Smith Seminars
Continuing Education Credits
AARC-Approved for 2 CRCE
Emergency Preparedness

Objectives
1. Identify the factors of natural disasters
2. Become aware of the components man-made disasters
3. Become familiar with bioterrorism factors and biological warfare agents
3. Identify pandemic flu infection and prevention factors
4. Review the role of respiratory care in the disaster response

Disasters are typically viewed as low probability yet high impact events. Although various definitions have been used, a disaster is frequently viewed as a situation in which the number of patients presenting to the medical facility within a given time period exceed the ability of the hospital to provide care without external assistance. As such, the definition is institution specific, and therefore preparedness must be likewise institution specific. The same event may represent a disaster for a 30 bed hospital and simply tax the capacity of an 1800 bed institution.

The term "hospital preparedness" is a catch-all phrase, covering a multitude of inter-related areas of medical and non-medical disaster management. Although the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) mandates specific standards for hospital preparedness, in many institutions these standards never extend beyond the written page. Prior to September 11 2001, hospital preparedness focused on either natural, or unintentional man-made mass casualty events accidents, including earthquakes, tornadoes, commercial building collapse, airline and school bus accidents. Since September 11, 2001, the reality of U.S. vulnerability to domestic terrorism has translated into an increased sense of urgency to prepare for potential terrorist acts. While each institution is mandated by JCAHO to develop a specific and unique disaster plan, certain elements of the plan are universally applicable.

One of the principal concerns in hospital preparedness is the determination of adequate staffing capabilities. The current health care situation is marked by lack of surge capacity and general staff shortages, all of which are expected to worsen over the next decade. Nursing shift "call-offs" are a routine event at many institutions, with the subsequent result of under-staffing during daily operations. Concern exists at many levels regarding staffing patterns during times of disaster hospital operations.

Much of the attention has been focused upon nursing issues. However, attention should also be placed upon ancillary staff and management. The ancillary staff is required for the hospital to function. Without trained housekeeping and maintenance staff, there is the potential for nosocomial spread as well as potential delay in the disposition and rooming of admitted patients. Despite the critical role of these individuals in hospital functioning, these ancillary staff may be more vulnerable to absenteeism during a disaster event due to a lack of medical awareness regarding actual versus perceived personnel risks. The importance of the management cannot be stressed. Institutions which led by example appeared to engender to support and trust of their staff.

Health care workers do not live within an insular system, and may be directly and personally affected by the disaster. Adequate staff contingency planning should take this reality into account. Health care workers may be amongst the victims, as may their families. After a disaster that significantly affects the local infrastructure, it may be necessary to provide safe shelter and food to the families of affected staff members. Without providing this, there will be little incentive for those staff members to report to work.

Modern health staffing is also convoluted. Individuals may be employed simultaneously by several hospitals, EMS agencies, and disaster teams. In the setting of a disaster, the presence of such individuals at any one institution cannot be assumed, and should be accounted for.

The nature of the disaster may impact staffing issues. In one survey, the willingness of staff to respond to a disaster was placed in the context of whether the disaster was an airplane crash scenario, a radioactive "dirty" bomb, or a biological agent scenario. The number of staff willing to work extra hours to care for disaster victims varied depending upon the circumstances, with 98% willing to help after an airline disaster, 76.4% willing to help after a radionuclide event, and 60.9% willing to work after a infectious agent scenario.

Natural Disasters

A natural disaster is the consequence of a natural hazard, such as volcanic eruption, earthquake, or landslide, which affects human activities. Human vulnerability, exacerbated by the lack of planning or lack of appropriate emergency management, leads to financial, environmental or human losses. The resulting loss depends on the capacity of the population to support or resist the disaster, their resilience.

A natural hazard will never result in a natural disaster in areas without vulnerability, such as strong earthquakes in uninhabited areas. The term natural has consequently been disputed because the events simply are not hazards or disasters without human involvement.

An avalanche is a geophysical hazard a slide of a large snow (or rock) mass down a mountainside, caused when a buildup of snow is released down a slope, it is one of the major dangers faced in the mountains in winter. An avalanche is an example of a gravity current consisting of granular material. In an avalanche, lots of material or mixtures of different types of material fall or slide rapidly under the force of gravity. Avalanches are often classified by what they are made of.

An earthquake is a phenomenon that results from a sudden release of stored energy that radiates seismic waves. At the Earth's surface, earthquakes may manifest themselves by a shaking or displacement of the ground and sometimes tsunamis. 90% of all earthquakes, and 81% of the largest, occur around the 40,000km long, which roughly bounds the Pacific Plate. Many earthquakes happen each day, few of which are large enough to cause significant damage.

A lahar is a type of natural disaster closely related to a volcanic eruption, and involves a large amount of material, including mud, rock, and ash sliding down the side of the volcano at a rapid pace. These flows can destroy entire towns in seconds and kill thousands of people.

A landslide is a disaster closely related to an avalanche, but instead of occurring with snow, it occurs involving actual elements of the ground, including rocks, trees, parts of

houses, and anything else which may happen to be swept up. Landslides can be caused by earthquakes, volcanic eruptions, or general instability in the surrounding land. Mudslides, or mud flows, are a special case of landslides, in which heavy rainfall causes loose soil on steep terrain to collapse and slide downwards.

A sinkhole is localized depression in the surface topography, usually caused by the collapse of a subterranean structure, such as a cave. Although rare, large sinkholes that develop suddenly in populated areas can lead to the collapse of buildings and other structures.

A volcanic eruption is the point in which a volcano is active and releases its power, and the eruptions come in many forms. They range from daily small eruptions which occur in places like Kilauea in Hawaii, or extremely infrequent super volcano eruptions, where the volcano expels at least 1,000 cubic kilometers of material in places like Yellowstone Caldera, which has the potential to become a super volcano in the near geological future. Some eruptions form pyroclastic flows, which are high-temperature clouds of ash and steam that can trial down mountainsides at speed exceeding an airliner.

Floods are the result of prolonged rainfall from a storm, including thunderstorms, rapid melting of large amounts of snow, or rivers which swell from excess precipitation upstream and cause widespread damage to areas downstream, or less frequently the bursting of man-made dams or levees. Tropical cyclones can result in extensive flooding and storm surge.

A tsunami is a wave of water caused by the displacement of a body of water. Tsunami can be caused by undersea earthquakes or by landslides. Meteotsunamis are caused by meteorological phenomena. A megatsunami is an informal term used to describe very large tsunamis. The largest waves are caused by very large landslides, such as a collapsing island, into a body of water.

A blizzard is a severe winter storm condition characterized by low temperatures, strong winds, and heavy blowing snow.

A drought is an abnormally dry period when there is not enough water to support agricultural, urban or environmental water needs. Extended droughts can result in deaths by starvation or disease, and can result in wildfires. Scientists warn that global warming may result in more extensive droughts in coming years.

A hailstorm is a natural hazard where a thunderstorm produces numerous hailstones which damage the location in which they fall. Hailstorms can be especially devastating to farm fields, ruining crops and damaging equipment.

A heat wave is a hazard characterized by heat which is considered extreme and unusual in the area in which it occurs. Heat waves are rare and require specific combinations of weather events to take place, and may include temperature inversions, katabatic winds, or other phenomena.

Cyclonic storms, tropical cyclone, and typhoon are different names for the same phenomenon: a cyclonic storm system that forms over the oceans. It is caused by evaporated water that comes off of the ocean and becomes a storm. The Coriolis Effect causes the storms to spin, and a hurricane is declared when this spinning mass of storms attains a wind speed greater than 74 mph. Hurricane is used for these phenomena in the Atlantic and eastern Pacific Oceans, tropical cyclone in the Indian, typhoon in the western Pacific.

An ice storm is a particular weather event in which precipitation falls as ice, due to atmosphere conditions.
A tornado is a natural disaster resulting from a thunderstorm. Tornadoes are violent, rotating columns of air which can blow at speeds between 50 and 300 mph, and possibly higher. Tornadoes can occur one at a time, or can occur in large tornado outbreaks along squall lines or in other large areas of thunderstorm development. Waterspouts are tornadoes occurring over tropical waters in light rain conditions.
A wildfire is an uncontrolled fire burning in wildland areas. Common causes include lightning and drought but wildfires may also be started by human negligence or arson. They can be a threat to those in rural areas and also wildlife. Wildfires can also produce ember attacks, where floating embers set fire to buildings at a distance from the fire itself.

Man-made Disasters

Man-made hazards are threats having an element of human intent, negligence, error or involving a failure of a system. Man-made disasters are the result of man-made hazards for which adequate emergency management measures have not been adopted.
Arson is the criminal intent of setting a fire with intent to cause damage. Arson is the greatest cause of fires in data repositories. Sometimes, human-induced fires can be accidental: failing machinery such as a kitchen stove is a major cause of accidental fires.
Civil disorder is a broad term that is typically used by law enforcement to describe forms of disturbance. Although civil disorder does not necessarily escalate to a disaster in all cases, the event may escalate into general chaos. Rioting has many causes, from low minimum wage to racial segregation.
Terrorism is a controversial term with multiple definitions. One definition means a violent action targeting civilians exclusively. Another definition is the use or threatened use of violence for the purpose of creating fear in order to achieve a political, religious, or ideological goal. Under the second definition, the targets of terrorist acts can be anyone, including civilians, government officials, military personnel, or people serving the interests of governments. In the early 21st century, terrorism has been considered by some a constant threat to all people of the world, after the worst disaster of its kind struck on September 11, 2001 (known primarily as 9/11).
Industrial disasters occur in a commercial context, such as mining disasters. They often have an environmental impact.
Structural collapses are often caused by engineering failures. Bridge failures may be caused in several ways, such as under-design, by corrosion attack, and by aerodynamic flutter of the deck. Other failures include balcony collapses.
A power outage is an interruption of normal sources of electrical power. Short-term power outages (up to a few hours) are common and have minor adverse effect, since most businesses and health facilities are prepared to deal with them. Extended power outages, however, can disrupt personal and business activities as well as medical and rescue services, leading to business losses and medical emergencies. Extended loss of power can lead to civil disorder. Only very rarely do power outages escalate to disaster proportions, however, they often accompany other types of disasters, such as hurricanes and floods, which hampers relief efforts.

Bush fires, forest fires and mine fires are generally started by lightning, but also by human negligence or arson. They can burn thousands of square kilometers. If a fire intensifies enough to produce its own winds and "weather", it will form into a firestorm. When nuclear weapons are detonated or nuclear containment systems are otherwise compromised, airborne radioactive particles (nuclear fallout) can scatter and irradiate large areas. Not only is it deadly, but it also has a long-term effect on the next generation for those who are contaminated. Ionizing radiation is hazardous to living things, and in such a case much of the affected area could be unsafe for human habitation.
An aviation incident is an occurrence other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operations, passengers, or pilots.
Space disasters, either during operations or training, have killed around 20 astronauts and cosmonauts, and a much larger number of ground crew and civilians. These disasters include either malfunctions on the ground, during launch, or in orbit with technology, or of natural forces. Not all space disasters result in human fatalities, for example, unmanned orbiting satellites that drop to the Earth can incinerate and send debris spewing across the sky.

Preparedness for Disasters

Although disaster-related deaths are overwhelmingly caused by the initial traumatic impact of the event, disaster preparedness plans should consider the health needs of the surviving disaster-affected populations. The health impacts associated with the sudden crowding together of large numbers of survivors, often with inadequate access to safe water and sanitation facilities, will require planning for both therapeutic and preventive interventions, such as rehydration materials, antibiotics and measles vaccination materials.
Disaster response teams should be aware of and have access to the latest updated guidelines for communicable disease prevention and control.
The risk of outbreaks following natural disasters, though often incorrectly connected to the presence of dead bodies, is closely related to the size, health status and living conditions of the displaced population. The risk of transmission of endemic communicable diseases, such as acute respiratory infections and diarrhoeal diseases, is increased in displaced populations due to associated crowding, inadequate water and sanitation and poor access to health care. Improved detection and response to communicable diseases is important in order to monitor the incidence of diseases, to document their impact and to help to better quantify the risk of outbreaks following natural disasters.

Bioterrorism & Biological Warfare Agents

Biological agents are easy to acquire, synthesize, and use. The small amount of agent necessary to kill hundreds of thousands of people in a metropolitan area makes the concealment, transportation, and dissemination of biological agents relatively easy. In addition, biological warfare agents are difficult to detect or protect against; they are invisible, odorless, and tasteless, and their dispersal can be performed silently.
Dissemination of biological warfare agents may occur by aerosol sprays, explosives (artillery, missiles, detonated bombs), or food or water contamination. Variables that can alter the effectiveness of a delivery system include particle size of the agent, stability of

the agent under desiccating conditions, UV light, wind speed, wind direction, and atmospheric stability.

The use of an explosive device to deliver and disseminate biological agents is not very effective, since such agents tend to be inactivated by the blast. Contamination of municipal water supplies requires an unrealistically large amount of agent and introduction into the water after it passes through a regional treatment facility.

To be an effective biological weapon, airborne pathogens must be dispersed as fine particles less than 5 mm in size. Infection with an aerosolized agent usually requires deep inspiration of an infectious dose. Advanced weapons systems, such as warheads or missiles, are not required for the aerosolized delivery of biological agents. Low-technology aerosolization methods including agricultural crop-dusters; aerosol generators on small boats, trucks, or cars; backpack sprayers; and even purse-size perfume atomizers suffice. Aerosolized dispersal of biological agents is the mode most likely to be used by terrorists and military groups.

Detection of biological agents involves either finding the agent in the environment or medical diagnosis of the agent's effect on human or animal victims. Early detection of a biological agent in the environment allows for early specific treatment and time during which prophylaxis would be effective. Unfortunately, currently no reliable detection systems exist for biological warfare agents. The US Department of Defense has placed a high priority on research and development of a detector system. Methods are being developed and tested to detect a biological aerosol cloud using an airborne pulsed laser system to scan the lower altitudes upwind from a possible target area. A detection system mounted on a vehicle also is being developed. This system will analyze air samples to provide a plot of particle sizes, detect and classify bacterial cells, and measure DNA content, ATP content, and identify agents using immunoassays.

A biological warfare agent attack is likely to be covert. Thus, detection of such an attack requires recognition of the clinical syndromes associated with various biological warfare agents. Physicians must be able to identify early victims and recognize patterns of disease. This requires integrated epidemiologic surveillance systems performing real-time monitoring with information shared at many levels of the health care system.

Preliminary criteria for suggestive outbreaks of disease that could provide indications of a possible biological weapons event include disease (or strain) not endemic; unusual antibiotic resistance patterns; atypical clinical presentation, case distribution geographically and/or temporally inconsistent; and other inconstant elements (number of cases, mortality and morbidity rates, deviations from disease occurrence baseline).

Indications of possible biological warfare agent attack include disease entity that is unusual or that does not occur naturally in a given geographic area or combinations of unusual disease entities in the same patient population; multiple disease entities in the same patients, indicating that mixed agents have been used in the attack; large numbers of both military and civilian casualties when such populations inhabit the same area; data suggesting a massive point-source outbreak; apparent aerosol route of infection; high morbidity and mortality rates relative to the number of personnel at risk; illness limited to fairly localized or circumscribed geographic areas; low attack rates in personnel who work in areas with filtered air supplies or closed ventilation systems; sentinel dead animals of multiple species; and absence of a competent natural vector in the area of outbreak (for a biological agent that is vector-borne in nature).

Protective Measures of Biological Warfare Agents

Protective measures can be taken against biological warfare agents. These should be implemented early (if warning is received) or later (once suspicion of biological warfare agent use is made). Currently, available masks such as the military gas mask or high-efficiency particulate air (HEPA) filter masks used for tuberculosis (TB) exposure filter out most biological warfare particles delivered by aerosol. Multilayered HEPA masks can filter 99.9% of 1- to 5-mm particles, but face-seal leaks may reduce the efficacy by as much as 10-20%. Individual face-fit testing is required to correct seal leak problems.

Most aerosolized biological agents do not penetrate unbroken skin, and few organisms adhere to skin or clothing. After an aerosol attack, simple removal of clothing eliminates a great majority of surface contamination. Thorough showering with soap and water removes 99.99% of the few organisms left on the victim's skin after disrobing. The use of sodium hypochlorite is not recommended over soap and water.

The use of special suits by health care providers is not necessary. Normal clothing provides a reasonable degree of protection against dermal exposure. Latex gloves and universal precautions provide sufficient protection when treating most infected patients. Place patients in a private negative-pressure room and practice proper sanitation with universal precautions. Proper disposal of corpses is essential. In the case of anthrax spores, this should be performed by incineration.

Of the potential biological warfare agents, only plague, smallpox, and viral hemorrhagic fevers are spread readily person to person by aerosol and require more than standard infection control precautions (gown, mask with eye shield, gloves). Regardless, place all potential victims of biological warfare agents in isolation. Medical personnel caring for these patients should wear a HEPA mask in addition to standard precautions pending the results of a more complete evaluation.

Broad-spectrum intravenous antibiotic coverage is recommended initially for victims when a biological warfare agent is suspected. Institute this even prior to the identification of the specific biological warfare agent. Vaccinations currently are available for anthrax, botulinum toxin, tularemia, plague, Q fever, and smallpox. The widespread immunization of nonmilitary personnel has not been recommended by any governmental agency. Immune protection against ricin and staphylococcal toxins may be feasible in the near future.

Influenza Pandemic

Influenza pandemics occur when a new strain of the influenza virus is transmitted to humans from another animal species. Species that are thought to be important in the emergence of new human strains are pigs, chickens and ducks. These novel strains are unaffected by any immunity people may have to older strains of human influenza and can therefore spread extremely rapidly and infect very large numbers of people. Influenza A viruses can occasionally be transmitted from wild birds to other species causing outbreaks in domestic poultry and may give rise to human influenza pandemics.

The World Health Organization (WHO) warns that there is a substantial risk of an influenza pandemic within the next few years. One of the strongest candidates is a highly pathogenic variation of the H5N1 subtype of Influenza A virus. As of 2006, prepandemic

influenza vaccines are being developed against the most likely suspects which include H5N1, H7N1, and H9N2.

Influenza, commonly known as flu, is an infectious disease of birds and mammals caused by an RNA virus of the family Orthomyxoviridae (the influenza viruses). In humans, common symptoms of influenza infection are fever, sore throat, muscle pains, severe headache, coughing, and weakness and fatigue. In more serious cases, influenza causes pneumonia, which can be fatal, particularly in young children and the elderly.

Sometimes confused with the common cold, influenza is a much more severe disease and is caused by a different type of virus. Although nausea and vomiting can be produced, especially in children, these symptoms are more characteristic of the unrelated gastroenteritis, which is sometimes called "stomach flu" or "24-hour flu."

Typically, influenza is transmitted from infected mammals through the air by coughs or sneezes, creating aerosols containing the virus, and from infected birds through their droppings. Influenza can also be transmitted by saliva, nasal secretions, feces and blood. Infections occur through contact with these bodily fluids or with contaminated surfaces. Flu viruses can remain infectious for about one week at human body temperature, over 30 days at 0 °C (32 °F), and indefinitely at very low temperatures (such as lakes in northeast Siberia). Most influenza strains can be inactivated easily by disinfectants and detergents.

Flu spreads around the world in seasonal epidemics, killing millions of people in pandemic years and hundreds of thousands in non-pandemic years. Three influenza pandemics occurred in the 20th century and killed tens of millions of people, with each of these pandemics being caused by the appearance of a new strain of the virus in humans. Often, these new strains result from the spread of an existing flu virus to humans from other animal species. Since it first killed humans in Asia in the 1990s, a deadly avian strain of H5N1 has posed the greatest risk for a new influenza pandemic; however, this virus has not mutated to spread easily between people.

Vaccinations against influenza are most commonly given to high-risk humans in industrialized countries and to farmed poultry. The most common human vaccine is the trivalent influenza vaccine that contains purified and inactivated material from three viral strains. Typically this vaccine includes material from two influenza A virus subtypes and one influenza B virus strain. A vaccine formulated for one year may be ineffective in the following year, since the influenza virus changes rapidly over time and different strains become dominant. Antiviral drugs can be used to treat influenza, with neuraminidase inhibitors being particularly effective.

Variants of Influenzavirus A are identified and named according to the isolate that they are like and thus are presumed to share lineage, according to their typical host, according to their subtype, and according to their deadliness.

Variants are sometimes named according to the species (host) the strain is endemic in or adapted to. Some variants named using this convention are bird flu, human flu, swine flu,

horse flu, or dog flu. Avian variants have also sometimes been named according to their deadliness in poultry, especially chickens, Low Pathogenic Avian Influenza (LPAI) and Highly Pathogenic Avian Influenza (HPAI), also called deadly flu or death flu.

In a bad pandemic, some communities attempt to cut themselves off totally while others have half (or more) of their population die, and others may not feel many of the effects but may still be affected due to the high degree of illness and the bereavement felt by the

members of the community. Desperate people try anything to cure or prevent the illness. There is great social disruption and a sense of fear and efforts to deal with the pandemic always leave a great deal to be desired due to selfishness, lack of trust, illegal behavior, and ignorance.

Flu pandemics typically come in waves. The 1889–1890 and 1918-1919 flu pandemics each came in three or four waves of increasing lethality. But within a wave, mortality was greater at the beginning of the wave. Mortality varies widely in a pandemic.

If influenza remains an animal problem with limited human-to-human transmission it is not a pandemic, though it continues to pose a risk.

Strategies to slow down a flu pandemic include vaccines and anti-viral drugs.

A vaccine probably would not be available in the initial stages of population infection. A vaccine cannot be developed to protect against a virus which does not exist yet, and the influenza virus capable of generating the next pandemic has not been identified yet. Once a potential virus is identified, it normally takes at least several months before a vaccine becomes widely available, as it must be developed, tested and authorized.

Many nations, as well as the World Health Organization, are working to stockpile anti-viral drugs in preparation for a possible pandemic. Oseltamivir (trade name Tamiflu) is the most commonly sought drug, since it is available in pill form. Zanamivir (trade name Relenza) is also considered for use, but it must be inhaled. Other anti-viral drugs are less likely to be effective against pandemic influenza.

Limit contact by travelling less, working from home, or closing schools so there is less opportunity for the virus to spread. Populations should be repeatedly informed of the need for "respiratory hygiene" (covering mouth when coughing or sneezing, careful disposal of soiled tissues or other materials). No mask can provide a perfect barrier but products that meet or exceed the NIOSH N95 standard recommended by the World Health Organization are thought to provide good protection. WHO recommends that health-care workers wear N95 masks and that patients wear surgical masks (which may prevent respiratory secretions from becoming airborne). Any mask may be useful to remind the wearer not to touch his face. This can reduce infection due to contact with contaminated surfaces, especially in crowded public places where coughing or sneezing people have no way of washing their hands. The mask itself can become contaminated and must be handled as medical waste when removed. Frequent handwashing, especially when there has been contact with other people or with potentially contaminated surfaces can be very helpful. Alcohol-based hand sanitizers also kill both bacteria and viruses.

Respiratory Care Disaster Response

The respiratory therapist can be involved in the planning process of a disaster plan and must include adequate respiratory supplies and equipment. Increased staffing will be a necessary factor to address.

Preparedness planning is essential in medical settings to prevent confusion and chaos during uncontrolled events that may affect hospital staff, patients, visitors and the community. Uncontrolled events occur during disastrous situations that emerge involving mass casualties such as a bio-terror attack, severe weather, fire/explosion or large influx of infectious patients. Hurricane destruction, flooding, tsunamis, and structure collapses are examples of reports of disasters that healthcare workers have managed recently. Plans for management of mass casualties and interruption of vital

utilities must include steps that will ensure continued safety practices for patients and staff. Infection prevention measures must be included in the plans and maintained. Compliance with infection control measures is critical.

Steps you can take to minimize infection risk before and during a disaster include:

Educate staff on the importance of standard precautions. Standard precautions are precautions taken to prevent acquisition of blood-borne pathogens. Healthcare workers follow standard precautions during the care of all patients regardless of presumed or diagnosed infectious status. Standard precautions should be maintained at all times. Personal protective equipment (gloves, gowns, goggles) should be easily accessible. It is helpful to remind staff of the proper way to remove PPE so as to prevent self contamination. Good hand hygiene should be taught to ensure continued practice. Contaminated items should be discarded in bio-hazardous waste containers.

Educate staff on special isolation precautions. Isolation precautions should be in place for infected patients. These precautions supplement standard precautions and are used to prevent transmission of infectious agents that are spread by airborne, droplet, and contact mechanisms. Indicators such as door signage, computerized/written medical record message, and isolation supply carts inform staff of these patients. Such indications should be maintained at all times.

Educate staff on the importance of hand hygiene. Hand hygiene is primary to all infection prevention measures. Soap and water hand washing remains the gold standard for soiled hands, however, the convenience and even the necessity of an alcohol-based sanitizer makes it useful in disasters when water may not be available. Alcohol-based sanitizers are effective and the first choice when hands are not visibly soiled since they work well and increase healthcare worker compliance. Good hand hygiene should be practiced before and after direct contact with patients and contact with the environment.

Educate staff on storage of medical/food supplies. Medical and food supplies may be delivered in excess to ensure adequate supplies are available during a disaster. These supplies should be stored for safety. Maintain appropriate temperatures of medical and food supplies according to the manufacturer's instructions. Keep temperature logs for temperature sensitive medical and food supplies. It is recommended that these items be stored at least 6 inches off of the floor to maintain the ability to clean beneath the shelving. If there is a potential for severe flooding, supplies should be stored at a height less likely to be affected by water. Food is a necessary commodity and during a disaster, the medical setting may become a place of refuge and a reliable source of help for members of the community, including adequate and safe food provisions.

Educate staff on proper decontamination/sterilization of procedural instruments. During disasters it is not unusual to cancel most elective procedures. However, certain invasive and/or medical procedures may still be needed during a disaster. Aseptic techniques should be practiced at all time. Plans should consider supplies needed to continue proper cleaning, high-level disinfection and sterilization of surgical and procedural instruments since such practices remain critical during a disaster.

Educate staff on the importance of a clean and disinfected environment. Maintenance of the environment of care is critical to reducing risk of transmission of infections. Cleaning of spills and debris should be performed promptly and proper disinfection of patient equipment should take place routinely.

Handle general and infectious waste by having appropriate waste disposal and storage on site. Contracted waste companies may not be able to reach your facility. Roadways may become flooded or debris laden. Local, state, and federal waste disposal and storage mandates for general and regulated medical waste should be followed.

Clean linen should be covered and kept free from dust or other contamination. It is recommended that linen be stored at least 6 inches off of the floor to assist in cleaning the floor area. If there is a potential for severe flooding, linen should be stored at a height less likely to be affected by water. Soiled/contaminated linen should be stored and handled as potentially infectious as part of standard precautions. On site laundry service is important in order to ensure adequate stock of clean linen.

Water for drinking and sanitization is necessary. Safe water systems should be maintained. A large stock of bottled water is critical for drinking and food preparation needs. It is important to communicate to staff methods to safely conserve water if necessary. Moreover, a large stock of water is needed to continue plumbing in order to maintain sanitary conditions and planning should consider other sources of water. Water for showers and baths for patients as well as for staff and community should be considered. If water is unavailable or limited, waterless, no-rinse body cleansers work well for personal hygiene needs.

After the disaster it is important to assess patient, staff, and community needs. Continue surveillance. Compare pre- and post-disaster conditions. The assessment will guide decisions that may need to be made for public health and the epidemiological needs of your health care setting. Determine if a vaccination program needs to be implemented. Provide hygiene and safety information according to the needs of community members, depending on the type of disaster.

Mass casualty incidents overwhelm the resources of individual hospitals. Equally important, a mass casualty incident is likely to impose a sustained demand for health services rather than the short, intense peak customary with many smaller scale disasters. This adds a new dimension and many new issues to preparedness planning for hospitals. Hospitals, because of their emergency services and 24 hour a day operation, will be seen by the public as a vital resource for diagnosis, treatment, and follow-up for both physical and psychological care.

Hospital preparedness for disasters has focused historically on a narrow range of potential incidents. To increase their preparedness for mass casualties, hospitals have to expand their focus to include both internal and community-level planning.

Traditional planning has not included the scenario in which the hospital is the victim of a disaster and may not be able to continue to provide care. Hospital planners should consider the possibility that a hospital might need to evacuate, quarantine, or divert incoming patients.

There are limited data on hospital emergency capabilities. In multi-hospital communities and regions there is a need to develop a real-time database, including an unduplicated count of potential staff.

Preparedness would benefit from development of a community-wide concept of “reserve staff” identifying physicians, nurses and hospital workers who are retired, have changed careers to work outside of healthcare services, or now work in areas other than direct patient care, such as risk management or utilization review. While developing the list of candidates for a community-wide “reserve staff” will require limited resources, the

reserve staff concept will only be viable if adequate funds are available to regularly train and update the reserves so that they can immediately step into roles in the hospital which allow regular hospital staff to focus on incident casualties.

Hospital preparedness can be increased if state licensure bodies develop procedures allowing licensed personnel in one jurisdiction to practice in another under defined emergency conditions.

Everyday communications systems used in the community are likely to be overwhelmed in a mass casualty incident. Backup and redundant systems need to be developed, tested and drilled.

A single community spokesperson for the mass casualty incident needs to be identified in advance, press and media briefings need to be regularly scheduled away from the hospital(s) but with supporting medical expertise.

Community-wide systems for locating patients need to be planned with a single point of contact.

Finally, hospital preparedness can be increased more rapidly if standardized but scalable national resources for staff training, building design, and facilities operations are developed and widely disseminated. Implemented together, these recommendations would increase hospital preparedness for mass casualty incidents.

Recent manmade and natural disasters have focused attention on the need to provide care to large groups of patients. Clinicians, ethicists, and public health officials have been particularly concerned about mechanical ventilator surge capacity and have suggested stockpiling ventilators, rationing, and providing manual ventilation. These possible solutions are complex and variously limited by legal, monetary, physical, and human capital restraints.

Mass casualty and pandemic events pose a substantial challenge to the resources available in our current health care system. The ability to provide adequate oxygen therapy is one of the systems that could be out-stripped in certain conditions. Natural disasters can disrupt manufacturing or delivery, and pandemic events can increase consumption beyond the available supply. Patients may require manual resuscitation, basic oxygen therapy, or positive-pressure ventilation during these scenarios. Available sources of oxygen include bulk liquid oxygen systems, compressed gas cylinders, portable liquid oxygen (LOX) systems, and oxygen concentrators. The last two are available in a variety of configurations, which include personal and home systems that are suitable for individual patients, and larger systems that can provide oxygen to multiple patients or entire institutions. Bulk oxygen systems are robust and are probably sustainable during periods of high consumption, but are at risk if manufacturing or delivery is disrupted. Compressed gas cylinders offer support during temporary periods of need but are not a solution for extended periods of therapy. Personal oxygen concentrators and LOX systems are limited in their application during mass casualty scenarios. Large-capacity oxygen concentrators and LOX systems may effectively provide support to alternative care sites or larger institutions. They may also be appropriate selections for governmental emergency-response scenarios. Careful consideration of the strengths and limitations of each of these options can reduce the impact of a mass casualty event.

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