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Emergency Preparedness for Imaging Service Providers

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Executive Summary

- While the images of Hurricane Katrina are still vivid, it is important to draw from them the lessons that can be applied to protect patient care services in the event of other disasters. It is important that healthcare providers anticipate the possibility of these events and plan accordingly.

- A comprehensive plan involves preparation for a disaster, prioritization of the community’s immediate needs to restore critical patient care services first, and prevention of future event impacts.

- A number of considerations should serve as a starting point for conversations regarding a facility’s emergency preparedness plan. These involve identifying potential natural and man-made disasters, utility interruptions, equipment damage, patient transportation, care prioritization, and potential outside resources.

- Some important points to remember when preparing for substantial wind and flood damage:
  - Follow original equipment manufacturer (OEM) recommendations regarding preemptive equipment power-down/ramp-down, particularly for concerns about storm quenches.
  - For magnetic resonance imaging (MRI) scanners, maintain Running, top off cryogens, if possible.
  - Cover all non-removable equipment with taped-down heavy plastic sheeting to protect against roof failures/leaks.
  - Raise all electronic equipment and emergency response supplies as high off the floor as safely possible to protect against flooding.
  - Provide adequate food and potable water for staff/patients that cannot be evacuated.
  - Prior to the storm, contact vendors to secure options on mobile imaging equipment, portable generators, and cryogen service after the storm passes.
  - If power is lost, restore power to the MRI cold-head as quickly as possible.

For most Americans—indeed, much of the world—a good portion of early September was spent watching the disaster created by Hurricane Katrina unfold in Louisiana, Mississippi, Alabama, and the Florida panhandle. The devastation is so vast that sometimes it seems unreal, other times all too real.

With the lion’s share of the news coverage about the pressing need to save lives and find suitable shelter for the displaced, the extent of the damage to the region’s healthcare infrastructure may only really be quantified in the months yet to come. It is known that the devastation will be enormous. One imaging provider with 4 facilities in the New Orleans area was expecting that all 4 magnetic resonance imaging (MRI) systems would be destroyed and that its buildings were likely damaged, if not completely destroyed.

In the Gulfport-Biloxi area, where the hurricane winds and storm surge scoured the coastline, Hurricane Katrina leveled structures and denied electricity to a number of those that avoided substantial damage. Hospitals and imaging centers have scrambled to care for the injured with greatly limited services.

While the images of Hurricane Katrina are still vivid, it is important to draw from them the lessons that can be applied to protect crucial patient care services in the event of other disasters. After all, between earthquakes, tornados, fires, ice storms, and widespread power outages, there are disasters, both natural and man-made, that can impact everyone, regardless of location. Therefore, it is important that healthcare providers anticipate the possibility of these events and plan accordingly.

Preparation

Whether looming close, or over a distant horizon, healthcare professionals may have to deal with an emergency situation at some point during their careers. When that “perfect storm” strikes a facility, will radiology administrators know what to do to protect their facilities, equipment, staff, and patients?

While some of the following considerations may not be relevant to every facility, there are circumstances that should be a part of any preparation strategy.
Water Damage

Whether from roof failure, burst pipes, storm surge or rising rivers, every facility has the potential for water damage to equipment and facilities. Damages can range from inconveniences cured by a couple of hours with a wet-dry vacuum, to flooding of equipment electronics and a subsequent quench of MRI systems. It does not take much water to incapacitate or destroy millions of dollars of imaging equipment.

Structural Damage

Whether from hurricane-force winds, earthquakes, or even simply shoddy construction, structural failure is also a universal concern to all radiology / imaging facilities. Building codes require much greater stoutness of hospitals than outpatient facilities, though no one is completely immune from the potential. Even if a structural failure did not incapacitate a facility’s imaging equipment, it could leave the building uninhabitable for days, weeks, or months. A mobile ultrasound unit likely could be removed to serve patients elsewhere; however, modalities such as computed tomography (CT), positron emission tomography (PET), and MRI—which are built-in to a space—are captive until the building can be rehabilitated or the equipment removed and relocated.

MRI presents a particular challenge with structural failure. The vibration alone could initiate a quench and damage the radio frequency (RF) shield. In the process of being ripped apart, iron or steel elements of the building construction can be torn loose and drawn to the MRI, turning it into a stationary version of a junkyard magnetic crane. Provided the magnet is not critically damaged in the structural failure, superconducting magnets may be ramped-down, allowing the steel pieces from the building to be removed. However, permanent magnets, frequently used in many low-field open systems, could wind up an irresolvable tangle looking more like postmodern sculpture than MRI.

Power Outage

As was shown in the widespread power outage that struck many northeastern and great lake states that plunged New York City into darkness, it does not take nature to create disaster situations. Short of the tongue depressor and stethoscope, most diagnostic tools rely on sophisticated computers and reliable sources of power to operate. Widespread power outages can disable all but the most rudimentary means of diagnosis and treatment.

Fortunately, most modalities that are dark during the outage can be quickly restarted once the power is restored. MRI, always the exception to the rule, may be damaged by prolonged power outages. Without an operational vacuum pump to keep the cryogen within the MRI cold, the cryogen will begin to bleed off at an accelerating rate. At some point—likely a few days to perhaps a week—after power is lost, the magnet may spontaneously quench, discharging all of its remaining cryogenic gasses, posing a safety risk to anyone near the discharge and potentially destroying the magnet’s capacity to run in the future. However, if power to the vacuum pump and cryogen levels are restored prior to a quench, there should be no long-term consequences to the magnet’s operation.

Prioritization

Once the disaster has hit, it is important to assess the immediate needs of the community and restore those critical patient care services first.

For example, while bone scans are vital to preventative care for many, after an earthquake, osteoporosis will undoubtedly take a back seat to broken limbs and other trauma. Restoring the operation of equipment and facilities in these critical situations should not fall to a “catch as catch can” model. Healthcare providers, even those dedicated to outpatient care, will need to triage their own facilities, first restoring the services that are most critically needed in the wake of the disaster.

This triage takes 2 forms—protection and restoration. Protection is what can be done to prevent damage to equipment and patient care services to enable a more rapid return to service later. This may involve temporary power to an MRI’s cold head, for example, or sandbags. Restoration is what can be done to return a facility to operation as quickly as possible, such as clearing storm debris or repairing building damage.

These activities should be closely coordinated with the local or regional emergency management officials to make sure that the most vital community assets receive the greatest protection and highest priority should they need restoration. But simply having a set of priorities does not mean that the facility will have the tools needed to actualize them.

Prevention

While this really should be the first topic, human nature is to apply lessons learned the hard way—by personal experience. Perhaps the magnitude of the Hurricane Katrina devastation has given those removed from the immediate impact a sense of what it has been like—and will motivate healthcare professionals to try and minimize the impacts of future events.

Do whatever is necessary can to avoid the normal “hard-knocks” curriculum. Learn from others’ experiences. One does not need to be in Mississippi to recognize the consequences of high winds or flooding. And one does not need to be in New Orleans to see the short sightedness of putting emergency generators in flood-prone basements. In the years to come, the tragedies of Hurricane Katrina will spawn new building codes and planning tools, but healthcare professionals do not need to wait before we can intelligently plan for disasters.

While it is the nature of catastrophes to be surprises, healthcare professionals can anticipate the types of disasters that have higher likelihoods. California and coastal
Alaska can expect earthquakes. The central and southern plains states can anticipate tornadoes. Northern states can expect massive snows or ice storms. Anywhere downstream of a major watershed should consider flooding a real possibility. Fortunately, there are resources for healthcare professionals developing an emergency preparedness plan. State and federal offices of emergency preparedness are dedicated to anticipating and preparing for the specific threat for any region (Table 1).

Even for those in areas of particular risk and without a plan, all is not lost. There is no bad time to develop an emergency response plan—though it becomes far more complicated to try and develop the plan during the emergency, as opposed to the months and years ahead of one.

The hallmark of most disasters is not a new pathogen that the healthcare system cannot treat. It is that the disaster directly affects hospitals and healthcare providers. When this happens, the point is soon reached where run-of-the-mill healthcare issues such as simple infections and dysentery cannot be treated in a timely fashion. It is this breakdown in simple health maintenance that is the greatest threat to the public.

In order to prevent the incapacitation of radiology services—one of the crucial elements of the contemporary healthcare system—radiology administrators must assess the criticality of services and of the facilities and equipment that are vital to sustaining those services. They must plan how to support the physical department—the bricks and mortar—that are the platform from which radiology professionals care for the public.

Fortunately, one of the major threats to the healthcare system is also one of the easiest to correct. Temporary electrical power can be provided either through on-site generators or, if a radiology administrator is willing to wait for help to arrive, through a number of companies that can bring a generator on the back of a truck. If using the latter option, consider having a pre-approved contract with a vendor that outlines what is required and when it would be delivered on site. Co-generation, or generating one's own electricity all the time, may not be economically feasible for smaller or stand-alone sites, but it is increasingly appealing to hospitals for a number of reasons, emergency capacity being one only.

The second threat is damage to equipment and facilities that cannot be repaired quickly. For those who find themselves in this situation, a veritable semi-trailer-based radiology department can be just a phone call away. There are providers who can appear on site—assuming that they can get there—with CT, MRI, and every other imaging modality that will fit in the back of a semi-trailer. For gravely incapacitated facilities, this sort of mobile fleet may be the only means of quickly restoring radiology capacity.

When planning renovations or upgrades to an existing facility, think about what would minimize disaster-related damage and downtime and what would facilitate the rapid restoration of critical patient care services. Again, this does not have to be an “all or nothing” proposition. A facility can make incremental planned improvements that can compound over a series of equipment upgrades and remodels.

For those thinking of an expansion or new location, now is the perfect opportunity to plan the facility that will be of the greatest value to patients and the community at the time when it will be needed the most. The good news is that the incremental costs of building in emergency preparedness are minor—if they are part of the overall planning effort.

**Key Questions**

Below are a number of considerations that should serve as a starting point for conversations about a plan for emergency preparedness at a facility.

- What are the likely possible natural disasters to affect the area?
- What are the likely possible man-made disasters to affect the area?
- Would electrical power be interrupted?
- Would other utilities (natural gas, telecommunications, etc) be interrupted?
- What equipment would be inoperative during the outage?
- What equipment could be damaged by the outage?
- What equipment should be provided with critical or backup power?
- If the utility service is not quickly restored, what other risks are there?
- Would patients and staff be able to get to the facility?
- Would patients or staff be trapped at the facility?
- What is the criticality of each patient care service provided at the facility?
- In order of criticality, how does the facility protect the equipment needed to support each service?
- If the facility does not have the resources on site, who can provide them?

**Conclusion**

If Hurricane Katrina teaches anything, it should be that Mother Nature has the capacity to affect the living conditions of millions of people. While the devastation along the Gulf Coast is astounding, it would be naive to suggest that the rest of the world is safe because it is removed from hurricane alley.

Particularly, those involved in providing patient care should look to how they will provide care at the times when it is most widely and desperately needed. They may find that while staff is willing, the facilities, equipment, and infrastructure required have not been adequately protected. Today is the day to start to change that by protecting facilities, equipment, and, ultimately, patients.

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