowing the population density, type of threat, average patient census in a community's medical facilities, and estimated number of casualties that may be generated, it is possible to predict the types of medical support that will be needed, along with transportation requirements for safe medical evacuation.

Several factors must be considered when planning for modes of transportation. Such factors include, but are not limited to, the following:

- Is the patient ambulatory?
- If yes, does he or she need assistance?
- Can the patient tolerate sitting?
- If yes, for how long?
- Is support or restraint needed for the patient to stay seated?
- Does the patient require a litter?
- Does the patient require specialized equipment that requires oxygen or an electrical hook-up?
- Does the patient require continuous medical care or interventions?
- Does the patient pose a threat to self or others?

These factors, together with total patient volume and distances involved, determine what modes of transportation can best be used.

## Modes of Transportation for Mass Casualty/Patient Evacuation

In the event of a catastrophic disaster where the demand for evacuation outweighs the availability of ambulances and paratransit assets in a local community or state, all modes of transportation have to be considered in the planning. Table 9.1 describes some characteristics of standard medical evacuation platforms as applied to large-scale patient evacuation.

Whenever possible, medical evacuation should be performed by standard medical transportation vehicles, with dedicated medical staff on board to move the patient, but to provide en route care as well. Ambulances may provide ALS or BLS care. Depending on ambulance type and patient acuity, they may transport one or two patients per trip. The term "paratransit" formally refers to unscheduled transportation. This is provided by many communities for those who have disabilities that prevent them from using the public transportation system. In federal disaster planning, the term is used to indicate a vehicle that can accommodate wheelchair patients. This may be anything from a van or "chair car" to a coach bus equipped with a wheelchair lift. This variability means that planners must determine and request the number of paratransit seats that are required, rather than the number of vehicles needed.

When patients or casualties have to be moved aboard non-medical modes of transport, such as high-water vehicles and other trucks, boats, trains, and airframes that are not medically configured, the risks to patient safety have to be weighed against the risk of staying in place. Buses are typically used for ambulatory patients in a mass evacuation. Depending on the patients involved, specific care providers may be needed to accompany patients on a bus. Some plans commit one empty ambulance for every bus convoy in case of emergencies en route. Alternatively, an EMT or paramedic with equipment may be stationed on the bus. Planning considerations for non-medical modes of transportation are shown in Table 9.2.

The U.S. Department of Defense (DoD) has resources that can be deployed to assist in the process of medical evacuation during a time of crisis. This is done under the National Disaster Medical System and Emergency Support Function 8 of the National Response Framework.[5]

TABLE 9.1

**Characteristics of Standard Medical Transportation Platforms in Disaster Operations**

| Mode | Distance | Limiting Factors | Planning Factors | Notes |
|---|---|---|---|---|
| Ambulances | Good for short or intermediate distances for litter patients (no more than 250 miles) | The amount of oxygen it can carry<br>Road conditions | One critical or two stable patients per ambulance | Evacuation of hospital patients may require care that exceeds most paramedic training |
| Paratransit vehicles | Good for short or intermediate distances for wheelchair patients | | How many "seats" are required | Contractor determines the number of vehicles based on seats requirement |
| Commercial air ambulances | Rotary wing for short distances; on- and off-load at hospitals<br>Fixed wing good for longer distances | Aircraft model determines distance | Normally one or two litter patients per aircraft | |

TABLE 9.2

**Characteristics of Non-Medical Transportation Platforms in Disaster Operations**

| Mode | Distance | Limiting Factor | Planning Factor | Notes |
|---|---|---|---|---|
| Trains | Good for intermediate and long distances for ambulatory patients<br>Only for patients who can tolerate sitting and have minimal medical support needs | Rail service in the area and the availability of passenger cars | 48 ambulatory patients per Pullman car | Contractor determines the number of passenger cars based on number of seats required |
| Trucks | Good for short distances (20 minutes)<br>Can be used to move both ambulatory patients and litters | Oxygen<br>Exposure<br>Model and size of truck | Litters: typical military stretcher is 22-7/8 inches wide × 72 inches long | |
| Trucks, 5-ton cargo | Good for short distance | Oxygen<br>Exposure | 12 litters or 16 ambulatory patients | |
| Buses (44 passengers) | Good for intermediate distances (no more the 250 miles)<br>Can be used to move ambulatory patients, or litter patients if configured | Patients should be stable, needing little oxygen or medical equipment<br>Ambulatory patients: 37<br>Litters: 18 | Plan to deploy empty ALS ambulance with bus convoys and/or place at least a BLS provider on each bus | Buses with wheelchair lifts are great for moving individuals who are wheelchair-bound |
| Helicopters (non-medical) | Good for distances up to 250 miles (depending on the model)<br>Can be used to move both ambulatory patients and litters | Oxygen (small bottle, 17 to 20 minutes) | | Depending on severity, medical staff must accompany patient |
| Commercial aircraft | Good for long distances for those who can tolerate sitting and have minimal medical support needs | Patients should be able to tolerate sitting and have little need of medical support in flight | Model dependent | |
| Boats/ferries | Good for short distances (20 minutes)<br>Can be used to move both ambulatory patients and litters | Oxygen | Model dependent | Depending on severity, medical staff must accompany patient |

DoD has a combination of dedicated medical evacuation platforms[6] and non-standard evacuation platforms that can be employed if a state requests assistance, Federal Emergency Management Agency (FEMA) tasks DoD with the request, and the secretary of defense approves the mission assignment. These include military ground and air assets as shown in Table 9.3.

When a military, non-medical platform is used for evacuation, it is referred to as casualty evacuation (CASEVAC). This means there are no medical personnel or equipment aboard; it is simply a mode of transportation. Examples appear in Table 9.4.

By completing the estimate process, decision makers will understand the nature of the threat to the community, the demands that will be made on the medical evacuation system, the transportation networks that might be used, and the amount and types of transportation assets that may be required. This is a sufficient amount of information to develop an executable plan.

## PLANNING

A good plan is simple and flexible. It sets the stage by laying out the situation, threat, and available resources. Such a plan is based on facts, and when facts are not available, valid assumptions. The plan provides organization, as it lays out how the mission will be accomplished, what agencies are responsible for what tasks, and how the responders will coordinate with one another. Resources and materials are identified as well as any existing shortfalls. Equally important, a

TABLE 9.3

**Military Medical Evacuation Platforms and Considerations for Use in Disaster Operations**

| Mode | Distance | Limiting Factor | Planning Factor | Notes |
|---|---|---|---|---|
| M1010 truck ambulance | Good for short and intermediate distances | Oxygen | 4 litters or 8 ambulatory patients | 91 W (EMT) on board |
| UH 60 Blackhawk MEDEVAC | Good for distances up to 250 miles<br>Can be used to move both ambulatory patients and/or litters | Oxygen | 4 litters and 1 ambulatory patient | 91 W (EMT) on board |
| C-130 Hercules | Good for long distances | Oxygen<br>Clinical considerations | 50 litters or 50 ambulatory patients | Although C-130 is capable of moving 74 litters at its maximum configuration, it is difficult to load and upper berths are extremely difficult to access<br>2 flight nurses and 3 aeromedical evacuation technicians on board<br>Critical care air transport teams (CCATTs) |
| C-17A | Good for long distances | Oxygen<br>Clinical considerations | 36 litters or 54 ambulatory patients | |

TABLE 9.4

**Characteristics of Selected Examples of Military, Non-Medical Platforms Used for CASEVAC**

| Mode | Distance | Limiting Factor | Planning Factor |
|---|---|---|---|
| Truck, 5-ton cargo | Good for short distances for ambulatory patients or litters | Oxygen<br>Exposure | 12 litters or 16 ambulatory patients |
| UH 60 Blackhawk | Good for distances up to 250 miles<br>Can be used to move both ambulatory patients and/or litters | Oxygen | 4 litters or 4 ambulatory patients |
| CH-47 Chinook | Good for distances up to 350 miles<br>Can be used to move both ambulatory patients and litters | Oxygen | 24 litter or 31 ambulatory patients |

good plan will clearly define command and control relationships and the means and ways that communication will be accomplished throughout the operation (Figure 9.4).

**Planning Outline**

1. Situation
   - Facts
   - Assumptions
   - Limitations
2. Mission
3. Execution
   - Concept of the operations
   - Tasks
4. Logistics and Administration
5. Command, Control, Communications

**FIGURE 9.4. The Five Basic Paragraphs of a Plan.**

## Planning Considerations

The medical evacuation plan must address how casualties will be evacuated from point of injury/illness to definitive care as well as patients who must be moved out of compromised medical facilities following a disaster. It must integrate all possible modes of transportation and the networks that enable them.

The plan also must take the following considerations into account:

- Operational considerations
  - Ingress and egress routes
  - Ways of dealing with potential obstacles to evacuation
  - Loading and off-loading areas for ambulances
  - The need for casualty collection points and holding areas
  - Establishment of ambulance exchange points
  - Credentialing of ambulances and EMS personnel
  - Location and establishment of staging areas
  - Site access
  - Security
  - Medical and support staffing
  - Work/rest cycles
- Clinical Considerations
  - Triage
  - Emergency care
  - En route care
- Logistical considerations
  - Support for essential operations and services
  - Medical supplies and resources
  - Buildings of opportunity

- Environmental control (heat, water, light)
- Latrines
- Blankets, litters, litter stands, straps, backboards
- Provision for food and drink

- Command and control (interface among authorities having jurisdiction and emergency responders); may include coordination and communications with:
  - Incident commander
  - Local dispatch
  - EMS provider(s)
  - Hospitals and other medical institutions
  - Local and state emergency operation centers
- Federal Emergency Support Function 8, likely located in a joint field office and includes Departments of Health and Human Services, Homeland Security, Veterans Affairs, and Defense
  - Port authorities
  - National Guard
  - Other agencies and organizations as appropriate

Medical institutions are responsible for having evacuation plans in place, including contracts or other agreements with transportation providers to execute them. However, large-scale medical evacuation of an entire region will likely require private, local, state, and federal assets to accomplish the mission. Individuals with special medical needs have the responsibility to self-evacuate whenever possible. However, many who are poor or elderly do not have the means to evacuate themselves. Those who cannot self-evacuate will require assistance from the local community. If the local government cannot effect medical evacuation of those who need it in the necessary timeframe, assistance from the state and the federal government, under the National Response Framework, will be requested.

The National Disaster Medical System (NDMS) merges federal medical evacuation resources into a unified response. The major federal partners are the Department of Health and Human Services, DoD, the Department of Veterans Affairs (VA), and FEMA. DoD has the lead for coordinating patient movement and, together with the VA, coordinates definitive care operations outside the impacted area.

# EXECUTION

In the event of a catastrophic incident, local responders will be the first to answer the call and will activate emergency plans using the Incident Command System (ICS),[7] as described in Chapter 1. Casualties must be quickly collected or extricated, triaged (see Chapter 2), stabilized, and evacuated.

When arriving at the scene of a mass casualty event, responders must carry out the following tasks:

- Assess the situation.
- What type of disaster, how large an area does it cover, and what is its magnitude?
- How many casualties are there and what types of injuries?
- What are the ingress and egress routes into the area?
- Implement the ICS.
- Communicate the situation on the ground so that the proper authorities are notified and additional resources can be dispatched to the scene.
- Begin medical operations and evacuation.

## Casualty Collection Points

Casualty collection points may be established a safe distance away from the immediate threat with access to transportation networks. Casualties are brought to this location, rapidly triaged, given immediate care, and prepared for evacuation.

As patients are triaged and sorted, life-saving treatment is administered. Ongoing reassessment and therapy should be conducted as needed in this area. When possible, collection points can be divided into lanes based on triage categories. This will assist in the treatment and the rapid transport of casualties from the scene. Ambulances are either co-located with the collection point or staged nearby where they can be called forward. Casualties are loaded onto appropriate vehicles as they become available and then evacuated to local area hospitals, alternate care facilities if the local hospitals are unable to receive patients, or ambulance exchange points for evacuation outside the jurisdiction. A system for communicating with destination hospitals and dividing patient volume according to their capabilities is critical.

## Ambulance Exchange Points

Casualties are transferred from one mode of transportation to another at ambulance exchange points (AXPs). As part of the planning process, it is important to preidentify locations that may function in this manner. There are several possible reasons for establishing an ambulance exchange point.

First, the situation may dictate that the type of transport asset has to change. Following Hurricane Katrina, casualties and patients were evacuated by boats to AXPs where ground vehicles could be used. In some instances, it was necessary to do an exchange again from ground ambulance to rotary wing aircraft.

Second, patients may be evacuating the local jurisdiction. Local, state, and federal assets may be used at exchange points to facilitate transfer of patients outside the impacted area. Time–distance factors may determine that the best way to maximize lift capacity is to establish an AXP so that local assets can return to the incident scene faster.

Third, an AXP may serve as a hub, maximizing evacuation capacity by receiving patients from multiple collection points for longer-distance transportation.

Factors to consider when establishing an AXP follow:

- Traffic flow. Whenever possible the AXP should have easy access to the highway or road network. Vehicles should be able to come into the AXP, off-load the casualties, and then quickly leave without having to back up. The area should be well marked with directional signs and traffic cones. The entry and exit should be easily identifiable. Personnel to assist in directing the traffic flow should be identified, and be wearing highly visible identification.
- Off-loading and on-loading areas. Appropriate areas where casualties can be easily off-loaded and on-loaded to another form of transportation should be identified and marked. If there is any delay between off-loading and boarding the second transport, then it is critical to establish a holding area, preferably in a building that is climate controlled.
- Medical support. Provisions must be made for establishing some type of medical treatment capability at the AXP if delays between off-loading and loading may be involved. This function could be performed by a disaster medical assistance team, medical reserve corps members, or a similar capability that can provide basic medical care.
- Communications. Communications are critical. The local emergency operations center must be informed when an AXP is established, where it is established, what it requires, the number of casualties that are flowing through, and when it is closed. That information has to be passed to all stakeholders. Whenever possible, the AXP must have redundant communication equipment.
- Security. Law enforcement, crowd control, and traffic control are issues that must be addressed when establishing the AXP. Coordination with local law enforcement must occur when establishing this type of operation.
- Establishing landing zones (LZs). If helicopters are used at the exchange point then a formal LZ must be established. When establishing an LZ, consider the following:
  - The minimum requirement for an LZ is 30 m × 30 m in diameter with an approach/departure zone clear of obstructions.
  - Sufficient space must be allowed for hovering and maneuvering during landing and take-off.
  - Whenever possible, approach zones should allow the aircraft to land and take off into the wind.

## PATIENT EVACUATION FROM MEDICAL FACILITIES

In a catastrophic disaster affecting a large geographic area, hospitals themselves may be damaged or destroyed or may be overwhelmed by patient volume. In such a scenario, patients may have to be evacuated out of the jurisdiction, region, and possibly the state for definitive care.

In an event that provides warning, such as a hurricane, vulnerable medical institutions will make a decision based on their location and past experience on whether to evacuate. Most hospitals in the path of a storm will discharge all patients who can safely go home. They will then determine which patients, if any, need to shelter in place if that is an option, and which patients may require evacuation to another facility. In a no-notice event, a damaged or disabled hospital will likely require evacuation for its full, normal patient volume.

There are several courses of action that could be played out in either scenario. Medical institutions that have agreements with other facilities outside the affected area can activate their transportation plans, typically involving contracted ambulances and buses, although these resources may be limited during such an event. These institutions would maintain communications with their receiving facilities until the transfer operations were completed. If those arrangements fail, then these institutions would request assistance through their local and/or state emergency operations centers (EOCs).

Based on the request for assistance being generated, local authorities can assemble medical evacuation assets from within the local area or through mutual aid agreements with neighboring jurisdictions. If the demand for evacuation resources exceeds these resources, then the request for assistance would be passed to the state. The state may assemble evacuation assets from other jurisdictions within the state that are not threatened, execute contingency contracts with EMS providers, activate the National Guard, request assistance from other states using the Emergency Management Assistance Compact (EMAC)[8] or other inter-state mutual aid agreements. If assets are still insufficient to meet the demand, it is likely that the state governor will already have declared the area a state disaster and requested a declaration from the president. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (PL 100-707) provides the president of the United States the ability to declare an area a national disaster and authorize the use of federal resources.

Federal assistance for medical evacuation falls under Emergency Support Function 8—Public Health and Medical (ESF-8) of the National Response Framework. Medical evacuation specifically for hospitalized patients would likely be conducted under the umbrella of the NDMS. Another available option that could be used separately or in tandem with NDMS is the FEMA National Ambulance Contract.[9]

In an event that provides no warning, such as an earthquake, medical institutions that are damaged or destroyed will have to conduct evacuation under even more stressful conditions. The population in the facility when the disaster occurred is only the starting point. Adding to the burden will be casualties caused by the event, damage to critical infrastructure and transportation networks, and absenteeism of critical staff members. In a catastrophic scenario of this na-

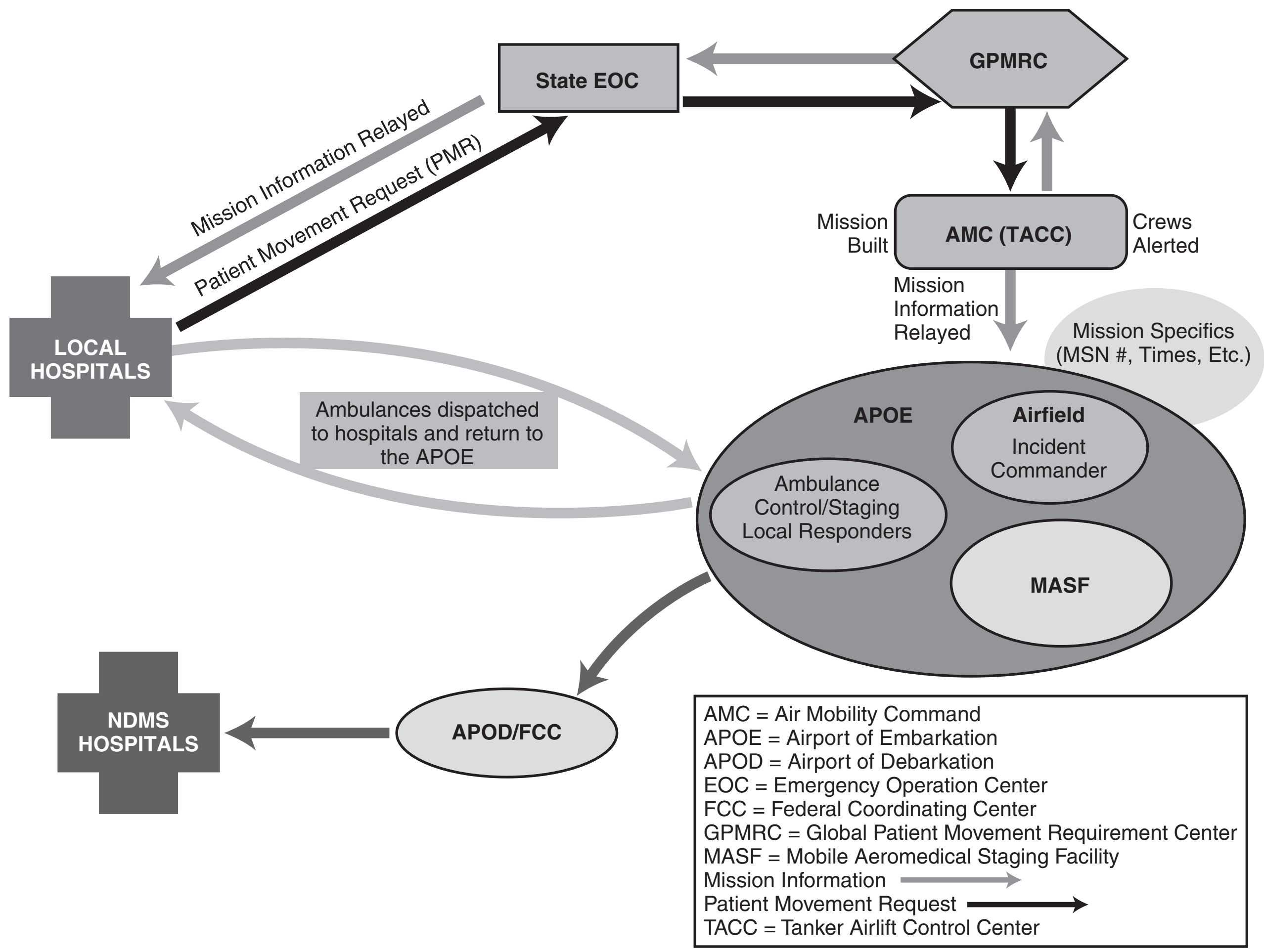


**FIGURE 9.5.** **NDMS Evacuation.**

ture, a state may ask immediately for federal assistance to include the activation of NDMS.

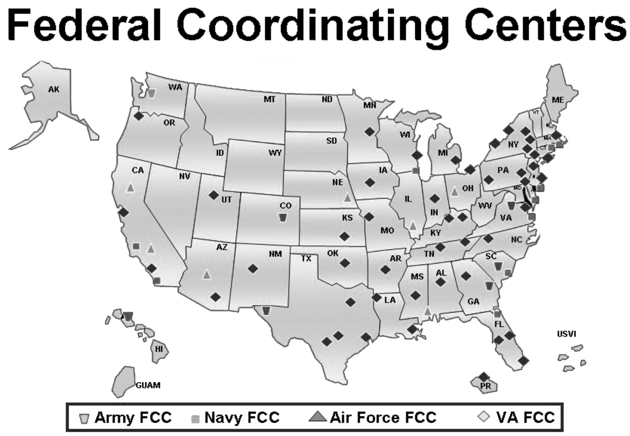


FIGURE 9.6. Federal Coordinating Centers.

## PATIENT EVACUATION USING THE NATIONAL DISASTER MEDICAL SYSTEM

Patients being evacuated via NDMS move normally on DoD aircraft, so clinical considerations for flight have to be taken into consideration as well as patient safety. When it is determined that patients will be evacuated by NDMS, a patient movement request (PMR) is generated at the threatened hospital and sent to the local and state EOC. The PMR identifies the patient by name, sex, age, category, and medical condition, and identifies any special equipment requirements.

The state passes the PMR to the Global Patient Movement Requirement Center (GPMRC) located at Scott Air Force Base, Illinois. Under NDMS it is GPMRC's responsibility to regulate the patients from a given hospital to an NDMS-member hospital.

GPMRC forwards the PMR to the Tanker Airlift Control Center (TACC), Headquarters Air Mobility Command, also located at Scott Air Force Base, where aircraft and crew are matched with the mission. TACC sends completed mission information back to GPMRC, which returns the information to the state EOC and receiving federal coordination centers.

Once given the mission, air medical forces are deployed to the airport of embarkation (APOE) to establish operations in conjunction with local and state emergency responders (Figure 9.5).

When alerted that an aircraft is inbound, the operational commander at the airfield dispatches ambulances to the hospitals to pick up the patients manifested for that flight. On arrival at the airport, the patients are turned over to a mobile aeromedical staging facility (MASF). The MASF prepares patients for flight by exchanging hospital or EMS equipment for airworthy equivalents, ensuring that casts have been bi-valved, providing blankets (since the cargo compartments of military aircraft that have been configured for patient transport are cold during flight), and other interventions. Patients are then loaded onto the aircraft with assistance from additional litter bearers. The plane departs the local airport for the designated federal coordination center that will, in turn, arrange for local transportation to the appropriate destination hospital (Figure 9.6).

Federal coordination centers are located throughout the country and are operated by DoD and VA. They are responsible for coordinating definitive medical care within a geographical area. This is accomplished by recruiting non-federal local hospitals into the NDMS. In addition to this role, they are also responsible for coordinating patient reception operations at the airport of debarkation and distributing patients to the appropriate hospitals.

## SUMMARY

The keys to success in large-scale patient evacuations are to prepare an estimate that includes threat, area characteristics, demands that are likely to be placed on the system based on population, the scope of the incident, and response requirements. To ensure that the plan is executable, it should be detailed, and all necessary assets to accomplish it should be identified prospectively. Once the plan is completed, it is important to exercise it. All participants must know their roles and responsibilities and be comfortable in the execution of those roles and functions.

## DISCLAIMER

The opinions or assertions in this chapter are solely the author's, and do not necessarily represent the official views of the Department of Defense.

## REFERENCES


1. Lieutenant Colonel William Darby, U.S. Army North. Hurricane Threat and Possible Impacts on Health, July 2008.
2. Lieutenant Colonel William Darby, U.S. Army North. Earthquake Threat and Possible Impacts on Health, July 2008.
3. U.S. Census Bureau. Data Access Tools. Available at: http://www.census.gov/main/www/access.html.
4. Rodriguez JP, Comtois C, Slack B. The Geography of Transport Systems. New York: Routledge, 2006.
5. Department of Homeland Security. National Response Framework, January 2008. Available at: http://www.fema.gov/emergency/nrf/. Accessed July 15, 2008.
6. US Army Field Manual 2-02.2, Medical Evacuation, May 8, 2007.
7. California FIRESCOPE. Fire Service Field Operations Guide, ICS 420-1, July 2007. Available at: http://www.firescope.org/ics-big-fog/ICS420-intro.pdf.
8. National Emergency Management Agency. Emergency Management Assistance Compact Articles of Agreement and Model Legislation. Available at: http://www.emacweb.org/?564. Accessed July 17, 2008.
9. Federal Emergency Management Agency. Overview of AMR/FEMA Federal National Ambulance Service Support, April 10, 2008. Available at: http://www.amr.net/contact/Overview_of_FEMA_Service_Support.pdf.