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Emergency Preparedness and Response

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Man has had to deal with crises and their aftermath since the beginning of his existence. Then, as now, some emergencies could be anticipated, such as a gradually increasing water level that might result in flooding, while other emergencies could not be reasonably predicted, as evidenced through the destruction of the city of Pompeii by a volcanic eruption in 79 AD. While modern people have the benefit of technological advances that might predict and even control potential emergencies, technology can also cause new hazards and catastrophes, as seen by the Bhopal Disaster in 1984, an industrial accident that led to thousands of deaths and the exposure of hundreds of thousands of people to the airborne release of methyl isocyanate.

There are many types of emergencies, but it is important to recognize that not every emergency is a disaster. An emergency is an occurrence of a natural catastrophe, a technological accident, or a human-caused event resulting in severe property damage, multiple injuries, or death. Natural crises would include those events related to climate, such as blizzards, ice storms, hurricanes, or tornadoes, related to geology, such as earthquakes or volcanic eruptions, and related to biological events, such as smallpox or pandemic flu. Technological emergencies would include failures of technical systems, such as power failures, communications/information technology system failures, or elevator malfunctions. Human-caused events could be accidental, such as hazardous materials releases or transportation accidents, or intentional, such as acts of terrorism, bomb threats, or civil unrest (Goss and Adams, 2007, pp. 4–5).

In planning to manage emergencies, all stakeholders need to work together to jointly plan to address the five phases of emergency management, which are prevention, preparedness, mitigation, response, and recovery. The National Fire Protection Association's ''Standard on Disaster/Emergency Management and Business Continuity Programs'' (NFPA 1600), defines these phases as follows:

Prevention – ''activities taken to avoid an incident or to stop an emergency from occurring.''

Preparedness – ''activities, tasks, programs, and systems developed and implemented prior to an emergency that are used to support the mitigation of, response to, and recovery from emergencies.''

Handbook of Loss Prevention Engineering, First Edition. Edited by J. M. Haight.

Mitigation – ''activities taken to reduce the severity or consequences of an emergency.''

Response – ''immediate and ongoing activities, tasks, programs, and systems to manage the effects of an incident that threatens life, property, operations, or the environment.''

Recovery – ''activities and programs designed to return conditions to a level that is acceptable to the entity.''

Examples of prevention activities would include actions such as immunization against communicable diseases, or even quarantine where a disease that is not readily controllable has already occurred and efforts are needed to prevent its spread into a population. Other examples might include development and enforcement of access control protocols to prevent unauthorized entry into a facility, mail handling and screening procedures to prevent exposure to hazardous materials such as anthrax or to prevent letter bombs, or safe handling of foods to prevent contamination of the food supply and potential foodborne illnesses.

Preparedness activities would include actions such as training employees, volunteers, and community members in the proper and safe response to incidents. Not all emergency preparedness efforts are intended exclusively for traditional emergency responders such as firefighters, police officers, or emergency medical services. Other employees should also be trained in their role in an emergency, such as shutting down critical activities, participating in evacuation efforts, or maintaining an inventory of essential supplies that may be needed. Similarly, good and accepted safe practice dictates that volunteers should be trained and prepared for their unique role in an emergency, including volunteer firefighters and emergency medical technicians, community emergency response team (CERT) members, or members of voluntary organizations active in disasters (VOADs). Private, nonprofit VOAD participants, for example, may help with providing temporary housing, food, and clothing to persons who might be affected by an emergency, while others might work to perform repair and restoration of damaged housing. The training needed for each of these groups would need to be commensurate with the hazards to which they might reasonably be expected to face. Repair of flooded homes might present volunteers with hazards such as mold or water-strewn debris or hazardous materials. Community members also need to be included in preparedness activities. For example, citizens should be familiarized with the need to have a family emergency plan that will help them know where to go during or before an event, as well as having a personal emergency kit that would include essentials such as prescription medications, insurance information, and essential contact information. The American Red Cross provides an excellent template for family emergency plans that can be accessed on its web site (Figure 29.1) www.redcross.org.

Mitigation activities would include actions that will minimize the severity of an event. This could include the adoption of building codes designed to ensure that buildings or infrastructure could withstand excessive forces. For example, an area prone to flooding might have structures elevated above ground level on pilings,

Be Red Cross Ready

Get a kit. Make a plan. Be informed.

It's important to prepare for possible disasters and other emergencies. Natural and human-caused disasters can strike suddenly, at any time and anywhere. There are three actions everyone can take that can help make a difference …

Be Red Cross Ready Checklist

- ❑ I know what emergencies or disasters are most likely to occur in my community.
- ❑ I have a family disaster plan and have practiced it.
- ❑ I have an emergency preparedness kit.
- ❑ At least one member of my household is trained in first aid and CPR/AED.
- ❑ I have taken action to help my community prepare.

Get a kit

At a minimum, have the basic supplies listed below. Keep supplies in an easy-to-carry emergency preparedness kit that you can use at home or take with you in case you must evacuate.

• Water—one gallon per person, per day (3-day supply for evacuation, 2-week supply for home) • Food—non-perishable, easy-to-prepare items (3-day supply for evacuation, 2-week supply for home) • Flashlight • Battery-powered or hand-crank radio (NOAA Weather Radio, if possible) • Extra batteries • First aid kit • Medications (7-day supply) and medical items • Multi-purpose tool • Sanitation and personal hygiene items • Copies of personal documents (medication list and pertinent medical information, proof of address, deed/lease to home, passports, birth certificates, insurance policies) • Cell phone with chargers • Family and emergency contact information • Extra cash • Emergency blanket • Map(s) of the area

Consider the needs of all family members and add supplies to your kit. Suggested items to help meet additional needs are:
• Medical supplies (hearing aids with extra batteries, glasses, contact lenses, syringes, cane) • Baby supplies (bottles, formula, baby food, diapers) • Games and activities for children • Pet supplies (collar, leash, ID, food, carrier, bowl) • Two-way radios • Extra set of car keys and house keys • Manual can opener

Additional supplies to keep at home or in your kit based on the types of disasters common to your area:
• Whistle • N95 or surgical masks • Matches • Rain gear • Towels • Work gloves • Tools/supplies for securing your home • Extra clothing, hat and sturdy shoes • Plastic sheeting • Duct tape • Scissors • Household liquid bleach • Entertainment items • Blankets or sleeping bags

Make a plan

- ❒ Meet with your family or household members.
- ❒ Discuss how to prepare and respond to emergencies that are most likely to happen where you live, learn, work and play.
- ❒ Identify responsibilities for each member of your household and plan to work together as a team.
- ❒ If a family member is in the military, plan how you would respond if they were deployed.

Plan what to do in case you are separated during an emergency

- ❒ Choose two places to meet:
  - Right outside your home in case of a sudden emergency, such as a fire
  - Outside your neighborhood, in case you cannot return home or are asked to evacuate
- ❒ Choose an out-of-area emergency contact person. It may be easier to text or call long distance if local phone lines are overloaded or out of service. Everyone should have emergency contact information in writing or programmed into their cell phones.

Plan what to do if you have to evacuate

- ❒ Decide where you would go and what route you would take to get there. You may choose to go to a hotel/motel, stay with friends or relatives in a safe location or go to an evacuation shelter if necessary.
- ❒ Practice evacuating your home twice a year. Drive your planned evacuation route and plot alternate routes on your map in case roads are impassable.
- ❒ Plan ahead for your pets. Keep a phone list of pet-friendly hotels/motels and animal shelters that are along your evacuation routes.

Be informed

Learn what disasters or emergencies may occur in your area. These events can range from those affecting only you and your family, like a home fire or medical emergency, to those affecting your entire community, like an earthquake or flood.

- ❒ Identify how local authorities will notify you during a disaster and how you will get information, whether through local radio, TV or NOAA Weather Radio stations or channels.
- ❒ Know the difference between different weather alerts such as watches and warnings and what actions to take in each.
- ❒ Know what actions to take to protect yourself during disasters that may occur in areas where you travel or have moved recently. For example, if you travel to a place where earthquakes are common and you are not familiar with them, make sure you know what to do to protect yourself should one occur.
- ❒ When a major disaster occurs, your community can change in an instant. Loved ones may be hurt and emergency response is likely to be delayed. Make sure that at least one member of your household is trained in first aid and CPR and knows how to use an automated external defibrillator (AED). This training is useful in many emergency situations.
- ❒ Share what you have learned with your family, household and neighbors and encourage them to be informed.

Emergency Contact Cards for All Household Members
Get your cards online at **http://www.redcross.org/prepare/ECCard.pdf**.

- ❒ Print one card for each family member.
- ❒ Write the contact information for each household member, such as work, school and cell phone numbers.
- ❒ Fold the card so it fits in your pocket, wallet or purse.
- ❒ Carry the card with you so it is available in the event of a disaster or other emergency.

Let Your Family Know You're Safe

Tell your loved ones about the American Red Cross Safe and Well Web site available through RedCross.org. This Internet-based tool should be integrated into your emergency communications plan. People within a disaster-affected area can register themselves as "safe and well" and concerned family and friends who know the person's phone number or address can search for messages posted by those who self-register. If you don't have Internet access, call 1-866-GET-INFO to register yourself and your family.

American Red Cross

For more information on disaster and emergency preparedness, visit RedCross.org.

Figure 29.1 Template for family emergency plans from the American Red Cross. Available at *http://www.redcross.org/images/MEDIA_CustomProductCatalog/m4240190_Be_Red_Cross_Ready.pdf*.

Figure 29.2 Preparation for hurricanes. Photograph reproduced with permission from Adrian Lewis, earthntrees@yahoo.com, copyright 2012.

areas prone to hurricanes might have structures, or building components, built to resist high winds using hurricane tie-downs, and areas that experience heavy snow would have sloped roofs to minimize the potential for snow loading that might compromise the building's structural integrity. Other mitigation activities might include providing emergency generators for standby power, automatic fire sprinkler systems, or even placement of sandbags in anticipation of flooding (Figure 29.2).

Response activities refer to the more obvious and visible aspects of emergency management. Response would include the broad range of efforts such as rescuing victims, treating patients, extinguishing fires, and stopping conditions that might have a cascading or escalating effect. Response also includes the coordination of various resources and functions, such as local, municipal, state/province, regional, and national efforts. Response efforts should be managed using the Incident Command System (ICS). According to the United States Federal Emergency Management Agency (FEMA), Incident Command is a:

''standardized, on-scene, all-hazards incident management approach that:

- Allows for the integration of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure.
- Enables a coordinated response among various jurisdictions and functional agencies, both public and private.
- Establishes common processes for planning and managing resources.''

ICS had its roots in the early 1970s in the United States as a result of wildfires in California that necessitated multiple separate agencies working together for a common mission. This flexible system allows for coordinated and collaborative cross-jurisdictional incident management and is used as a model for single agency or multi-agency response, with FEMA referring to ICS as ''the model tool for the command, control, and coordination of resources and personnel at the scene of emergencies'' (Cole, 2000, p. 7).

Recovery activities are those efforts taken to help a facility or community return to normalcy. In a business environment, an organization might have a business continuity plan to aid in restoring its usual processes, or at least begin its resumption of normal activities. In a community environment, recovery might include public assistance to rebuild damaged infrastructure, temporary housing for displaced persons, as well as efforts to rebuild the local economy. Recovery needs to consider human issues, such as assisting workers and families in rebuilding their lives, and also rebuilding or repairing actual structures and building systems, such as plumbing, heating, ventilation, communications, and electrical systems. Engineering professionals play an essential role in the recovery phase, as exemplified by the demolition and rebuilding of the World Trade Center, the reconstruction of hurricane damaged levees in New Orleans, or the reconstruction of flooded homes.

To plan to manage the five phases of emergency management, it is important to use an all-hazards approach (Briggs, 2005, pp. 585–589). This refers to having a comprehensive emergency plan that addresses all types of emergencies, even those that might not be readily anticipated. It is essential that such planning be done in collaboration with the community. When a facility or organization does its planning, it should engage a multidisciplinary team of internal and external stakeholders, including law enforcement, fire department, rescue, emergency services, and health care organizations to the extent possible. When a governmental agency does such planning it should reach out to private industry, particularly utilities, telecommunications, supply chain management, and health care facilities. Part of developing such an all-hazards plan entails conducting a risk assessment or hazard vulnerability analysis (HVA). The hazard vulnerability analysis provides a formal method of determining the probability or likelihood of an event occurring based on potential and historical frequency of such events, as well as the severity of such an event, if it were to occur (Young Landesman, 2012, pp. 113–125). The planners would review the probability or likelihood of all reasonably anticipated natural catastrophes, technological accidents, or human-caused events and then assess the cascade potential of escalating events, as well as the worst case extent of possible impacts such as life safety, public health, security, physical plant or infrastructure, utilities, communications, and business or economic impact. This assessment of risks helps planners to prioritize where to place their resources, using probability, severity, and level of preparedness as a means of quantifying risk and vulnerability, as stipulated by the National Fire Protection Association's "Standard on Disaster/ Emergency Management and Business Continuity Programs" (NFPA 1600). For example, in regions that experience frequent heavy snowfalls, the likelihood of snow occurring in any given season would be high, yet such communities generally have developed plans for managing snowfall, including snowplowing, de-icing, and other controls. On the other hand, a snowstorm affecting an area that rarely experiences snow could paralyze a community's roads and transportation systems, since such a rare occurrence might not have justified the investment in snow and ice control or remediation resources. For example, large areas of upstate New York and Vermont suffered severe flooding that destroyed entire communities when they were affected

Figure 29.3 Sandbagging measure taken at Carleton College, Northfield, USA in 2010. Photograph reprinted with permission of Dave Pape, Carleton College Media & Public Relations department, copyright 2010.

by the remnants of Hurricanes Irene and Lee in 2011. These regions routinely plan for and manage snowstorms very effectively, but were unprepared for the extent of hurricane-caused flooding in an area that very rarely experiences hurricane effects.

Other controls that could be implemented to manage occurrences that might happen frequently or that potentially have catastrophic results, even if infrequent, might include such efforts as emergency power generators in hospitals or uninterruptible power supplies for critical safety functions. Hospitals rely on being able to have continuous medical telemetry, mechanical ventilation, and surgical equipment at all times. For this reason, organizations such as The Joint Commission (TJC), formerly known as the Joint Commission for Accreditation of Healthcare Organizations (JCAHO), require that hospitals maintain an emergency management plan, a utilities management plan, and a medical equipment management plan, among others, with annual evaluations being performed by facility leaders to ensure the effectiveness of the plans. Engineering professionals in health care organizations must plan to maintain these essential services, as well as other needs such as water supply. For example, the American Water Works Association (AWWA) and the US Centers for Disease Control (CDC) have developed an ''Emergency Water Supply Planning Guide for Hospitals and Health Care Facilities,'' which is very effective in helping facility engineers create their own site specific plans and determine emergency water supply alternatives (CDC and AWWA, 2011). As is the case with other environmental health and safety risks, the hierarchy of controls should be used to develop solutions in advance for the management of potential hazards that might result in emergencies. Safety professionals maintain that engineering controls are preferable to administrative/work practice controls or personal protective equipment. An engineering control such as ventilation would be preferable to work practice controls such as wet processes to minimize dust, while personal protective equipment such as respirators would be a last resort (Hagan, Montgomery, and O'Reilly, 2009, p. 158). Using the hierarchy of control

model, flood levees would be preferable to the hurried placement of sandbags, and both would be preferable to needing life vests or flotation devices (Figure 29.3).

When conducting a risk assessment or hazard vulnerability analysis, it is important to consider the potential for cascading events in which the hazards escalate into newer or greater risks. A 9.0 magnitude earthquake that affected Japan in March 2011 also resulted in a tsunami, which, in turn, caused impairments to the power supply and cooling capacity of the nation's Fukushima nuclear power plant, which then escalated to the release of radiation into the surrounding community. The combined disasters killed nearly 23 000 people, with many more people being sickened or injured, and the long-term health impacts have yet to be fully determined. These multiple simultaneous or sequential impacts increase the scope of the disaster and make response, mitigation, and recovery even more difficult. An additional example of cascading events would be those created by Hurricane Katrina, the hurricane that affected New Orleans in 2005. This Category 3 storm resulted in high winds and flooding, with multiple failures of the existing flood levees occurring, causing mass fatalities, with over 1800 deaths due to the storm itself or the subsequent flooding. Flooding resulted in large-scale evacuations, including hospitals and long-term health care facilities, as well as power outages, communications outages, oil spills, hazardous materials releases, and, ultimately, building failures, water contamination, and the spread of disease. In terms of business continuity, the National Oceanic and Atmospheric Administration (NOAA) has indicated that Hurricane Katrina is considered the United States' most destructive storm in terms of economic losses, with the storm costing the Gulf Coast states as much as an estimated $125 billion, including over $34 billion in insured losses.

A hazard vulnerability analysis should also address realistic worst-case scenarios. In some areas, tornados are not an unusual event. Buildings may be constructed to withstand substantial forces, but even those are unlikely to remain unscathed when confronted with stronger tornados than expected. The 2011 tornado that struck Joplin, Missouri was the deadliest such storm in over 50 years and resulted in the collapse or compromise of numerous buildings, including hospitals, large stores, schools, residences, and even fire stations.

Airplane crashes and high-rise building fires are realistic emergency situations, but when these events coincide they can be catastrophic. The events of the attacks on America on 11 September 2001 have been widely documented, with terrorists crashing two hijacked planes into the north and south World Trade Center Towers, another plane into the Pentagon, and a fourth hijacked plane that had been en route to Washington D.C. being crashed into a field in Shanksville, Pennsylvania when the passengers fought back. In total, 2749 people were killed in the World Trade Center attacks alone, including 343 FDNY firefighters, 23 NYPD police officers, and 37 Port Authority police officers (Levy and Sidel, 2003, p. 22).

The impact of the World Trade Center attacks on the health and safety of emergency responders was devastating, yet was not limited solely to the 403 police and firefighter fatalities, but also to the uncounted injuries and illnesses sustained by emergency responders. This was largely the result of a failure to include

occupational safety and health planning as part of the local emergency plans (Levy and Sidel, 2003, p. 83).

Among the serious injuries and illnesses suffered by fire, rescue, and emergency personnel as a result of the attacks, two significant and ultimately preventable affects stand out: respiratory exposures that produced respiratory disease as well as various other diseases to other target organs, and post-traumatic stress disorders. While acute respiratory symptoms affected 99% of firefighters who were present at the time and manifested themselves within a week, chronic exposures have continued to be observed. Research has shown that firefighter pulmonary function during the years post-9/11 had eroded at a rate greater than 12 times that which is normally associated with the aging process and the rate was even more magnified for firefighters who had been present at the time of the collapse of the towers (Feldman, 2004, pp. 1256–1264).

More than 13 000 fire, rescue, and emergency personnel were present at what is now referred to as *Ground Zero* and this cohort includes a very significant proportion of employees who have sustained significant erosion of lung function. Significantly, there was no reversal or recovery of lung function over a seven year period post-exposure (Aldrich, 2010, pp. 1263–1272).

Similarly, construction personnel who worked at Ground Zero during the recovery process have been identified as having a rate of respiratory disease that is three times the rate of similar illness among construction workers who did not have the same exposure. The length of work assignment is also a significant causal factor, as is the actual job task and work location (Tao, 2007, pp. 1063–1072).

These occupational respiratory diseases are particularly troublesome since federal administrators specifically indicated that the air around Ground Zero was safe for workers and residents. Former New Jersey Governor Christine Todd Whitman was the Administrator of the United States Environmental Protection Agency at the time of the attacks. In a 18 September 2001 EPA Fact Sheet entitled ''EPA Response to September 11,'' (EPA, 2001) Whitman was quoted as follows:

> ''We are very encouraged that the results from our monitoring of air quality and drinking water conditions in both New York and near the Pentagon show that the public in these areas is not being exposed to excessive levels of asbestos or other harmful substances,'' Whitman said. ''Given the scope of the tragedy from last week, I am glad to reassure the people of New York and Washington, D.C. that their air is safe to breathe and their water is safe to drink,'' she added.

Respiratory exposures due to false or misleading information were not limited to rescue or recovery personnel. Researchers have also documented that pediatric asthma health care in the adjacent Chinatown community rose by almost 50% in the year following the attacks (Szema, 2004, p. 423).

Protection for workers at Ground Zero was not given sufficient priority, especially during the early days and weeks of the response (Nordgren, Goldstein, and Izeman, 2002). Safety professionals working at the site expressed concerns that risk-taking

by rescue workers was the norm rather than the exception (Vincoli, Black, and Burkhammer, 2002, pp. 21–28). Safety professionals there further noted that normal OSHA compliance was not feasible, with former US Department of Labor Occupational Safety and Health Administration Assistant Secretary of Labor John Henshaw stating that ''the World Trade Center Site is potentially the most dangerous workplace in the United States.''

Had EPA Administrator Whitman been as honest with the public as Henshaw at the beginning, even simply stating that there was insufficient data, emergency responders and recovery workers may have been more likely to have made use of personal protective equipment, specifically including respiratory protection. A 2003 EPA report entitled ''EPA's Response to the World Trade Center Collapse: Challenges, Successes, and Areas for Improvement,'' stated that, in actuality, the agency ''did not have sufficient data and analyses.'' (EPA, 2003, p. 7) As a result, as Morrison noted in *Safety + Health* magazine, ''nearly a decade has passed since the September 11 terrorist attacks in New York, but rescue workers are still struggling with illness they acquired at ground zero.'' (Morrison, 2010, p. 42).

What are the lessons to be learned from this massive respiratory exposure of emergency responders, as well as to the community at large? Most importantly, the traditional hierarchy of controls for safety and health needs to be adhered to, including engineering controls, administrative controls, and, as a last resort, personal protective equipment. The prompt provision of respiratory protection would have greatly minimized the extent of respiratory disease among those exposed. Officials need to be quick to enforce the use of personal protective equipment, and quick to keep people away to prevent exposure.

Similarly, storm and flood cleanup tasks can be extremely dangerous, and anyone working on disaster cleanup should be familiar with the hazards that may be presented, as well as safety precautions to prevent injury and illness to both workers and volunteers. The United States National Institute for Occupational Safety and Health (NIOSH) has developed several recommendations for the protection of emergency responders and disaster relief workers, including medical screening, immunization, personal protective equipment, and worksite hazard control. NIOSH's compilation – including ''Protecting Emergency Responders: Lessons Learned from Terrorist Attacks,'' ''Protecting Emergency Responders, Volume 2: Community Views of Safety and Health Risks and Personal Protection Needs,'' ''Protecting Emergency Responders, Volume 3: Safety Management in Disaster and Terrorism Response,'' and ''Personal Protective Equipment Guidelines for Structural Collapse Events, Rand Volume 4'' – may be viewed at *http://www.cdc.gov/niosh/npptl/guidancedocs/rand.html*. The United States Environmental Protection Agency also has established recommendations for planning, preparing, response, and recovery after natural disasters and weather emergencies, with an emphasis on community protection. These are available at *http://www.epa.gov/naturalevents*.

Finally, emergency plans should include a realistic assessment of resources that might be available pre- and post-event. In many cases, employees may be unable to

report to work due to event-related injury or illness to themselves or to family members, due to a lack of child care or elder care, due to damage to their own homes and vehicles, or due to event-related damage that impedes their ability to travel, such as flooding, downed trees, and damaged roadways, bridges, and other infrastructure. Some estimates have indicated that as much as 40% of critical employees would be unable or unwilling to report to work in the event of an outbreak of pandemic flu. Many essential employees are also ''two hatters,'' such as emergency responders who double as volunteer firefighters or emergency medical technicians, or members of the National Guard and Reserve, while other essential employees may be married to essential employees and cannot both be away from home simultaneously. In the latter case, organizations should consider implementing plans for child care, elder care, and even pet care to ensure that essential employees are available when needed (Gallant, 2008, p. 91).

In summary, while the mission is to prevent injury, illness, and property damage from occurring in the first place, there is little that loss control and safety professionals can do to prevent many types of disasters, including natural catastrophes, technological accidents, or human-caused events; there is, however, much that can be done to prepare for and respond to such emergencies. This ongoing challenge will remain a top priority for the profession.

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