Hospital Evacuations: Historical Precedence and Modern Preparedness

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Hospital Evacuations: Historical Precedence and Modern Preparedness

Nicholas Squillace

6/24/2010

Master of Public Health Program

Wright State University Boonshoft School of Medicine
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To my committee members, Drs. Mark Gebhart, M.D. and Cristina Redko, Ph.D., who guided me through this process adding depth and challenging me to critically think. Ultimately, their guidance has led to an enriching experience for me and a product that has the potential to save lives.
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Abstract

Objectives: The purpose of this research was to identify common problems encountered during hospital evacuations and how those problems are or should be addressed when creating a hospital evacuation plan. Methods: Articles relating to hospital evacuations were retrieved from PubMed and CINAHL in addition to government websites and the Joint Commission on Accreditation of Healthcare Organizations. The articles collected were limited to within the last 20 years, from 1990 to 2010. Hospital plans were collected from search engines including Google and Yahoo. Moreover, a plan was obtained from a Dayton area hospital. Results: Numerous instances of hospital evacuations that were attributed earthquakes, hurricanes, tornadoes and fires have been documented. Frequently cited problems in these evacuations were related to communication, transportation and staffing problems. The hospital evacuation plans that were reviewed included the San Joaquin County Hospital Evacuation Plan, New York Center for Terrorism Planning and Preparedness, Washington Hospital Center Emergency Evacuation Plan and a Dayton, Ohio Hospital Emergency Evacuation Plan. Discussion: Plans need to be able to incorporate communication needs including emergency radios and cellular telephones with backup power sources. Updated call-lists are also crucial components to the successful execution of a hospital evacuation by helping to alleviate potential staffing shortages during an event. Transportation needs, including mutual aid agreements, need to be frequently reviewed and innovative measures must be taken to ensure success. Conclusion: Hospitals today are not prepared to adequately handle an evacuation. Comprehensive plans that incorporate the lessons learned from previous evacuations are crucial components for community resiliency.
**Introduction**

In the 21st century, the potential hazards that hospitals face are ever-increasing. Hospitals must be prepared to respond to a growing number of threats in order to ensure patient safety and community resiliency. Potential problems facing healthcare facilities are natural disasters such as tornadoes, floods, hurricanes and earthquakes; man-made disasters such as bombings and chemical spills; and internal disasters such as severe power failures and fires (Sternberg, Lee and Huard, 2004). Hospitals need to have plans in place that address all potential hazards not only to ensure continued operations and patient safety, but to meet the accreditation requirements set by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). Furthermore, the staff of the hospital, in addition to the local emergency personnel, should be well-versed with these plans in order to ensure, should they need to be executed, that they can be performed without confusion or inappropriate improvisation.

**Methods**

Articles related to evacuations were retrieved from the journal database, PubMed and CINAHL. Additionally, the Joint Commission on Accreditation of Healthcare Organizations’ and the federal government’s National Incident Management System/Federal Emergency Management Agency websites were searched for reports related to hospital evacuation. The clinical sciences librarian at Wright State University assisted with the search through the databases. Articles relating to clinical practice were among the articles relating to evacuations and accordingly, these articles were excluded from the project. The keywords used in the searches included combinations of the following: hospital evacuation; ICU evacuation; evacuation, hurricane, tornado, fire, wildfire, flood, bomb, terrorist, chemical, Katrina, Loma Prieta, Northridge,
earthquake, ice, power failure, power outage; evacuation drill; evacuation exercise; horizontal evacuation; vertical evacuation. Incidents were limited to those that have taken place in North America. This was due to the fact that other areas of the world may have different infrastructures in terms of the hospital’s operation, government obligations and geography and therefore, incidents that have occurred outside of North America were excluded to add strength to the reviews and suggestions. Furthermore, evacuation recommendations were retrieved from the Joint Commission on Accreditation of Healthcare Organizations. Google searches were done in order to retrieve documents relating to hospital protocols and procedures using the keywords: hospital emergency management, hospital evacuation plan, hospital emergency plan and hospital evacuation procedures. Additionally, through contacts in a Dayton, Ohio area hospital, a hospital evacuation plan was analyzed and compared against the actual evacuations and the evacuation plans that were available online. Articles used in the review process were limited to events that had taken place no longer than 20 years ago, 1990 to 2010. This limitation on the time period was set due to the evolving standards that regulate hospitals in addition to the workforce structure that has changed. Events that date beyond 20 years will have faced substantially different challenges that may not be relevant to events that occur today.

Results

Earthquake Evacuations

Over the past decades there have been many instances of hospitals being forced to evacuate (Sternberg, Lee and Huard, 2004). The Northridge Earthquake that struck southern California in 1994 prompted numerous hospital evacuations (Schultz, Koenig and Lewis, 2003). Hospitals
were faced with unique challenges such as severe and dangerous structural damages, immediate loss of all power including backup generators and overworked and thinly stretched health care personnel. Another unique challenge that this earthquake posed to hospitals was that of patient priority; referring to the order in which certain patient populations within the facility are evacuated.

The unplanned nature of earthquakes requires certain decisions to be made quickly by experienced personnel. In fact, the unplanned nature and the differences between area hospitals affected by the Northridge earthquake in California ultimately resulted in a lack of uniformity in the evacuations. Most of the hospitals that evacuated during the Northridge Earthquake did what the majority of hospitals do when evacuation is deemed necessary; they evacuated the most critical patients first (Schultz, Koenig, and Lewis, 2003).

One hospital that received extensive damage in the Northridge Earthquake, in which the hospital personnel felt the hospital was on the verge of collapse, decided to evacuate the stable and ambulatory patients first and then, time allowing, evacuate the more critical patients last (Chavez and Binder, 1995). This decision was likely made in the belief that, with more ambulatory patients than critical patients being housed, evacuating mobile and stable patients first could potentially save more lives. To ensure that all patients were evacuated and to prevent a duplication of efforts, an X was placed on each room once the room was empty. This strategy also ensured that no patients were left behind. Challenges with critical care patients were well-described in this article including ventilator and IV issues.

Several ICU patients that were ventilator dependent relied on bag-valve ventilators once the earthquake struck. Bag-valve ventilators are comprised of a bag that is attached to tubing that allows for air to be manually directed in and out of the airway. Furthermore, electronic IV
lines were converted to gravity flows along with medication that had to be converted to a gravity rate. Simply stated, gravity pumps rely on valves to be turned in such a way that the force of gravity is the mechanism driving the medications and other substances into the IV versus an electronic monitor and pump system that uses electricity.

The earthquake occurred at approximately 4:30 a.m., which further challenged this facility because decision-making management was not available during the evacuation (Chavez and Binder, 1995). Lastly, the article discussed the need for a more resilient communication system. After the earthquake struck, the hospital faced greatly reduced communication capabilities. The article calls for better wire and cellular systems that give the hospital priority should a major incident impact the area resulting in a surge of calls (Chavez and Binder, 1995).

It should also be noted that the earthquake that occurred near San Francisco, California in 1989 prompted numerous hospital evacuations (Martchenke and Pointer, 1994). Although this earthquake has historical significance, any literature beyond 20 years from present day was deemed less relevant to more recent procedures and events. Operating procedures, evacuation requirements and lessons learned have been incorporated into today’s health care operations that may be vastly different from 20 years ago and beyond. For example, technology is heavily integrated into today’s hospitals, which make normal hospital operations more efficient but problems can manifest in an emergency situation with transferring patient files. Additionally, equipment used in the hospital is vastly more technical meaning more reliance on electronic systems that do not have manual capabilities if power loss occurs.
**Hurricane Evacuations**

Another relatively common cause for evacuation of many types of health care facilities, including hospitals, is hurricanes. Hurricanes present entirely different challenges to hospitals not encountered by those impacted by earthquakes. First, there is some degree of foresight when a hurricane may impact the normal operations of a facility (Thomas and Lackey, 2008). The advantage of foresight allows the hospital to decide to evacuate before circumstances hinder the response. This also adds the unfortunate side effect of staffing shortages (Sexton, Alperin, & Stobo 2007).

As has been often observed in the facilities that have evacuated in response to a hurricane, the hospital personnel can be greatly impacted by the disaster in their personal lives. Although those involved in an earthquake may be personally impacted, they are generally not afforded the same luxury of response because, if they are at the hospital when the incident occurs, they are likely to take care of the patients’ and hospital’s needs before tending to their own. Those involved in hurricanes appear to be more likely to tend to their personal safety preserving their own possessions and ensuring the safety of their family (Thomas and Lackey, 2008). This observation becomes even more pronounced when comparing hurricane responses against earthquake responses. To overcome this loss of staff, one hospital impacted by Hurricane Katrina created an area for the staff’s families, including pets, to be housed for the duration of the storm and the aftermath. As stated by Bernard and Mathews (2008) they accommodated their staff and families when the stress mounted: “After previous storms, our staff told us the usual shifts of 12 hours were too difficult. The stress of worrying about the storm combined with concern for the needs of family members with them at the hospital made the shift of 6 hours, which still provided continuity of care and allowed our staff to rest and interact with
their families” (p. 215). Hurricanes, in addition to inducing staffing shortages, tend to compound the disastrous effects through substantial amounts of rain, which can lead to significant flooding (Cocanour et al., 2002).

The immediate effects of high winds and power outages are not the only concerns that hurricanes impose on health care facilities; flooding presents with many issues that can greatly hinder patient evacuation. One such hospital impacted by Hurricane Katrina, Memorial Medical Center, had numerous critical neonates. This proved to be a logistical nightmare for their subsequent evacuation. The heavy flooding that enveloped the surrounding area prevented the hospital from receiving any ground transportation. Air evacuations were the only option for the hospital; this, although a shorter transit time, posed many unique hazards. The hospital’s helipad had not been used for over 10 years; additionally, the coast guard had difficulty determining if the helipad could support their aircraft since the hospital’s staff had limited knowledge on aircraft and the parameters of the helipad (Bernard and Mathews, 2008).

Hurricanes often bring massive power outages in their path of destruction. The overwhelming heat and humidity that completely swamped the hospitals impacted by Hurricane Katrina, created a precarious situation for everyone (Bernard and Mathew, 2008). As evacuations took place from the Memorial Medical Center, confusion regarding the flight plans began to manifest. The problem arose when the flight plan that the pilot had did not match with the hospital’s plan. As has been seen in many evacuations, finding facilities that are able to accept more patients can be difficult. When a situation such as a hurricane occurs, neighboring facilities, which are part of mutual aid agreements, may also be adversely impacted by the hurricane. Hospitals may be forced to transfer patients to distant facilities that have enough space and resources available to accept these patient transfers.
An example of a hospital taking advantage of the foresight that comes with hurricanes was in Galveston, Texas. After witnessing the devastating effects of Hurricane Katrina, Shriners Hospital for Children, which is a pediatric burn center, made evacuation arrangements with their sister hospital in Cincinnati (Gallagher, Jaco, Marvin, and Herndon, 2006). In September of 2005, Hurricane Rita was projected to hit the barrier island, Galveston, Texas. Evacuation plans were put into effect and the challenges of evacuating their critical patients began. Several patients were flown via private flights and others, who were deemed more stable, were flown via commercial airlines (Gallagher et al., 2006). Though transport times were increased due to the mass evacuation efforts of the city and several evacuation times were double what they would be under normal conditions, this evacuation provides an example of a successful execution of an evacuation plan with the advantage of foresight before an incident (Gallagher et al., 2006). One type of incident that does not provide foresight, much like earthquakes, is caused by tornadoes.

**Tornado Evacuations**

The Midwestern and Southern portions of the U.S. are often unfortunate victims of tornadoes (“U.S. Tornado Climatology,” 2008). In 2007, an F3 tornado struck a Georgia hospital (“Georgia hospital hit by F3 tornado--all patients evacuated through the ED,” 2007). In this event it was decided that the critical care patients would be evacuated first. By evacuating and transferring the most critical patients first, the hospital personnel could focus their efforts and the limited resources on the more numerous ambulatory and stable patients. The hospital organized patients for priority of evacuation by lining them up from most-critical to least critical.

Many hospitals have been impacted by tornadoes not from direct facility damage, but from events that caused a surge of patients. Residents of a community impacted by a tornado
may seek refuge in hospitals or be forced to seek out treatment. Given the potentially large number of casualties in a tornado, hospitals may be inundated with patients. Some hospitals have reported near-miss incidents where tornadoes were reported on the ground very close to the hospital. Hospitals located in Tornado Alley are especially familiar with the impact this can have on operations. Numerous events have been recorded where minor horizontal evacuations have taken place where the patients are moved from their rooms into hallways and lower interior potions of the facility in order to be protected from flying debris (“Disaster planning: meeting the challenge of ‘killer’ tornadoes”, 1997).

In Georgia, the Sumter Regional Hospital took a direct impact from the tornado. It resulted in major damage from the tornado including partially collapsing areas, water leaking from fractured pipes, power failure and broken glass, but a potentially catastrophic consequence of the tornado, fire, was not reported.

**Fire Evacuations**

Whether internal or external, fires can precipitate many hospital evacuations. Internal fires pose the problem of limited access to different areas of the hospital and decreased air quality (Carey, 2007). At the end of 2005, a hospital in northern New York experienced a fire that began in the basement of a hospital where the laundry facility was not properly maintained (Carey, 2007). Smoke quickly filled the ICU and while waiting to determine if a full evacuation was necessary, the patients in the ICU were evacuated to another area of the same floor that was deemed, albeit temporarily, safer than the current location. Therefore, what is known as a horizontal evacuation took place in order to reduce the stress on patients who were already physiologically unstable as was stated by Carey (2007): “Two hours and 15 minutes after we first noticed smoke, all of the
trauma ICU patients had been relocated in other ICUs in the facility, including the burn, medical, surgical and cardiac ICUs” (p. 55). In this case, the horizontal evacuation resulted in a faster relocation than a vertical evacuation would have permitted.

The relative ease of executing a horizontal evacuation versus a complete relocation to a different facility, also known as an inter-hospital transfer, is demonstrated by the success of this evacuation. Those involved in this particular evacuation stated that if a more extensive fire had occurred and required a full facility evacuation, the outcome may not have been as positive. This incident occurred during winter and therefore, bringing these patients out into the cold could have resulted in increased instability in many already unstable patients (Carey, 2007).

The western portion of the U.S. can be prone to wildfires (Gallon, 2008). In fact, in 2007 an acute care facility and a nursing center near San Diego, California were forced to evacuate because of an encroaching wildfire. The decision to evacuate was a difficult one for the facility to make. Frequent communications between the hospital CEO and the battalion fire chief were necessary to continually reevaluate the threat. As the fire continued to advance making exit routes’ safety increasingly uncertain, the decision to evacuate was finally made. It was difficult for this facility to evacuate because of the sheer volume of residents and the lack of enough ambulances, which presented a major logistical challenge. The facilities met this challenge by collaborating with a local school district’s superintendent and secured the use of school buses for patient transport. These situations could be seen as somewhat ideal for fire evacuations, if ever there were such a thing for a facility evacuation, because the facility is not under immediate internal threat. This means that there is time to evacuate the patients in an organized and safe manner with access to elevators and the ability to locate facilities that are not being impacted and
who can accept your patients. Manmade threats including bomb threats and chemical exposures, can present challenges similar to the challenges posed by fires.

**Manmade Threats**

In 1999, at Galion Community Hospital located north of Columbus, Ohio, a manmade threat precipitated the evacuation of the entire facility (Augustine and Schoettmer, 2005). Two bomb threats were called into the hospital and after being evaluated with consultants from the local fire and police departments and deemed credible, the decision was made to evacuate. The hospital had a procedure in place for such events that, which Augustine and Schoettmer (2005) said included, “…defining an evacuation zone, identifying alternate patient care areas, creating manpower pool, arranging transfer of patients, providing care in an outside site, and ensuring communications with staff and community” (p. 69). Like the external threat from fire, this facility had the advantage of being able to use the elevators for evacuation. Additionally, since the evacuation zone was relatively small, the need to evacuate patients to a distant facility involving a patient transfer was not necessary. It was noted that several of the patients had their discharges expedited and that a women’s center and a local nursing home with an unopened Alzheimer’s wing worked in collaboration to accommodate several patients. A local church had agreed to open its doors to allow the patients a place to have care provided while the hospital was inspected for any explosive devices. Many patients, due to the ideal weather, were able to be wheeled down through the street to the library, which alleviated the need for vehicular modes of transportation. Another potential cause for a facility to evacuate comes from hazardous materials and chemical spills.
Hazardous Materials and Chemical Spills

In May of 1997, Helena Regional Medical Center, located in Arkansas, was forced to evacuate due to a chemical explosion at a chemical plant 1.5 miles from the hospital (Vasudevan and Wade, 1997). Within three hours of the smell first being noticed by the hospital’s employees, all patients and employees had been evacuated. Similar to the fire evacuation that took place in San Diego, this facility not only utilized medical transport vehicles such as ambulances, they also used school buses. The most critical patients were transferred to other facilities not impacted by the incident; the remaining patients were transferred to a local community college where the college staff was able to assist the hospital personnel. The college cafeteria was used for patients and cafeteria tables were used as beds for patients. Eventually, the patients were transferred to a nursing home with a space allocated for hospital use.

In Washington, all of the state’s institutions that provided emergency care were surveyed on whether they had evacuated their institution within the past five years. Ten respondents that had reported an evacuation due to hazardous materials were further questioned by the surveyors (Burgess, 1999). This evaluation showed one particular commonality for the majority of the hospitals in Washington reporting evacuations; they were caused by contaminated individuals reporting to the emergency department (ED) of the hospital: “Seven (64%) of the 11 hospital evacuations occurred in EDs, although other areas of hospitals were also involved. Actual exposures that led to evacuations generally caused symptoms in medical staff, and all of these involved inhalation or airborne exposures, although dermal contact did occur in two individuals” (Burgess, 1999, p 51). The unpredictable and highly variable nature of potential hazardous materials incidents makes this cause of evacuation unpredictable, but this study indicates that intensive care patients are not likely to need to be evacuated from a hazardous materials incident.
because often times contaminated patients report to the ED, which isolates the incident to a small area within the hospital.

These examples found in the literature provide details and circumstances of various health care facility evacuations. The circumstances that led to evacuation can vary substantially. While some causes can occur in any geographic location such as bomb threats and internal facility fires, others, such as earthquakes, tornadoes and wildfires, tend to be isolated to particular regions. While these articles provide certain details that are invaluable, they do not provide many specifics about the evacuation of more complex patients, intensive care unit patients, in terms of the number of personnel involved, timing for particular periods in the evacuation and differences between equipment that each patient may require. Collaboration with local, state and federal entities are essential to the successful evacuation of a facility.

**Regional Evacuation Exercise**

In 2000, a regional exercise centered around Minneapolis, MN took place, which simulated a biological attack (Lord and Cieslak, 2004). This exercise involved numerous medical facilities in surrounding states, including Ohio, Indiana, Michigan, Oklahoma and Nebraska. The exercise involved several organizations that would likely be needed in a large-scale event; some of the organizations involved included the Department of Defense, the Civil Air Patrol, the U.S. Department of Veterans Affairs, the Federal Bureau of Investigation, Minnesota Department of Health and the Salvation Army.

There were two components to this exercise: first, volunteer high school students and civil air patrol were used to simulate patients that would likely be relocated from area hospitals to neighboring hospitals in order to make room for critical patients impacted by the biological or
chemical attack. They were transported to hospitals in neighboring states using aircraft from the Air Force Reserve and Minnesota Air National Guard’s fleets. The second component to this exercise involved a mix of mannequins and live volunteers that simulated patients suffering from exposure to botulinum toxin.

The comprehensive scope of this exercise allowed participants to realistically prepare for such a widespread event. It involved collaboration among the likely responders to a biological or chemical attack. A problem, however, occurred when executing this exercise because of the scarce resources. Several of the facilities that were originally scheduled to participate in the exercise were forced to limit or back out of the exercise entirely. Participating in the valuable training was deemed too taxing on the facility when day-to-day operations had to be simultaneously maintained. One important detail that emerged involved nursing and medical staff and their role in disaster response units.

Certain health care professionals who may work for local hospitals may also be military reservists who are, on occasion, called to duty. When health care personnel wear multiple hats it can be impossible for them to fulfill both of their roles. This unfortunate, and possibly detrimental, problem was made very clear in this exercise when participating hospitals in Minneapolis had staff members that were unable to fulfill their duties. When this occurs vacancies arise and the logistics of large-scale events become even further complicated.

Lastly, the resources involved in responding to disasters may come from different sources such as the U.S. Air Force Reserve or Veterans Affairs. This presented a challenge in this exercise because participants were unsure where resources were coming from and how much and what kind of resources would be available.
While this exercise provided valuable training and lessons learned for other facilities to use for their evacuation drills and plans, it is lacking any details relating to the transfer of ICU patients or the potential impact on the ICUs of impacted facilities. This is important due to the fact that ICU patients require substantial resources, which can be challenging for a facility that is experiencing an evacuation. Facilities located in an area that has been struck by an extreme event will likely be required to evacuate many, if not all, departments of the hospital. Details of specific department evacuations would be useful for planning purposes.

**ICU Evacuation Drills**

In what is described as a small Midwestern suburb in Michigan, a vertical evacuation simulation of ICU patients took place in March of 2003 (Manion and Golden, 2004). Through this simulation, Manion and Golden (2004) said the hospital had several goals: “1) identify resources and the time needed to evacuate the 12 patients from this ICU; 2) test a newly located emergency operations center (EOC); 3) test internal and external communications to be used during a vertical evacuation; 4) evaluate ‘grab-n-go’ oxygen cylinder; and 5) study the physiologic effects of the evacuation on the firefighters” (p. 15). In addition to physicians, respiratory therapists and nurses, local firefighters also participated in the evacuation. Local high school students acted as the patients with simulated conditions varying from postsurgical repair of an abdominal aortic aneurysm to a traumatic subdural hematoma, 1-day post craniotomy with multiple rib fractures and a hemothorax (Manion and Golden, 2004). Equipment was connected to students in the most realistic manner as possible; intravenous and respiratory tubing were taped to the skin.

“A time keeper was assigned to the ICU to document the first sight of firefighters into the unit, the time they exited a room with a patient, and the number of persons involved in the
transport off the unit” (Manion and Golden, 2004). Once evacuations began, the nurses working on the unit made a priority list, which prioritized the least critical patients first. This prioritization was similar to what was seen in the majority of the cases of true hospital evacuations discussed above. An average of six to seven people were required to evacuate each patient and the reported mean extraction time for each patient was 14.7 minutes (Gildea and Etengoff, 2005). The simulation reported several lessons:

1. More rescue personnel than evacuation plans call for is an inevitable part of an unplanned event (Manion and Golden, 2004).

2. “Critical-thinking skills are well-developed in an experienced staff” (Marion and Golden, 2004, p. 18). The procedure was modified during the evacuation, which allowed for easier patient transfer from their beds onto the stretchers.

3. “Planning for adverse conditions. The vertical evacuation drill reported in this drill occurred in stairwells that were lit, free of smoke, and from a unit that had not lost electrical power” (Marion and Golden, 2004, p. 18). This simulation was under ideal conditions so when planning, a team should expect the unexpected.

4. Having sufficient equipment in order to evacuate ICU patients is crucial. This includes sufficient portable oxygen tanks and stretchers or backboards. Some of the equipment in this drill was reused, which may not be realistic to a real-world evacuation. (Manion and Golden, 2004).

Another important aspect of this training exercise was to look at the firefighters involved and their level of fitness. A crucial component to the fitness evaluation was its division of firefighters into groups of either three or four (Gildea and Etengoff, 2005). Furthermore, these divisions allowed for logistical comparisons and to elucidate the optimal number of firefighters
for a vertical evacuation. Before and after the evacuation of each patient, the firefighters had their vital signs assessed to determine their levels of fitness and exertion throughout the exercise. Most of the firefighters showed an initial increase in their vital signs followed by a slight decrease, which was attributed to an initial arousal caused by the excitement and uncertainty when the exercise began and then the participants became accustomed to the way in which the evacuation was taking place (Gildea and Etongoff, 2005). However, the drill also noted that a few of the firefighters showed an increase in vital signs throughout the exercise, which indicated an increased level of exertion. This drill emphasizes the need for emergency responders to maintain a certain level of fitness in order to ensure a successful evacuation.

The optimal number of firefighters was an inconclusive outcome. The firefighters that participated felt that the optimal number was three firefighters (Gildea and Etongoff, 2005). They believed this because going down the narrow stairwells was easier with fewer people to accommodate. Three firefighters also allowed more space around the patients while being evacuated and therefore, the medical staff was able to access the patients for care. The authors of the article, on the other hand, felt that this drill may not have been realistic enough. Since the actors portraying the patients were local high school students, they tended to be small and easier to carry down the stairwells. In reality, ICU patients may be larger and although the lighter patients make the trek easier for smaller teams, the real-world may not support it (Gildea and Etongoff, 2005). Furthermore, the article also described how the stairwells may be crowded with other teams and rest periods may be nonexistent. The evidence provided by this article supports the author’s opinion that four emergency responders per patient may be an optimal number. When compounded with urgency, special limitations and physical demands, a more is better approach, with regard to the number of firefighters involved in an evacuation, may prove to be
the safest guideline. Skimping on the number of responders per patient may jeopardize patient safety during the evacuation so erring on the side of caution may be appropriate.

Summary

The literature contains numerous incidents requiring hospital evacuations. Some incidents that have occurred over the past two decades occurred more frequently or were, at the very least, documented more frequently, see Table 1. Additionally, the variety of incidents prompting evacuations requires different responses from each facility. Some facilities are impacted in a relatively minor way prompting only a partial horizontal evacuation; whereas other facilities may be impacted to the point of needing to do a full hospital evacuation where all patients must be transferred to other facilities, see Table 2 and Table 3. Numerous documented incidents prompting evacuations detail lessons learned. The documentations also detail discrepancies when compared to policies and procedures of other facilities and against accreditation requirements set by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). One such discrepancy can be seen when examining the patient priority during evacuations.
Table 1

Disaster Frequency Prompting Documented Evacuations

<table>
<thead>
<tr>
<th>Disaster Type</th>
<th>Reviewed Evacuations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous Material</td>
<td>12</td>
</tr>
<tr>
<td>Hurricane</td>
<td>10</td>
</tr>
<tr>
<td>Earthquake</td>
<td>8</td>
</tr>
<tr>
<td>Tornado</td>
<td>7</td>
</tr>
<tr>
<td>Fire</td>
<td>3</td>
</tr>
<tr>
<td>Flood</td>
<td>2</td>
</tr>
<tr>
<td>Power Outage</td>
<td>1</td>
</tr>
<tr>
<td>Terrorist/Bomb Threat</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2

Frequency of Evacuation Types

<table>
<thead>
<tr>
<th>Evacuation Type</th>
<th>Horizontal</th>
<th>Vertical</th>
<th>*Relocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Emergency</td>
<td>6</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>± Planned</td>
<td>0</td>
<td>0</td>
<td>17</td>
</tr>
</tbody>
</table>

Definitions
* Relocation - transferring patients to a different facility
☐ Emergency – emergent incident allowing minimal time for evacuation preparation
± Planned – incident which allows some level of preparation
Table 3

**Documented Full and Partial Evacuations**

<table>
<thead>
<tr>
<th>Evacuation Type</th>
<th>Reviewed Evacuations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial Evacuation</td>
<td>10</td>
</tr>
<tr>
<td>Full Evacuation</td>
<td>20</td>
</tr>
</tbody>
</table>

Patient priority is an issue that was discussed several times throughout the articles. The majority of the evacuations prioritized the most critical patients for first priority (Schultz, Koenig and Lewis, 2003; see also Vasudevan and Wade, 1997; “Georgia hospital hit by F3 Tornado – all patients evacuated through the ED,” 2007), see Table 4. Many of the documented incidents likely prioritized these patients because, due to their critical status, more resources, including personnel, must be allocated to these patients, so the sooner these facilities are able to transfer critical care patients to fully functioning facilities, the sooner the personnel and equipment can be allocated to less critical patients. However, several facilities documenting evacuations and the evacuation simulations reported evacuating the most stable patients first. When a threat is presented that may be considered an immediate and imminent danger to life, the strategy may be to save as many lives as possible. The more stable patients in hospitals require less support during an evacuation and so scarce resources may be allocated to many patients instead of a few and therefore, more lives may be saved. Ultimately, this may be a question of ethics for facilities. The patients, the patient’s family and the hospital personnel are all stakeholders in this decision and tough questions may have to be addressed with extremely limited time. Facing
realities such as, patients in the ICU are less likely to survive when compared to ambulatory patients, even without the added stress of an evacuation, are part of the planning process.

Table 4

*Patient Status in Relation to Evacuation Priority*

<table>
<thead>
<tr>
<th>Priority of Patients</th>
<th>Reviewed Evacuations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical/Non-ambulatory</td>
<td>9</td>
</tr>
<tr>
<td>Ambulatory</td>
<td>2</td>
</tr>
</tbody>
</table>

Communication needs were also frequently discussed as a source of problems when evacuations occurred. When a facilities phone lines are interrupted, walkie-talkies and cellular telephones tend to be used for communication (Sexton, Alperin, and Stobo 2007). A problem may present itself when the finite battery power of these devices runs out. It was frequently cited that having adequate battery power for potential communication is crucial to the successful functioning of a facility when an incident arises. Furthermore, the devices should be tested to ensure that they are able to receive signals in all areas of the hospital. Reliance on cell-phones should not be limited to one particular carrier. Widespread disasters may impact local cellular towers and affect certain networks more than others (Cocanour et al., 2002). Some facilities can be quite large and sturdy and may be capable of interfering with walkie-talkie and cellular telephone signals.
For certain disasters, such as hurricanes, a shelter-in-place\(^1\) approach may be used. Staffing retention issues may present and one successful strategy that has been used to prevent this issue has been to provide plans for the housing of staff members’ families and pets (Bernard and Mathews, 2008 and Mitchell et al., 2009). For certain incidents, such as a tornado, where staff are needed to assist after the incident, updated and easy access staff call-lists are essential (“Georgia hospital hit by F3 Tornado – all patients evacuated through the ED,” 2007) to meet the increased demands. To meet staffing shortfalls in certain situations, community volunteers, such as boy scouts, may be a valuable asset for a facility (Cocanour et al., 2002). After a large scale event, the usual medical transport vehicles may be limited; it is necessary to have prior arrangements with atypical modes such as working with local school districts to have school buses available.

As many facilities begin the conversion of traditional paper-based medical records to electronic medical records, access to reliable transferrable records is a necessity. Not only is this need demonstrated with patient transfers and the necessary medical information that must accompany them, but it is also seen by the need for continuity of care. The patient’s physician may need to follow the patient to the receiving facility and therefore, accurate records of patient transfers must be maintained. This also includes patients who may have expedited discharges due to an incident (Cocanour et al., 2002).

With power failure at a facility comes the problem of temperature control. Several facilities cited temperature regulation as a potential problem (Bernard and Mathews, 2008 and

\(^1\) Shelter-in-place – this method refers to maintaining operations during an incident as was cited in the San Joaquin County Hospital Evacuation Plan. Shelter-in-place is also referred to as defend-in-place as was cited in the New York Centers for Terrorism Preparedness and Planning Hospital Evacuation Protocol.
Nates, 2004). Loss of power can occur with many types of incidents and generator failure was not an uncommon occurrence, especially when the duration of the incident lasted more than a few hours or a sudden and catastrophic incident occurred. Extreme temperature, whether hot or cold, can cause stress on not just the patients but the staff as was cited by Bernard and Mathews (2008), “Without electricity or generator power, portable fans no longer worked and temperatures soared to 110 degrees Fahrenheit...we attempted to stay hydrated, but many of our staff and family members succumbed to the heat and dehydration and required administration of IV fluids” (p. 220).

Loss of water for facilities during an incident presented many challenges as well. Hygiene capabilities quickly deteriorate under such conditions (Bernard and Mathews, 2008). Bathrooms may be useless meaning that bodily wastes must be disposed of in ways that are less than ideal creating the perfect circumstances for disease transmission (Bernard and Mathews, 2008; see also Sexton, Alperin, and Stobo, 2007). Facilities may install private wells and have agreements with outside water vendors in order to have an adequate and reliable supply under all circumstances (Mitchell et al., 2009).

Table 5

Summary of Problems Associated with Evacuating

<table>
<thead>
<tr>
<th>Disaster Type</th>
<th>Cited Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthquake</td>
<td>Power failure - no elevator use, no mechanical ventilation</td>
</tr>
<tr>
<td></td>
<td>Water damage - overhead sprinklers, pipe bursting</td>
</tr>
<tr>
<td></td>
<td>Telephone unreliability - inability to communicate externally, overloaded cellular systems</td>
</tr>
<tr>
<td></td>
<td>Absence of management - reduced decision-making capacity</td>
</tr>
<tr>
<td></td>
<td>HICS - difficulty implementing the standardized system</td>
</tr>
</tbody>
</table>
### Table 5 Continued

<table>
<thead>
<tr>
<th>Disaster Type</th>
<th>Cited Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire</td>
<td>Orthopedic transfers - difficulty moving orthopedic patients due to deep vein thrombosis and dislocation risks</td>
</tr>
<tr>
<td></td>
<td>Communication - updating staff on timelines</td>
</tr>
<tr>
<td></td>
<td>Patient information - not all patient information may be transferred to receiving facilities</td>
</tr>
<tr>
<td></td>
<td>Outside weather - inclement weather may further jeopardize patient's health</td>
</tr>
<tr>
<td>Hurricane</td>
<td>Flooding - renders equipment and areas of the hospital useless</td>
</tr>
<tr>
<td></td>
<td>Complete utility loss - no use of plumbing including sewage backup, electricity or telephone service</td>
</tr>
<tr>
<td></td>
<td>Battery failure - cell phones, radios, medical equipment relying on battery power will fail</td>
</tr>
<tr>
<td></td>
<td>Heliport information - no knowledge of heliport to relay, travel arrangement confusion</td>
</tr>
<tr>
<td></td>
<td>Transporting isolettes - moving baby isolettes presents identification problems, fitting in vehicles, ventilation failures</td>
</tr>
<tr>
<td></td>
<td>Climate humidity control - no power results in extreme internal temperatures and humidity</td>
</tr>
<tr>
<td></td>
<td>Looter threats - criminals threaten staff and patients</td>
</tr>
<tr>
<td></td>
<td>Traffic - substantial transport time increases</td>
</tr>
<tr>
<td></td>
<td>Vehicle availability - large scale events may reduce availability of evacuation vehicles</td>
</tr>
<tr>
<td></td>
<td>Cellular use - within the facility cell phones may not receive reception in all locations</td>
</tr>
<tr>
<td></td>
<td>Lighting - lighting may be limited or nonexistent in areas such as stairwells</td>
</tr>
<tr>
<td></td>
<td>Volunteer use - volunteers tire, their use is finite</td>
</tr>
<tr>
<td></td>
<td>Equipment transfers - equipment that accompanies patients to other facilities may not be recovered if not tracked</td>
</tr>
<tr>
<td></td>
<td>Staffing levels - staff may be unavailable if they're preoccupied with the incidents impact on their family/property</td>
</tr>
<tr>
<td></td>
<td>Government guidance - government may be unable to provide direction during an event</td>
</tr>
</tbody>
</table>
Some of the problems encountered in the different disasters were universal. Communication, transportation and staffing problems were cited in numerous incidents. Some disasters tend to present very unique problems to the facilities. For example, during tornadoes, vehicles and other large debris may severely impact the ability to transport patients via the usual

### Table 5 Continued

<table>
<thead>
<tr>
<th>Disaster Type</th>
<th>Cited Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood</td>
<td>Generator location - basement generators may be flooded</td>
</tr>
<tr>
<td></td>
<td>Surgical procedures - surgery may be occurring during an event</td>
</tr>
<tr>
<td></td>
<td>Air quality - generators may contaminate internal air</td>
</tr>
<tr>
<td>Bomb Threat/Terrorist</td>
<td>Revenue loss - revenue may be severely impacted, costs must be tracked</td>
</tr>
<tr>
<td></td>
<td>Premade worksheets/checklists - ease of evacuation can be accomplished through ample evacuation worksheets</td>
</tr>
<tr>
<td></td>
<td>Surgery schedule - the upcoming surgeries may need to be cancelled</td>
</tr>
<tr>
<td></td>
<td>Evacuation announcement - use of plain English evacuation announcement</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Patient families - patients may become distressed without family during an evacuation</td>
</tr>
<tr>
<td></td>
<td>Staff relocating - staff may be required to relocate along with patients during transfer</td>
</tr>
<tr>
<td>Tornado</td>
<td>Damaged vehicles - ambulances may be damaged, cars may impede roadways</td>
</tr>
<tr>
<td></td>
<td>Voice amplification - without power, directions must be able to be given over a potentially loud, chaotic situation</td>
</tr>
<tr>
<td></td>
<td>Surge - local damage may result in an influx of patients to a disrupted hospital</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Staff impacted - staff may be injured coming in contact with contaminated patients</td>
</tr>
<tr>
<td></td>
<td>Bed availability- improvisation may have to be used when relocating patients to a facility other than a hospital, i.e. tables</td>
</tr>
</tbody>
</table>
exit routes. In a hazardous materials incident where a patient contaminates the emergency
department, staff and the facility may be uniquely impacted. Understanding the challenges that
each disaster poses ensures a more effective response.

The level of detail provided in the reviewed evacuations was consistent throughout.
Articles tended to report broad details presenting the scenario and the facility wide evacuation,
but specifics regarding any particular subpopulation within the facility were lacking. The most
detailed description of an evacuation was a simulation of an evacuation for critical care patients
(Manion and Golden, 2004). The review of the available literature leaves gaps of information
for those interested in incident planning. What are general times involved with evacuation?
What are realistic personnel expectations for an evacuation of critical patients? What equipment
will need to be involved for evacuation of critical patients? These questions are left relatively
open. It is crucial that data be made available for those involved in planning evacuations so that
the best decisions can be made that will result in a successful and smooth evacuation for all
patients within the facility.

Evacuation Plans

Reviewing current evacuation plans is integral to fully grasping today’s state of hospital
preparedness. A total of four evacuation plans were reviewed, which is sufficient to see a
snapshot of preparedness. For proprietary, legal and security reasons, hospitals are reluctant to
relinquish copies of their plans and therefore, they have proven difficult to obtain. The plans
vary in scope and geographic location allowing for more diverse samples to be used for
evaluation.
Creating an evacuation plan for a hospital is not only a requirement for accreditation; it is a requirement that ensures a level of preparedness and in turn, safety for its employees and patients. When creating an evacuation plan, there are many areas that must be addressed: 1) when to evacuate, 2) where to evacuate and 3) who will be involved in the evacuation. Additionally, plans need to incorporate instructions for special needs populations, management personnel for the incident, patient record transfers and transfer facilities. The Joint Commission on Accreditation of Healthcare Organization (JCAHO) sets the standards for emergency management.

The standard for emergency management can be found in the 2007 edition of JCAHO’s annual accreditation manual for hospitals (see Table 6). As per the JCAHO standard, hospitals must examine all of the potential hazards that may affect their community and the facility, directly or indirectly. Furthermore, the standard also requires hospitals to be active with the community so that if and when an incident arises, the community and the hospital can work in collaboration with relative ease. This standard also includes a requirement for the community’s first responders to be notified in the event of an emergency.

Table 6

The Joint Commission Summary Emergency Management Guidelines

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Performance Standard Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Determine potential disasters that may affect ability to provide services</td>
</tr>
<tr>
<td>2</td>
<td>Determine most likely emergencies to impact the facility</td>
</tr>
<tr>
<td>3</td>
<td>Establish an integrated command structure both internally and with the surrounding community</td>
</tr>
<tr>
<td>4</td>
<td>Create a written emergency management plan that can be implemented successfully</td>
</tr>
<tr>
<td>5</td>
<td>The plan will detail emergency mitigation, preparedness, response and recovery</td>
</tr>
<tr>
<td>6</td>
<td>The plan will describe when it is to be initiated and there will be a method for notifying personnel</td>
</tr>
<tr>
<td>Guideline</td>
<td>Performance Standard Description</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>7</td>
<td>The plan will specify employee responsibilities and will allow for notification of emergency responders.</td>
</tr>
<tr>
<td>8</td>
<td>The plan details evacuating the facility.</td>
</tr>
<tr>
<td>9</td>
<td>The plan allows for transferring of patients by identifying receiving facilities, transportation, tracking and communication.</td>
</tr>
<tr>
<td>10</td>
<td>Communication capabilities are maintained during an emergency.</td>
</tr>
<tr>
<td>11</td>
<td>Necessary medical functions can be maintained during an emergency (electricity, water, ventilation, medical gases).</td>
</tr>
</tbody>
</table>

Adapted from JCAHO’s 2007 Accreditation Manual, Section 2, EC 4.10

JCAHO’s lack of description is presumably intentional. Due to the wide variation between the various facilities that they accredit, there must be a degree of flexibility. For example, while one facility that is accredited by JACHO may be located in a rural area that is not likely to fall victim to a terrorist attack but can easily fall victim to a tornado will have different plans in place when compared to a facility located in a major metropolitan area that may be impacted by a terrorist attack or earthquake.

The most important aspect to the standard may well be the requirement for having a plan in place for both horizontal and vertical evacuations. Related to this requirement, JCAHO also requests that hospitals have adequate communications with geographically close facilities. It is crucial for hospitals to have planned provisions with neighboring facilities, which allow for rapid patient transfers in the event of an evacuation.

The facility must identify what relationships are currently established with other organizations and facilities in the community and how those can be utilized for preparedness. Relationships such as those formed for joint endeavors including educational activities held for the community, can be built upon when planning. Ties with the local emergency responders, schools and other health facilities can be strengthened. The hazards that are unique to the facility’s community need to be assessed and then used in the planning process. A set of expected goals for a potential incident need to be established so that the endpoint is clear to
everyone involved. The current capabilities of the facility need to be considered while developing a plan. JCAHO also describes the need for mental health needs to be considered when planning. Those involved, including the health care personnel, may be presented with challenges in which a mental health professional may need to be involved in order to ensure a holistic approach to treatment. Outward physical distress may not cover any potential mental distress. Furthermore, JCAHO also emphasizes the need for identifying vulnerable populations. The uniqueness of different populations and differences in the layout of different facilities creates a need for a detailed and well-thought plan. Additionally, JCAHO identifies the need for drills. They include in their guidelines a need to utilize all potential players in incident response including potential receiving facilities and emergency management services. Familiarity with the incident command system, through training is also stated as an important aspect of training. Realism of the drill adds to the value of the training by creating as realistic scenario as possible (Gildea and Etongoff, 2005).

San Joaquin County Hospital Evacuation Plan² (SJCHEP)

In collaboration with the San Joaquin County Public Health Officer, the San Joaquin County Emergency Medical Services Agency Administrator developed a hospital evacuation plan for San Joaquin Acute Care Hospitals. This plan addresses the evacuation protocol and logistics for the area’s facilities with special emphasis on transferring the patients. The plan adopted the use of the Hospital Emergency Incident Command System (HEICS).

² All information in this section was taken from the document cited below:
Hospital Evacuations: Historical Precedence and Modern Preparedness - Squillace

The plan allocates many of the responsibilities of hospital evacuations to San Joaquin’s Emergency Medical Services (EMS). For example, during an evacuation, all available beds and patient transfers are to be coordinated by the Disaster Control Facility provided by the San Joaquin General Hospital (SJGH), but if SJGH is the impacted hospital, the plan calls for an EMS Agency Duty Officer to coordinate with other hospitals in the area in order to determine where available beds are located. This process is centralized and relieves the burden of coordinating the available beds and patient transfers from the individual hospitals.

The SJCHEP identifies three types of evacuations, each requiring different responses: emergent evacuation, planned evacuation, and shelter-in-place evacuation. The first type of evacuation is referred to as an emergent evacuation, which the SJCHEP defines as an, “unplanned spontaneous movement of patients out of the hospital due to an immediate threat that renders the facility unsafe for occupancy” (p 6). During this type of evacuation, the EMS Agency Duty Officer helps coordinate the Medical Mutual Aid system once the evacuating hospital has evacuated the patients to a safe nearby area such as a parking lot. Additionally, this evacuation type recommends the practice of having registered nurses accompany any critical care patients being transferred to other facilities whenever possible. Incarcerated patients are required to have a correctional officer accompany them during the transfer.

Planned evacuations are another type of evacuation that this plan identifies. When circumstances arise that do not pose an immediate threat to the patients or personnel within the facility, such as a malfunction in the heating, ventilation and air-conditioning system of a hospital during a period of extreme temperatures, a more orderly and staggered evacuation may be executed. The procedures for evacuation are similar to that of an Emergent Evacuation other than the lack of involvement from the Disaster Control Facility. Instead, many of the
coordinating efforts among the other agencies rest primarily on the EMS Agency Duty Officer’s shoulders.

The third and last type of evacuation is the shelter-in-place method. Though not a true evacuation, this method is also referred to as defend-in-place. Under this approach, the affected hospital will likely be encountering a situation such as a nearby volatile chemical spill that is producing toxic chemical vapors, and the appropriate response will be to secure the facility’s external openings such as windows and doors in addition to shutting down the HVAC system.

**New York Center for Terrorism Planning and Preparedness**

The New York Center for Terrorism Planning and Preparedness, NYCTPP, was designed to assist in the planning for emergency events for a consortium of several major hospitals located in the greater New York City Area. Through a grant received from the federal government, an emergency management protocol was developed for the participating institutions that outline the appropriate strategies for managing an incident that can impact the facility’s ability to operate. Sections within this protocol lay general foundations for specific facilities and those facility’s departments to use as a general framework when developing their own specific plans.

The protocol addresses circumstances in which evacuation may be deemed necessary. It underscores the fact that, due to the extreme nature of a hospital evacuation, evacuations are only appropriate as a last resort. The plan goes on to detail various methods of handling emergencies in relation to evacuation techniques. Several times the protocol states that whenever any patient is in immediate danger, no matter the circumstance, the first priority is for the staff member to

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3 All information in this section was taken from the document cited below:

move the patient away from the immediate danger without waiting for any orders, which is contrary to how the rest of the plan requires evacuation to take place under the orders of the Incident Commander, IC.

The facilities are required to follow the Hospital Emergency Incident Command System (HEICS) model, which describes the individual positions of a team responding to an incident. Under the model, the IC is the person who determines if evacuation is necessary. Either the Liaison Officer or the IC is in charge of notifying the Office of Emergency Management in New York to help determine the appropriate level of evacuation and the safe perimeters for evacuation. There are three approaches to emergencies, which vary among their potential to adversely impact the patients and staff: defending-in-place, horizontal evacuation and vertical evacuation.

The first response is to defend in place, which was stated in the NYCTPP Hospital Evacuation Protocol as, “the safest place for a patient is in his/her room” (p. 9). As the name of the strategy implies, defending-in-place requires personnel to close doors and windows and isolate themselves with the patient such as in case of a small fire in a distant location. The second approach presents itself when there is a situation in which the patient’s current location places them in danger, and then a horizontal evacuation may be appropriate. In this type of evacuation, patients are moved from their current locations to another area located on the same floor so as to prevent unneeded stresses on patients. As a last resort, the third approach, a vertical evacuation, may be the safest and most appropriate evacuation for patients. A vertical evacuation requires patients to be moved from their current location to another floor. This can be very taxing on patients and personnel due to the instability and equipment associated with more critical patients. A vertical evacuation can easily transition into a total facility evacuation,
which requires hospitals to completely evacuate all personnel, patients and any other persons present within the facility.

The protocol details the priority in which patients are to receive when evacuating: first priority for evacuation are any patients who are in immediate danger, ambulatory patients are to be evacuated next, then patients in wheelchairs, isolettes or cribs should be evacuated and lastly, patients who are bedbound.

The personnel working at the facility during an incident have responsibilities outlined in the protocol. Many of the non-clinical staff members have supporting roles that may be different from their usual duties during an emergency such as the building services personnel are expected to assist in moving patients. Furthermore, the protocol identifies the importance of volunteers and details specific procedures and duties that can be assigned to volunteers. The NYCTPP Hospital Evacuation Protocol states that, “significant number of people will volunteer their help during an emergency, including family members, visitors and nearby residents” (p 7).

During an emergency, the protocol states under the general standards section that additional personnel are to be requested during an emergency, especially during a night or weekend when low-staffing is likely. Furthermore, the protocol states the patient’s belongings, including medical records, should be placed in a well-labeled bag.

Vulnerable populations including patients in the ICU, labor and delivery, mother-baby unit, pediatrics, NICU and psychiatric unit are each addressed in the protocol giving attention to their specific needs (NYCTPP, p 13-14). The protocol calls for ICU patients to be carefully evaluated in order to possibly discharge as many patients as possible to their homes. By discharging as many patients as possible, scarce and taxed resources and personnel can be allocated to the most critical patients. For those patients who are not discharged, careful
coordination among the medical/surgical staff and respiratory therapists needs to take place in order to evaluate which equipment is necessary for evacuation.

Evacuation of ICU patients can be done by wrapping them in blankets and using stretchers and beds depending on the circumstances. Children are also addressed in this section by stating that they are to be treated as any other patients. Interestingly, the NYCTPP Hospital Evacuation Protocol states that for ambulatory children, an evacuation line should be formed alternating between younger and older children in the line; this procedure is the same for ambulatory confused and coherent ambulatory patients alternating between the confused and coherent in the evacuation line. For the former, this procedure is likely to help keep the younger children calm and organized and for the latter, the coherent can assist in keeping the confused calm and cooperative. Lastly, babies in incubators are addressed by stating that the incubator, with the baby inside, should be moved. In the event of a total facility evacuation, the protocol outlines a patient tagging system that assists in the triage and transportation processes. The evacuation tags should contain information about the patient to help determine the appropriate form of transportation and will help prioritize the order of the patients in the evacuation. Additionally, tagging helps with tracking patients. In order to ensure a successful evacuation, the protocol recommends the frequent evaluation of current lists and agreements with transportation resources and partnered facilities. The protocol’s description of the appropriate transportation measures drives home the importance of collaborative and communicative relationships, not only with neighboring hospitals, but also with EMS services as far away as neighboring states.
Washington Hospital Center Emergency Evacuation Plan\textsuperscript{4} (WHCEEP)

Washington Hospital Center, a private hospital located in Washington, D.C., provides the public access to their emergency evacuation plan. The details of potential evacuations and the necessary procedures that are to follow are outlined in this plan. The call to evacuate can only be initiated by a high-ranking staff member of the hospital including the IC, Nursing Supervisor, administration, Safety Officer or EMS. During an evacuation, the Hospital Emergency Operations Center (EOC) will direct all evacuations with the necessary personnel. Under ideal circumstances, the EOC should be activated prior to evacuation but different incidents may not permit this.

In this evacuation plan, several evacuation types are identified including an Emergency Evacuation, Controlled Evacuation, Partial Evacuation and Full Evacuation. An Emergency Evacuation takes place when an event occurs that is immediately threatening the facility’s ability to operate and/or lives within the hospital. A Controlled Evacuation occurs when a threat is presented that does not necessitate a rapid and immediate evacuation. Emergency and Controlled Evacuations are further subdivided into Partial and Full. A Partial Evacuation is one in which the hospital will only partially evacuate and is further broken down into two categories: horizontal and vertical. A horizontal evacuation is described as moving patients to a different section on the same floor that is separated via a smoke barrier door. On the other hand, a vertical evacuation is moving the patients from one floor to another. A vertical evacuation, by default, should always take place by using the stairwells unless the IC authorizes the use of elevators. In

\footnote{\textsuperscript{4} All information in this section was taken from the document cited below: (n.d.) \textit{Washington Hospital Center Emergency Evacuation Plan}. Retrieved April 9, 2010, retrieved from http://www.uha-utah.org/DisasterPrep.htm}
the most serious situation a full evacuation will be needed, which requires the entire facility to be evacuated. Under most circumstances, the building is to be evacuated from a top down fashion.

In the event that the evacuation procedures are activated, the IC is to communicate with neighboring facilities in order to determine where bed space is located, should transfers be required, and to acquire additional personnel for evacuation assistance. Each floor is required to evaluate all the patients located within it to determine which patients will be evacuated first. The plan also calls for a minimum of two-person teams to evacuate patients; ambulatory patients are to be evacuated via the outside stairwell and non-ambulatory patients are to be evacuated via the interior stairwell.

Staffing duties and allocations for the evacuations are clearly outlined. A respiratory therapist is required to accompany each ventilated patient. The plan recognizes that some non-ambulatory patients may require up to four team members to assist in evacuation. Contrary to how most of the historical evacuations prioritized patients, the WHCEE Plan calls for patients in immediate danger to be evacuated first followed by ambulatory patients, semi-ambulatory patients and lastly, non-ambulatory patients. These patients are to be classified via a color-coded sticker system.

The WHCEE Plan lists several potential ways for non-ambulatory patients to be evacuated including using an evacuation chair, stretchers, blanket dragging, 2-person carry and 1-person shoulder carry. When elevators are unavailable, the plan identifies using an evacuation chair as the best mode of evacuation for patients who can tolerate the position. For other patients, a stretcher may be more suitable. While using a stretcher, the patient should be carried feet first. Although no details are provided as to why this position is preferred, it may be due to
the blood flow in patients being angled downward in the stairwell. To reduce the level of stress on the patient, keeping the head elevated is best.

During an emergency horizontal evacuation, it may be necessary to evacuate patients by wrapping them in a blanket and dragging them headfirst. If, under these circumstances, a stairwell must be used, then the patient may be dragged down the stairs on a mattress. The 2-person carry method is another option available during an emergency evacuation. This method involves placing both arms of the patient across the shoulders of two people allowing the two people to carry the patient. Under extreme circumstances, a patient may be draped over the shoulder of one person and evacuated.

When the evacuation notification has been issued, the departments are to activate their disaster radios. Personnel communications will utilize either the radio or cellular phone. Staff members are permitted to use their personal cell phones for the evacuation and the plan states that they will be reimbursed for any expenses incurred. Similar to the other plans listed, the Hospital Emergency Incident Command System (HEICS) will be used for managing an incident. Under this plan and HEICS, protective services are to help ensure that certain areas have been evacuated by placing an X on the door of the room. The plan also identifies the transport unit leader as the coordinator of patient transfers with the use of vehicles including the MedStar ground and air transport and the use of ambulances, helicopters, buses and moving vans as needed. The plan prioritizes the use of the closest facilities first, which should come as no surprise because this strategy puts the least amount of stress on patients and staff. Lastly, the WHCEE Plan gives details about the recovery and cleanup portion of the evacuation process.
Dayton, Ohio Hospital Emergency Evacuation Plan\(^5\) (DHEEP)

The DHEEP begins by explaining the types of evacuations that the hospital may encounter: partial evacuation and complete evacuation. The partial evacuation is described as an evacuation that relocates patients, visitors and/or staff to a safe location from a specific area within the hospital that is being threatened, but not the entire facility. A complete evacuation, on the other hand, involves relocating all patients, visitors and/or staff to a safe area outside the hospital. No further details of evacuation subtypes are provided.

The plan lists potential incidents that may prompt an evacuation including fire, earthquake, tornado, hazardous/infectious materials, structural damage and loss of utilities. The IC is responsible for mandating an evacuation except in instances where an immediate threat is posed to a patient(s). A code yellow will be announced over the intercom system three times indicating an evacuation is underway. Two entities are to be involved in the response, the Montgomery County Office of Emergency Management and the Greater Dayton Area Hospital Association.

The plan specifies that ambulatory patients are the first priority for evacuation followed by non-ambulatory patients. Physicians and nursing leaders are responsible for prioritizing the patients for evacuation. Ambulatory patients are to be evacuated in a lined-up fashion with hands linked and are to be led by an assigned staff member. Methods for removing non-ambulatory patients are listed and include wheelchairs, gurneys, stretches, one or 2-person drag, blanket drag and beds. The stairs are to be used for evacuation unless otherwise stated and

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\(^5\) Due to proprietary, safety and legal concerns, the hospital that submitted their evacuation plan requested to not be explicitly identified in the review.
evacuated patients are to have their rooms marked with tape signifying that the room is been cleared.

The DHEEP goes on to detail the appropriate documentation that is to be completed during an event. Appendices in the plan provide the forms that are to be used to track patients and detail information about their medical status and the location to where they are being discharged. Additionally, the vehicles that are to be used are listed and include Wright Patterson Air Force Base buses, veteran’s affairs buses, local EMS and local public transportation.

DHEEP then goes on to list the duties and responsibilities of the positions within HEICS. The IC, Logistics Section Chief, Security and the Facilities Unit Leader are all delegated the responsibility of identifying a safe evacuation route. Furthermore, all patients are to have their charts accompany them throughout the evacuation, which is to include their name on the bag with their belongings. This responsibility for obtaining the patient’s charts is delegated to the Unit Clerk. Discharge records are also to be kept, which will be completed by strategic placement of personnel to document all patients exiting the hospital. Personnel in security and telecommunications are responsible for arranging for more staff members to assist with the evacuation as needed.

**Discussion**

The NYCTPP, WHCEEP and DHEEP were all individually critiqued. The SJCHEP was not individually critiqued due to its encompassing nature and that it aims to address the external hospital evacuation process, not the internal. All four plans were then compared against each other and against the guidelines set by JCAHO. Lastly, recommendations and conclusions were made from the historical evacuations and the reviewed plans.
NYCTPP Critique

The NYCTPP describes the prioritization of patients for evacuation. It lists ambulatory patients are to be evacuated first followed by non-ambulatory patients. This prioritization runs contrary to the many documented evacuations. In fact, virtually all of the reviewed evacuations that have occurred in U.S. facilities over the last 20 years that were well-documented prioritized bed-bound patients for primary consideration during an emergency.

When discussing the labor pool that will be available to assist with the evacuation, the NYCTPP asserts that volunteers will be available to assist. Although this influx of volunteers may occur, it may come off as presumptuous to assume that there will be an abundance of manpower in an emergency. Moreover, plans that rely too heavily on a highly variable volunteer labor pool may find themselves unable to respond efficiently to an emergency. Furthermore, the planners should be aware that incidents may occur during times where visitors are scarce such as the night or weekend. Furthermore, the skills that volunteers may bring may be of little use for the hospital during a complicated and chaotic evacuation situation. Volunteers in some circumstances could prove to be more burdensome than they’re worth.

When manpower is limited, additional personnel are to be requested. The protocol, however, does not detail a way that best addresses a potential staffing shortage in an emergency event. If an immediate emergency presents, staff may have minimal time to address staffing needs and so clarification would greatly reduce this potential liability. For example, stating that an updated phone list is to be kept in a certain area within the department would allow for quick direction for those referencing the evacuation plan during an incident.

The plan does detail many specifics regarding special needs populations including children and psychiatric patients. The plan details appropriate measures to take during an
evacuation when it describes the appropriate way to line patients up. Although individual hospitals must assess their own population and address it accordingly, it is a good idea for hospitals to mention these populations to some degree. At a minimum, the plan should acknowledge their special needs populations even if they do not require variations in the general evacuation plan.

Although this is unique and the detail provided can act as a template for other facilities, a point of concern can be found when the protocol states that in certain situations two babies may be placed in one incubator. While this may be necessary in certain circumstances, special attention should be given to ensuring the baby’s identity so as to avoid an accidental swap of identification. Extraordinary circumstances may require extraordinary measures that under normal circumstances would be considered a liability, i.e. risking a baby identity swap. However, the risk of death outweighs liabilities that the hospitals may face.

**WHCEEP Critique**

The WHCEEP states that floors will be contacted by the IC to determine the order in which patients are to be evacuated. Interestingly, there are no guidelines provided as to how the order should be determined and with the potential chaos in an emergency evacuation, one wonders how the floor staff will have time to not only determine which patients are to be evacuated first, but also how to coordinate this with other floors and departments. It is difficult to determine how this classification method will occur in combination with patients being prioritized on each floor and floors as a whole being prioritized in relation to other floors when the evacuation plan calls for a top down evacuation method. ICs must be able to effectively dictate which floors are to be prioritized to the necessary personnel based on the guidelines established by the plan.
The plan details certain personnel that are to be involved with evacuating and transferring the patients during the events: a respiratory therapist is to assist ventilated patients; nurses are to maintain a ratio of 5:1 during the evacuation; physicians, nurse practitioners and physician assistants are to assist with transferring patients whenever necessary. While this level of direction adds depth to the plan, no explanations are given on how this level of staffing will be reached and no alternatives are listed. Additionally, respiratory therapists are to assist patients while they are being evacuated through the stairwell. With four people carrying the patient down a poorly lit stairwell, respiratory therapists may not be able to perform their duties. Further elaboration of how this is to take place would strengthen this plan.

As has been observed in actual evacuations, ensuring that the radios are functional throughout the facility is vital. Since cell phones are permitted to be used, various cell phone providers should be tested throughout the facility in order to ensure functionality. These verified carriers and cell phone types can then be listed in the plan. This may be crucial in an instance where team members need assistance and only one cell phone is available that is non-functional in a certain area of the hospital.

**DHEEP Critique**

The DHEEP contains several shortcomings. First, the DHEEP lists partial evacuation and complete evacuation as the types of evacuations that the hospital may undergo. This neglects the level of detail that should be provided in a plan; it should also describe horizontal versus vertical evacuations and planned versus emergent. Providing further detail into the various types of evacuations that the hospital may encounter will not only give better understanding to the staff of the hospital but it will also empower personnel to critically think in emergency situations.
JCAHO requires that hospitals complete a risk assessment for potential hazards that may impact hospital operations. DHEEP’s list of potential hazards could use a few more examples including flooding. Flooding would pose unique hazards to the hospital and given the geography of the Dayton area, flooding is a real possibility. Furthermore, by providing a more detailed and comprehensive listing, personnel can be better prepared to respond to all hazards and be less likely to be caught off guard.

The IC, according to HEICS, has many responsibilities and is ultimately responsible for ordering the evacuation. This plan along with all of the plans that were reviewed, however, does not indicate who is to fill this role, although presumably it may be the Chief Executive Officer. Moreover, the plan does not address who shall fill this role if an incident occurs at a non-peak time: nights and weekends.

Furthermore, patient prioritization does not include floor prioritization. If stairwells have to be used for the evacuation a more organized description such as a top down fashion evacuation would be useful. DHEEP describes several methods for removing patients from the hospital but techniques such as one or 2-person carries, and blanket drags, which were described in the WHCEP, are not given any further description on how these methods are executed. This may be problematic during an incident for staff members who are unaware of the techniques and which methods should be prioritized. Although this may seem like common sense to some, these details should not be neglected because of the false belief that it will be easy to disseminate this information to staff members during an incident.

The IC, Logistics Section Chief, security and Facilities Unit Leader are all delegated the responsibility of identifying a safe evacuation route. While in practice this will likely take the efforts of many individuals, clarification as to how this information will be communicated to
those evacuating patients and from whom is crucial. In the chaos of an incident, potentially conflicting signals on safe evacuation routes may jeopardize the success of the evacuation and what’s worse, may jeopardize the safety of the personnel, patients and visitors. A hierarchy should be provided with specifications that all others involved in this evaluation are to report their findings to the position that is responsible for the final determination.

The plan describes the available modes of transportation and with whom they are to be coordinated. However, no mention of mutual aid agreements suggests the plan is relying on the assumption that these resources could be made available quickly. The transportation should also list school buses as a viable option as these have been utilized in several incidents. Additionally, aerial transportation should be acknowledged possibly by detailing area landing spots such as a helipad or parking garage. Related to transportation are the facilities that will receive patients.

Bed availability will not be known until an incident occurs because this is a constantly changing variable. The plan should, however, make note of local facilities and have aid agreements with more distant facilities should a large scale disaster occur that impacts all of the area hospitals.

During an incident phones may be unavailable, which is resolved by the plan listing radios as an alternative means for communication. However, no mention of cellular phones and alternative power sources for these devices is provided, which has been a source of problems in numerous incidents. Additionally, off-duty personnel may be called upon to assist in the evacuation. The plan delegates this responsibility to security and telecommunications, but as was mentioned several times in prior incidents, ensuring an up-to-date contact list is crucial. To ensure adequate assistance, the plan should also mention a provision for volunteers to assist
during the evacuation. Volunteers could be organized based on their capabilities and distributed appropriately to the floors by a thorough needs assessment.

**Comparisons of the reviewed evacuation plans against each other and JCAHO**

The four reviewed plans are written on different levels of specificity: the WHCEE Plan and the DHEEP are specific to one facility; the NYCTPP Plan addresses the management strategies of a partnership of several hospitals that will share resources in an event and are geographically close; the SJCHE Plan addresses the management strategies for all the hospitals located within San Joaquin County, California. The growing scope of these plans in combination with four different locations addressing different scenarios provides a unique opportunity to see how these plans compare to each other and how they address the standards set forth by JCAHO.

JCAHO requires that hospitals identify the most likely hazards that they face. This allows for the planners to be mindful of the hazards and developing appropriate protocols that help mitigate adverse consequences in such events. The NYCTPP lists numerous potential incidents that can impact the hospitals. It creates two categories of emergencies: internal and external. In the NYCTPP’s listing of internal emergencies: it identifies fire, smoke, fumes, loss of environmental support services, loss of medical gases, armed intruders and explosions as cause for activation of the emergency plan. The external disasters are general with natural hazards such as floods, earthquakes and tornadoes in addition to power outages, terrorism, gases and radiation. The external disaster listing could be expanded upon and list more specific hazards such as specific terrorist threats and elaboration of potential toxic gases that may be released.
The WHCEEP, when compared to the NYCTPP lists a broad set of hazards. WHCEEP relies heavily on high-level positions such as the Engineering Manager to recognize structural, non-structural and utility functionality; the medical staff or Chief Nursing Officer to evaluate the capacity for adequate patient care; the radiation Officer to determine radiation hazards; protective services dealing with combatants. Moreover, the DHEEP also provides a general list of potential incidents that may impact the facility. Without the specific list of hazards that the facility faces, it may presumably be difficult to recognize an emerging situation for staff that are not in the said positions. This approach is different from the NYCTPP and may not adequately address the standard set by JCAHO.

The SJCHEP does not list hazards that may impact the facilities within the county. The developers of the plan may have intended the individual facilities to list the hazards and did not want to duplicate efforts. When SJCHEP lists the various types of evacuations such as emergent, planned and shelter-in-place, it gives examples of hazards that may prompt this evacuation type. It uses fires, air-conditioning failure and chlorine gas release as examples. Given that this plan addresses an area prone to earthquakes and wildfires, these are important examples that should be included.

JCAHO requires plans to incorporate a command structure within the facility to respond to an incident. Furthermore, the command structure should be easily integrated into the community. The NYCTPP does not explicitly list a command structure. There are several instances where the NYCTPP identifies individuals that are within the Incident Command Structure but does not identify who will fill these roles and additionally, it does not give details as to the responsibilities of these individuals. Without information given on the Incident Command Structure, no information can be given as to how these roles will be integrated into the
community to respond to major incidents. Since the NYCTPP addresses multiple facilities, the command structure may be viewed as a responsibility of individual facilities to recognize but that leaves the potential for difficulty integrating responses with other facilities. On the other hand, the SJCHEP, which is also a plan that addresses the strategies for incident response, does give extensive detail into the command structure.

SJCHEP details a broad level of command structure that may easily be integrated into the command structure at individual facilities. It lists the positions and duties of those positions necessary to conduct patient transfers. These positions are necessary once the patients have been evacuated from the facility and need to be transferred to receiving facilities, which incorporates tracking efforts, identifies patient beds at receiving facilities and secures the necessary transport vehicles. This approach seems valid given the number of facilities that it encompasses.

The WHCEEP gives the most specific details on the command structure within HEICS including: the Incident Commander, Liaison Officer, Nursing Unit Leader and Patient Information Officer. Listed within the description of duties by each position are ways in which these positions will link in with the community’s IC as a Unified Command Structure. The extensive list of positions and duties by the WHCEEP addresses JCAHO’s standard.

Similarly, the DHEEP provides a detailed description of positions found in the HEICS model. The plan lists the IC, Operations Sections Chief, Logistics Section Chief, nursing unit leaders, Transportation Leader, security, Facilities Leader and telecommunications. The plan lists the necessary duties of each position but there are some overlapping duties that were discussed in the DHEEP critique.

The four plans all offer varying levels of response and mitigation strategies necessary to address the difficulties of an incident. However, JCAHO also requires the need to incorporate
recovery efforts: a return to usual services provided by the facility. Only one of the four plans
details information on how the facility is to return to normal operations, the WHCEEP.
WHCEEP lists strategies for the restoration and reopening of the facility which include the
necessary Officers to make the determination of what needs to be done and the point at which the
facility is deemed safe and operational again. WHCEEP also details how the patients will be
returned to the facility once reopened by discussing the transportation and documentation
necessary to execute this successfully.

Maintaining communication capabilities is listed by JCAHO as necessary for incident
response. The NYCTPP addresses the need for emergency communication by first recognizing
that the usual modes, hospital telephone service, may no longer be viable options. The plan lists
portable radios and public address systems as potential options for communication. This
ambiguity is likely due to the tailored backup communications that individual facilities may use,
which may vary from one hospital to another. The SJCHEP does not list backup communication
options, but does list the phone numbers that may be used when coordinating the response with
other agencies. If phones are no longer in service within the hospital, the plan does not identify
ways in which the organizations can be contacted. The WHCEEP lists backup emergency radios
for use during an incident. Furthermore, each department has at least one radio that may be used
during the incident. The plan also goes on to list the staff cell phones as a communication
resource during an event. DHEEP provides the least amount of detail in regards to alternative
communications. It briefly mentions radios are to be used in the event that phones are unavailable.

There is substantial variation among these plans. They all address many of the standards
set by JCAHO differently; in part due to their scope in terms of the number of facilities they
encompass and also due to their geographic differences. Some of the plans do not explicitly address all of the standards set by JCAHO, which may indicate that they are relying on other areas to address these standards such as reliance on specific hospitals or even specific departments within the hospitals to set these standards. Clarification and standardization will allow more seamless responses to events.

**Tying It All Together**

The literature related to hospital evacuations contains numerous, recurring problems related to evacuating the facility. Problems related to staffing, communication, lighting, climate, transportation and patient tracking littered the literature. Through this review it has been made evident that often times, facilities are not sufficiently prepared for disaster events. Though hospitals cannot guard against every possible scenario, they are obligated to develop a plan that can be successfully executed with short notice when an incident occurs. It is not only necessary for accreditation through JCAHO, as a crucial piece in the community, the facility’s ability to adequately respond to an incident ensures overall community resiliency.

Staffing levels can be impacted in a number of ways during an incident. In a non-emergent event such as a flood or hurricane, it may be wise for hospitals to consider having plans in place to house staff and even the family and pets of staff members (Siders and Jacobson, 1998). This strategy was utilized by a number of facilities and most certainly improved the outcome of the incidents when compared to not providing this option to their staff. Additionally, the time of day the incident occurs greatly impacts the level of response. If the event occurs at a time of day when staffing in the facility is low, it will be significantly more difficult to be able to safely extract patients from the facility. For example, the optimal number of persons that are
needed to carry an intensive patient down a stairwell was shown by Manion and Golden (2004) to be four. Furthermore, as the NYCTPP required, a respiratory therapist is to accompany intubated patients during the evacuation. Moreover, a person who will carry flashlights for lighting and guidance for the evacuation team in a darkened stairwell may be necessary. If an incident occurs during a night or weekend, having six people who are able to assist with each patient may be unrealistic. Updated call-lists are essential for facilities. Call-lists leads into a related and frequently cited source of problems for facilities, communication.

During an event, communication becomes crucial. Many hospitals have internal phones that may also link to outside lines. During many events, such as tornadoes and earthquakes, phone lines may be structurally damaged. Many facilities that have evacuated reported using radios; however, a reported problem with this was that frequencies may overlap with other emergency units in or around the facilities. In order to avoid this, specific and unique frequencies should be established within the plan and should also be coordinated with area emergency responders.

Furthermore, the structure may limit the ability for the radios to transmit signals from all areas of the hospital. Radios also have a finite battery life and in an event where the power has failed, recharging may not be an option (“Georgia hospital hit by F3 Tornado – all patients evacuated through the ED”, 2007). This indicates that in addition to having radios that have been tested throughout the hospital, backup battery sources should also be on hand. Relying on generators to power the recharging units is not sufficient as has been seen in certain incidents where flooding, hurricanes and generator fires have caused generator failure. Another alternative to using radios may be for the facility to rely on cellular telephones.
In several incidents and the WHCEE Plan, cellular telephones were or are to be used in an event that calls for alternative communication devices. Barring complications to the cellular towers, this may be a viable temporary alternative, however, like radios, cellular phones also rely on battery power. Additionally, the cellular signals may not be able to be transmitted through the facility. During an incident that impacts a large geographical area, landlines and cellular signals may be overwhelmed (Chavez, 1995). Phone systems should be able to prioritize signals to hospitals and emergency responders. Moreover, communication to large masses of patients, families and employees may be difficult without a functioning overhead speaker system. It is recommended that hospitals have battery powered voice amplifying devices such as megaphones available for an incident (“Georgia hospital hit by F3 Tornado – all patients evacuated through the ED”, 2007).

Lighting problems were cited in incidents where power failure occurred. Stairwells may be poorly lit during an incident; therefore, a sufficient number of flashlights must be on hand in order to ensure that adequate light can be made available. Backup power for flashlights must also be made available. Hospitals should consider having alternative lighting devices available such emergency lighting in stairwells that can operate independent from the generator power.

Having inadequate control of the climate during an event was commonly cited as a major problem during incidents. In fact, during Katrina, patient fatalities were attributed to the overwhelming heat and humidity that ensued after days without power during the intense New Orleans summer heat (Bernard and Mathews, 2008). In upstate New York, where the horizontal evacuation caused by a fire in a lower part of the facility led to a horizontal evacuation, the author cited that if the event had required the entire facility to be evacuated, patient safety may have been compromised due to the extreme cold (Carey, 2007). Additionally, earthquakes in
California have also taxed the patients after being evacuated outdoors where the temperature fluctuated from unseasonably cold to summer heat (Chavez, 1995). It is clear the plans must address temperature regulation in the event that power is lost. In the Northridge earthquake, staff ingeniously used their cars to keep some patients warm (Chavez, 1995). Having an adequate number of blankets to provide for patients in areas that are prone to cold temperatures, in addition to having heat packs such as those that work on reactive iron, may be valuable during an event. Furthermore, for areas that experience extreme heat, having excess cooling packs and other battery powered cooling devices may protect against some of the agony experienced during Katrina.

Acquiring transportation in order to transfer patients to safer facilities is essential for a full vertical evacuation; unfortunately, this was also cited as a source for problems in many evacuations. During Katrina, the scope of the disaster showed that even if prior arrangements such as agreements with busing services are in place, the transportation may never show up (Thomas and Lackey, 2008). Buses that the facility had anticipated never arrived because they were commandeered by state officials for transporting prisoners to safety. Also in Katrina, problems were encountered when knowledge regarding the hospitals unused helipad was limited (Bernard and Mathews, 2008). Facilities must have information regarding their helipad readily available for staff to access during an incident. As was cited in the NYCTPP, updating mutual aid agreements and having an extensive list of resources available for transportation needs is essential. Hospitals should not limit themselves to just emergency vehicles but may want to consider using buses, which can be accessed through agreements with local school districts. Even hearses and staff vehicles should be considered. With transporting patients comes the added difficulty of tracking.
Tracking patients through an incident to the receiving facility and back to the original facility can be a challenge. For one, transferring the patient’s records and belongings with them can be very difficult given that most facilities are now using electronic medical records and if an emergent event occurs such as a fire, there may be little to no time to print records to send with the patients. Furthermore, in the chaos of an evacuation, having someone record to where the patients are going is more easily said than done (Nates, 2004). The WHCEE Plan calls for staff members to follow certain patients to the receiving facility but this may further complicate the transfer process. This idea may prove difficult to implement due to the fact that very few of the historical evacuations documented transferring personnel along with patients. Staff members are still needed in order to assist with the remaining patients. A hard-copy documenting system should be available at all times with this responsibility delegated to well-trained personnel prior to an incident. The SJCHEP and DHEEP provide model templates for patient tracking that can be used adopted by other facilities.

One recurring theme that has been presented several times in this review is of patient prioritization. In general, most of the documented incidents chose to evacuate the non-ambulatory patients before the ambulatory patients. In sharp contrast, the plans that discussed patient prioritization consistently stated that ambulatory patients are to be evacuated prior to non-ambulatory patients. The best response is one that can be adapted to the situation at hand. During emergent events where the facility and patient’s lives are immediately threatened, the most ethical solution is to evacuate as many people as possible. With limited personnel that may be spread thin, prioritizing ambulatory patients is the most logical decision. However, in instances that allow for a more organized evacuation such as a utility failure or flooding, the ability of the facility to provide for non-ambulatory patients that may require resources such as
ventilators and suction, not to mention the increased number of personnel, evacuating non-
ambulatory patients may be the best option. A plan that incorporates both prioritizations with
ample explanations as to when they should be used ultimately provides the most well-thought,
ethical plan.

In order to ensure a successful evacuation it is crucial that facilities regularly hold
evacuation drills that require participation from all employees. Furthermore, regular updates of
the plan and call-lists are essential. Employees must also be sure to regularly review the
evacuation plan and understand their role within the plan. Ultimately, the employees will be
better prepared to anticipate and quickly identify potential incidents.

Disasters such as hurricanes, earthquakes and fires provided numerous articles
documenting evacuations; however, events that may be equally as common but scarcely
documented, such as floods and bomb threats, were not well-represented. In the future, more
details regarding these types of events should be recorded. Additionally, a universal
documentation tool would be invaluable for making uniform conclusions from these events such
as the documentation template designed by Schultz, Koenig, Hedie, and Olson (2005). Many of
the documented incidents lacked certain details, such as those relating to the cleanup process and
how specific patient populations, such as ICU patients, were evacuated down stairwells. A tool
that could be distributed by JCAHO for just such an event would add strength and depth to
evacuation plans. Moreover, a central database documenting all evacuations would allow
researchers to be able to readily contact the facilities documenting an evacuation and statistics
could be provided for risk assessment. Interviews with individuals who participated in
evacuations could add substantial depth to the existing body of knowledge.
A database like the one described above could be further expanded to include hospital emergency management plans. It proved difficult to find hospital evacuation plans. This can likely be attributed to two things: proprietary reasons and safety reasons. Hospitals, unfortunately, must compete with other facilities in their geographic area and therefore, by letting their competition have insight into their plans, they may be concerned that their competitors may exploit their perceived shortcomings. For safety reasons, hospitals may be concerned that their plans could be used to take advantage of the evacuation process by those who would want to harm the facility or the people within.

In general, the findings of this review are consistent with the existing literature. Hazardous materials, earthquakes and hurricanes were the most common cause for evacuation, which supports an earlier review performed by Sternberg, Lee, and Huard (2004). Many of the recommendations that have been provided were offered consistently in the literature by those who had experienced an evacuation. Mindful planning that incorporates the lessons learned from prior events and utilizes the strategies taken by other hospitals’ planning committees will improve the outcomes to incidents.

**Conclusion**

It has been shown that, contrary to what many hospital administrators would like to believe, incidents prompting hospital evacuations can and do occur. The literature is dotted with incidents ranging from tornadoes to bomb threats. It is a safe assumption that for every evacuation that was documented in some detail there have been countless others that were not written about. Consolidating what literature is available and extracting the important lessons learned has been crucial for comparisons against existing hospital evacuation plans and
JCAHO’s requirements. Hospitals do evacuate, the question all facilities need to ask is, are they ready for when it happens to them?
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