26 Preparing for Functioning Effectively in a Disaster

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Learning Objectives

After completing this chapter, the reader will be able to:

- • Discuss the nurse's role in preparing for bioterrorism events and disasters
- • Distinguish the phases of a disaster
- • Identify resources that nurses can use during a disaster
- • Identify the main agents used in a bioterrorism attack
- • List and discuss the key elements in preparing for a disaster
- • Explain the differences in the mechanisms of action of the three types of chemical agents
- • Name and explain the three key factors for effective treatment of chemical injuries
- • Distinguish between the different classes of protective wear for chemical or biological contamination

DISASTERS ON THE INCREASE

The United States has witnessed an increase in natural and terrorism-related disasters during the past decade. The vast majority of disasters are still considered natural. These range from the catastrophic failure of man-made structures, such as building collapses, to weather-related catastrophes, such as tornadoes, hurricanes, and floods. Most credible scientists believe that because of the significant climate change that is taking place, natural disasters will become more frequent and more destructive for decades to come. They point to hurricanes and superstorms such as Hurricanes Katrina and Sandy that devastated major metropolitan areas and caused billions of dollars in damage.

They also look at tornado events that took place in Joplin, Missouri; Moore, Oklahoma; and El Reno, Oklahoma. Tornadoes in the United States and Canada are rated on a scale from 0 to 5, based on the amount of damage they produce, with 5 causing catastrophic damage. This scale was initially developed by Dr. Tetsuya Fujita in 1971 (the Fujita scale) and then revised in 2007 and is now named the Enhanced Fujita (EF) scale. An EF-5 tornado is the most powerful windstorm on earth with winds in the range of 200 to 300 miles per hour or more with the ability to uproot large trees, vacuum up pavement, completely demolish a well-built house, and remove it from its foundation. A portable Doppler radar truck monitoring the May 5, 2003, Oklahoma City tornado clocked the fastest winds ever recorded on earth at 319 miles per hour. In the past, EF-5 tornadoes were very rare, with one occurring only once a year or about one out of every 1,000 tornadoes that occur every year in the United States. The Moore and El Reno tornadoes were both rated EF-5 and occurred within weeks of each other. The El Reno tornado was the largest tornado on record, measuring almost 3 miles wide. Just 4 months later, an EF-4 tornado struck Washington, Illinois, killing eight people and removing the town from the map.

Disaster Defined

Simply defined, a disaster is a catastrophic event that leads to major property damage, a large number of injuries, displaced individuals, or major loss of life. The American Red Cross defines a disaster as “an occurrence such as a hurricane, tornado, storm, flood, high water, wind-driven water, tidal wave, earthquake, drought, blizzard, pestilence, famine, fire, explosion, building collapse, commercial transportation wreck, or other situations that cause human suffering or create human needs that the victims cannot alleviate without substantial assistance.”[1]

Personal and Family Preparation for a Disaster

It is virtually impossible to make preparations to *avoid* disasters caused by acts of terrorism and catastrophic human engineering failures. Most natural disasters, except for earthquakes and volcano eruptions, have a warning period ranging from a few minutes to several hours. However, the aftermath of all disasters is very similar and preparations can be made to deal with those circumstances. Relief and rescue workers generally arrive quickly after a disaster, but they cannot take care of all the injured or trapped at the same time. During the time between the occurrence of the disaster and the rescue, individuals are left to their own devices and resourcefulness for their survival.

Extreme disaster preparedness is seen in those who are known as *doomsday preppers* or just *preppers*. They usually build large, elaborate underground structures costing anywhere from a few hundred thousand dollars to several million dollars. Preppers often make sure to have enough food, water, and other supplies to last up to 6 months without any contact with the outside world. They often have elaborate electrical generators and air-filtration devices to keep out unwanted viruses and toxins. Preppers also are generally armed to the teeth with a variety of powerful military-grade weapons to keep out individuals or groups who are seeking shelter in the preppers’ subterranean enclaves. However, even these strongly built structures can be destroyed by natural events such as earthquakes and floods or man-made devices such as large bombs.

Most U.S. citizens cannot afford or do not even want this type of extreme disaster protection. So what can they do when they are faced with an impending disaster? There are a number of relatively straightforward measures that can be taken when coping with a disaster and its aftermath. These can be modified to some degree to accommodate the most common types of disasters that are likely to be encountered in their areas. For example, an underground storm shelter is great protection from an approaching tornado but would not be appropriate in a coastal area where an approaching hurricane usually causes a great deal of flooding.

As health-care providers, nurses need to make the same basic emergency preparations as the general public to ensure their safety during the emergency so that they can effectively aid those injured during the disaster. An injured health-care provider is just another victim who needs care.

The Federal Emergency Management Agency (FEMA), in conjunction with the Red Cross, recommend the following four steps in preparing for a disaster:

- 1. Get informed
- 2. Make a plan
- 3. Assemble a kit

- 4. Update the plan and the kit[2]

"Most credible scientists believe that because of the significant climate change that is taking place, natural disasters will become more frequent and more destructive for decades to come."

Get Informed

Knowledge is the best preparation for any kind of disaster. Before a plan can be formulated, a sufficient amount of information must be gathered about potential dangers and ways to deal with them. The local emergency management office or local American Red Cross chapter is a good place to start the search for information. Some areas are more likely to experience certain types of disasters than others. Find out what disasters the community has experienced in the past. Is it on a fault line and likely to have earthquakes? Is it located in tornado alley? When was the last time a wildfire broke out? There may be some potential man-made hazards associated with the community. Does it have large fertilizer or fireworks plants that may explode? Is there a large oil or natural gas pipeline that runs under the town? How old is the freshwater dam that is located upstream from the community?

All communities should have a written disaster plan that provides information such as how local first responders are to organize rescue efforts, where community emergency shelters are located, and which roads are designated as evacuation routes. These plans will probably be located at the local Red Cross office or at firehouses. Ask for a copy of it. Other information that is valuable includes mass transportation plans. In the event that personal transportation is unavailable or has been destroyed, is public transportation or school buses available to evacuate people? Also find out what types of internal disaster plans schools, businesses, and hospitals have to protect the children, employees, and clients.[2]

All communities should have some type of early warning signals. These are usually sirens or horns, but it is important to learn beforehand what these sound like and know how much time there is between when the signals sound and the disaster hits. Most community disaster plans have some provision for how local authorities and rescuers will provide information to the public before, during, and after the disaster has occurred.

A commonly used method of notification is the National Oceanic and Atmospheric Administration (NOAA) weather radio system and the Emergency Alert System (EAS). Although emergency warnings can be broadcast over the network television system, purchasing an inexpensive NOAA alert radio can provide warnings 24 hours a day (**http://www.noaa.gov**). The automatic alert system sends a signal that triggers the radio to turn on. The speakers and audible-visual alert screen automatically turns on to provide instant alerts of conditions that may affect life and property. These radios have Specific Area Message Encoding (SAME) technology, allowing the radio to be programmed to receive only information specific to a particular geographic area. Most TV stations and the Weather Channel have apps that can be downloaded to smartphones or tablets that will also provide instantaneous weather alert information.

Make a Plan

After gathering sufficient information, sit down with all family members and develop a plan for possible looming disasters. Key elements in all emergency disaster plans should include:

An "Out-of-Town" Contact Person. This would most likely be a friend or relative who lives a considerable distance from the community. If they live too close, they may be caught in the disaster too. The contact person's phone number needs to be programmed into all family members' cell phones or memorized by everyone. After a disaster has struck, family members should call this person and tell them where they are and what their condition is. Because of damage to the cell system itself or overload of the system by many callers after a disaster, it is often easier to reach someone on a long-distance call than a family member who may be only a few blocks away.[3] Also, the phone's texting feature uses a different system than the voice phone, and it is often less problematic to get text messages through than a regular call.

A Preselected Meeting Place. Most of the time, disasters do not occur when everyone is together in one place. In the event of a larger disaster where family members are widely dispersed, such as at school and work, and the disaster prevents a return home because of its destruction or debris-blocked streets, select a location for everyone to meet at that is centrally located and likely to survive the disaster.[2]

A Family Communication Plan. All contact information for all family members, at any time, should be easily accessible. This includes work and school phone numbers. Other useful numbers can include National Poison Control Center (1-800-222-1222), local hospitals, and close relatives. These numbers can be programmed into phones or, in case of damage or loss of the phone, listed on a card or a form that should be carried at all times by all family members. A sample of this type of form can be found at **http://www.ready.gov** or at **http://www.redcross.org/** contactcard. These websites also provide blank wallet cards on which contact information can be recorded and carried in a wallet, purse, backpack, and so on, for quick reference.[4] It is probably a good idea to get this laminated to make them more durable and able to survive even if they get wet. Children must be taught how to call the emergency phone numbers and in what situation it is appropriate to do so. Also post a copy of the communication plan near each landline house phone, if these are still being used.

Escape Routes and Safe Places. Draw a floor plan of the house that shows all the rooms and the location of stairways, doors, and windows that lead outside. The locations of the utility shut-off points, particularly gas and electricity, should also be shown. There should be at least two ways to exit each room, such as a door and a window or two doors.[2] Everyone in the family should know the best escape routes out of the house and where the safe places are in the house for each possible type of disaster (i.e., if a tornado approaches, go to the storm shelter or basement or the lowest floor of the home or an interior room or closet with no windows). It is recommended that emergency evacuation drills be conducted at least two times a year and whenever any changes are made in the escape plan.

A Special Plan for Disabled Family Members. Items necessary for mobility such as walkers, crutches, and canes should be kept in the same place all the time so they are easy to get to quickly. For bed-bound individuals who have caregivers, the caregivers need an alternate plan if no one else is at home. Power companies should be notified if the disabled person is dependent on some life-support technology such as a ventilator.[3] Most of these devices have some type of battery backup system for short-term power outages, but there should be a plan for an alternate power source for long-term outages. It may require moving the person to another location. Also

have a several-day supply of important medications and other routinely used care items set aside that can be taken with the client.

A Plan for Pets. Pets can create considerable problems for rescue workers. Some people refuse to leave their pets when they are asked to evacuate and other times pets become protective of their injured owners and will not allow rescue workers to approach them, especially large dogs. If forced to evacuate, take the pet along if at all possible. Some individuals have many pets and taking all of them may not be possible. In the past, emergency shelters did not allow any animals other than service animals because of hygiene issues.[2] However, with the many disasters that have occurred in recent years, these rules have been relaxed to some degree. Some shelters are divided into no pets and pets sections. Identify boarding facilities, veterinarians, and "pet-friendly" hotels that would be willing to accept pets when a disaster occurs.

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Actions to Take Before a Disaster

Check Key Utilities Locations. Learn how to turn off water, gas, and electricity at the main switches or valves. Show all family members where they are and how to do it. If special wrenches or tools are required, buy a spare one and keep it near the valve or shutoff.[4]

Check Insurance Coverage. Most people tend to automatically renew their homeowners coverage each year when they receive the renewal notification. It is a good idea to sit down with an insurance agent every 1 to 2 years and discuss what is actually covered in the policy. The worst time to find out that a bargain basement online insurance policy does not cover roof or siding damage is after a wind or hailstorm. Homeowners insurance does not cover flood damage. Special flood insurance is available from the U.S. government.[2] Most home insurance does not routinely cover earthquakes either. Special additional coverage must be purchased.

Take a First Aid/CPR and Automated External Defibrillation (AED) Class. Contact the local American Red Cross chapter to find out when they are offering classes. The American Heart Association also provides CPR classes and can be contacted for locations and times of classes. Most hospitals hold classes also, generally for their employees, but they will often allow community members to attend.

Take an Inventory of All Home Possessions. In the past, this type of inventory required several written pages of information.[2] With the advent of phones and other digital devices with built-in cameras, it now is easy to do. Make a movie of the house inside and out, with particular focus on high-dollar items like the 70-inch LED smart-TV and computer equipment. Because the device also records audio, comments such as when it was purchased and particular additional features such as 3-D would be helpful in establishing its value.

Some polices have a "total replacement value" clause that will replace the item with a new one just like it no matter how old it is. These policies are more expensive, obviously. Most homeowner policies prorate the value of the item on its age. For example, if the computer cost $3,000 five years ago, it may be worth only $1,500 today. The $1,500 is all that the insurance company will reimburse the homeowner for this item. Also, make a movie of outbuildings, cars,

boats, and recreational vehicles. Obtain professional appraisals of jewelry, collectibles, artwork, or other items that may be difficult to evaluate. Make copies of receipts and canceled checks showing the cost for valuable items. Store this information in a place safe from flood, fire, or other disasters. Paper documents need to be in a safe-deposit box at a local bank. Electronic data can be stored on a flash drive or disk that also can be kept at the bank. In addition, electronic data can be stored at off-site electronic data storage facilities or even in the cloud.

Protect Important Records and Documents. These important documents include photocopies of all credit cards, home titles, birth and marriage certificates, Social Security cards, passports, wills, deeds, and financial information such a checking account numbers, insurance policies, and immunizations records. Ideally these should also be in a safe-deposit box, but fire- and waterproof home safes and strongboxes can provide adequate protection and are more convenient to access.

"The worst time to find out that a bargain basement online insurance policy does not cover roof or siding damage is after a wind or hailstorm."

Assemble a Kit

A disaster supplies kit is a collection of basic items a family would probably need to stay safe and be more comfortable during and after a disaster.[3] Store these items in plastic or metal portable containers and keep as close as possible to the exit door or in a secure place such as a storm shelter. At least once a year, the kit should be opened and all items checked. Family members' needs may have changed and certain items will exceed their expiration date. Smaller emergency kits can be kept in each vehicle and at work.

A well-stocked disaster supply kit should include the following:

- • Three-day supply of boxed and canned ready-to-eat nonperishable food
- • A hand can opener, knives, and other eating utensils (can be plastic)
- • Three-day supply of water (1 gallon of water per person, per day)
- • Portable, battery-powered radio, citizen band radio, or small television with extra batteries
- • Flashlight, portable LED lantern with many extra batteries
- • Well-stocked first aid kit with sufficient supplies to stop major bleeding injuries
- • Sanitation and hygiene items (hand sanitizer, moist towelettes, and toilet paper)
- • Matches or a lighter in waterproof containers
- • Whistle, horn, or some other type of device that can be used for signaling if trapped
- • Extra sturdy clothing and warm blankets
- • Photocopies of identification and credit cards
- • Cash (several hundred dollars if possible) and coins
- • Special needs items such as prescription medications, eyeglasses, contact lens solution, and hearing aid batteries
- • If applicable, items for infants, such as formula, diapers, bottles, and pacifiers

- • Basic tools (hammer, large pliers, screwdrivers, small pry bar), if applicable, pet supplies
- • Jacket or coat
- • Long pants and long-sleeve shirt
- • Sturdy shoes and socks
- • Sleeping bag or warm blanket[2]

Update the Plan and the Kit

Ideally, the plan should be reevaluated every 6 months. Ask family members about it and get their input. Check and replace food supplies that have expired and replace drinking water every 6 months.[4]

Issues in Practice

The 10 Commandments of Disaster Preparedness

Nurses and the general public should take the following preparation steps well before a disaster strikes:

- 1. Discuss the type of hazards that could affect your family. Know your home's vulnerability to storm surge, flooding, and high wind.
- 2. Locate a safe room or the safest areas in your home for high wind hazard. In certain circumstances, the safest areas may not be your home but within your community.
- 3. Determine escape routes from your home and places to meet.
- 4. Designate an out-of-state friend as a single point of contact for all your family members.
- 5. Make a plan now for what to do with your pets if you need to evacuate.
- 6. Post emergency telephone numbers by your phones and make sure your children know how and when to call 911.
- 7. Check your insurance coverage––flood damage is not usually covered by homeowners' insurance.
- 8. Stock nonperishable emergency supplies and a disaster supply kit.
- 9. Purchase and know how to use an NOAA weather radio. Remember to replace its battery every 6 months.
- 10. Take first aid, cardiopulmonary resuscitation (CPR), and disaster preparedness classes.

Sources: Goodhue CJ, Burke RV, Chambers S, Ferrer RR, Upperman JS. Disaster Olympix: A unique nursing emergency preparedness exercise. *Journal of Trauma Nursing,* 17(1):5–10, 2010; James JJ, Benjamin GC, Burkle FM, Gebbie KM, Kelen G, Subbarao I. Disaster medicine and public health preparedness: A discipline for all health professionals. *Disaster Medicine & Public Health Preparedness,* 4(2):102–107, 2010.

When the Disaster Strikes

Even with all the above listed precautions and preparations in place, when a disaster strikes, it is going to be both physically and emotionally traumatic to the whole family. Keeping a cool head and knowing what to do will allow all involved to survive and make the best of a bad situation.

It is important to follow the instructions of the professional first responders who have trained and planned for a variety of disasters. If a radio or television is available, valuable information can be obtained concerning the location of emergency shelters, the estimated time for rescuers to respond, and the general condition of the surrounding community.

It is important to wear sturdy clothing such as jeans and particularly important to protect feet by wearing sturdy shoes or boots.[2] If attempting to evacuate an area, it is best to use only the travel routes specified by local authorities. Emergency routes are generally the first ones cleared after a disaster where alternate routes and “shortcuts” can be blocked by debris or water and are impassable or dangerous. If at home after a disaster, only use flashlights if it is dark. There may be undetectable gas leaks or other dangerous fumes that can be ignited by matches or candles. Also, keep at least one general purpose fire extinguisher in an easily accessible location.[5]

Downed high-voltage power lines pose a particularly lethal threat to those who are near them. Even if a downed power line is not sparking, it may still be live and stepping on it or driving over it is a potentially deadly mistake. If water is present near the power line, it, too, can become electrified and cause a fatal shock several feet from the actual power line. It's important to check on neighbors, especially those who are elderly or disabled.

Many people have purchased portable generators in recent years as a backup source of power after a disaster. These pose their own set of dangers. The biggest one is carbon monoxide poisoning.[3] Some people think that running the generator in an attached garage is safe because the fumes go out the big open door. This is false! They should only be run outside in a well-ventilated area. In addition, refueling a generator while it is still hot or while it is running can cause a serious fire. Electricity is dangerous and there is always the potential for electrical shock or fire if the wiring is not connected correctly.

There are many resources for dealing with all types of disasters. FEMA's Community and Family Preparedness Program and American Red Cross Community Disaster Education are available online. Almost every agency that deals with disasters has written information that is available.

Health-Care Professional and First Responder Preparation for a Disaster

The information above is general information that all citizens, including health-care providers and first responders, should know in preparing for a variety of disasters. However, by the very nature of their work, health-care providers and first responders require additional knowledge and preparation in dealing with disasters. People look to them for help during their time of need. Although some of the knowledge overlaps, a higher level of preparation is expected of professionals. The information below focuses on this knowledge.

“Even if a downed power line is not sparking, it may still be live and stepping on it or driving over it is a potentially deadly mistake.”

Disaster Phases

Although there is a considerable amount of overlap, all disasters can be divided into three basic phases: The preimpact phase, the impact phase, and the postimpact phase. Nurses should learn what they need to do to provide care in all of the disaster phases.

The Preimpact Phase

Certain types of natural disasters are preceded by a warning period. For a tornado, this may range from a few minutes to as much as an hour; for hurricanes, it may be as long as several days. During the warning stage, also called the preimpact phase, the focus is on preparation for the aftereffects of the event. This preparation is primarily at the local community level.[6]

Even before a catastrophic event is predicted, first responders and health-care professionals in disaster-prone regions practice with disaster drills. These drills provide valuable training in a low-stress environment and identify the types of resources that may be needed during a disaster. This type of training helps identify unique risk situations for the community and builds the skill and knowledge disaster responders must have to meet the needs of the population. When the disaster becomes imminent and a warning is issued, preparations such as evacuations are put into operation by the local emergency response unit. Since Hurricane Katrina, FEMA, the Red Cross, and other government agencies have begun the practice of stockpiling essential supplies to be used after the disaster somewhere close to the disaster target area where they can be reached quickly and easily for distribution.

Communication Is Critical

One key element, brought to the forefront by recent disasters, is the ability of the various agencies involved to communicate with each other. The lack of the ability to communicate became painfully evident after the 9/11 disaster. Fire and rescue, first responders, law enforcement, public health, government agencies, and health-care services were using radios that all had different frequencies and were unable to exchange essential information with each other. Large sums of money were spent by the Bush administration to correct this problem so that victims could receive the best possible care. Proficient communication leads to a well-coordinated response. All agencies must have agreements in place and understand the role that each one is to play in the disaster. This preparation will eliminate the turf arguments sometimes seen among agencies.[7] In rural areas, agreements with nearby communities also become important for obtaining mutual aid.

The news media is playing an even larger part in disaster reporting; however, planning for the news media and the flow of information is often overlooked in disaster preparations. Nurses are likely to hear about a disaster from breaking news reports before they learn about it through official channels. One fear that can become real is group panic. Generally, all information released from a health-care facility should go through the public relations representative or the designated spokes person for the facility. Before any information is released, it should be determined how the news will affect particular populations. Families of victims often cling to every word and may misinterpret what is being said.

Persons designated to speak for the health-care facility should have experience with public speaking and be able to convey the information clearly and in terms that the general public can understand. They should also be able to “think on their feet” when responding to questions. However, question-and-answer sessions should be severely limited, especially when national media are involved. Reporters ask the same questions over and over again even when there is no information about the subject.

When people are under stress or have high levels of anxiety, communication must be direct, honest, and to the point. Long technical explanations will only confuse the facts. The public should also be calmed by reassurances that everything possible is being done. Regular updates every 30 to 60 minutes, even if there is little new information, are helpful in reducing anxiety levels.

“Often in disaster situations, nurses function outside their usual practice setting and may assume a variety of roles in meeting the needs of the disaster victims. Nurses must be able to perform under stressful and sometimes physically dangerous conditions.”

Who to Contact

The following agencies can help with planning during the preimpact phase:

- • *Disaster Medical Assistance Team (DMAT):* A group of frontline medical personnel, including nurses, who provide health care after a disaster. These may include terrorist, natural, or environmental disasters.
- • *Medical Reserve Corps:* Part of the USA Freedom Corps, which was developed in 2002 in response to Americans’ desire to volunteer and serve their communities in the wake of the 9/11 terrorist attacks.
- • *American Red Cross:* Registered nurses (RNs) can join their local Red Cross and receive specialized training in disaster and bioterrorism preparedness.
- • *Commission Corps Readiness Force:* Deploys teams to respond to public health emergencies.[6]
- • *National Disaster Medical System (NDMS):* Mobilizes comprehensive disaster relief and works closely with local fire, police, and emergency medical services. NDMS also uses volunteer disaster response teams called International Medical and Surgical Response Teams (IMSuRTs), of which nurses are an essential component. The IMSuRTs provide emergency medical services at any place in the world where there is a lack of resources.

The Impact Phase

When the actual disaster strikes, the impact phase begins. The goal during the impact phase is to respond to the disaster, activate the emergency response, and reduce the long-term effects of the disaster as much as possible.[8] Activation of the emergency response plans developed during the preimpact phase mobilizes all agencies involved. Because fire, rescue, and police are usually the first on the scene, they provide and establish the command post from which all other efforts will be coordinated. Their goal is to identify and remove victims from dangerous situations, deal with unstable structures, and provide first aid to those who have been injured.

Because of the recent heightened concern over acts of terrorism, law enforcement may initially take control of the disaster scene until it can be determined that the cause was not a criminal act such as a bombing. Even with natural disasters such as tornadoes or floods, law enforcement is often first on the scene and, by their training, tend to take over control. Nurses working in the early stages of disasters sometimes feel frustrated by law enforcement officers, who may limit their ability to provide care. It is important to remember that law enforcement is concerned with identifying a crime and preserving evidence that may be used later in criminal prosecutions. The whole disaster area is considered a crime scene until released by law enforcement.

The Incident Management System (IMS) is an effective tool in bringing some order to the confusion that always surrounds any disaster event. Based on a military model, IMS is a hierarchy with a well-defined chain of command. At the top is the incident commander or manager, who is responsible for coordinating all rescue efforts. A “job sheet,” really a vertical organizational chart, lists all the key people from all the essential agencies involved. It also outlines the responsibilities of each person and agency and must be followed throughout the disaster event for the best coordination of emergency services.[9] Most IMS plans now include hospitals within the service area. Information flows freely from the commander down to paramedics and from the street level back to the top.

Medical assistance is provided in hospitals, local clinics, or the field. Deployable Rapid Assembly Shelters (DRASHs) are mobile shelters that can be used by the IMSuRT team as a small independent hospital. The DRASH is designed with triage emergency care, intensive care units, and surgical rooms.

Protection for First Responders

Nurses and other first responders must always be aware of the potential dangers of any disaster. If the health-care providers become injured during rescue attempts, they can no longer provide care to the victims. As a result, protecting the lives and health of the first responders takes priority over rescue efforts. Because of the wide range of potential hazards, including chemicals such as nerve gas, biological substances, radioactive agents, and explosive devices, care providers must wear appropriate protective equipment.[7] Images of rescue personnel wearing bulky yellow or blue biohazard suits have become ingrained in the public consciousness. The biohazard suits, otherwise known as *personal protective equipment*, actually have a range of protective abilities against many types of substances (**Box 26.1**).

Most nurses have not received training in donning, wearing, or performing procedures in biohazard suits. If nurses find themselves in situations in which they may be required to wear such protection, it is important to recognize some of the limitations. The heavy gloves significantly reduce manual dexterity, and even routine procedures, such as starting intravenous (IV) lines or dressing wounds, become extremely difficult if not impossible. The hood restricts peripheral vision and the plastic view plate may distort the visual field. Even cursory physical examination, including the ability to use a stethoscope, becomes more difficult. Nurses may also find that the suit itself causes claustrophobia. The unusual taste and smell of the self-contained breathing equipment can sometimes cause nausea.

Box 26.1 Protective Levels of Biohazard Suits

- *Level A:* Resistant to all types of chemicals and biological and radioactive substances and is used in situations in which splashing or exposure to unknown agents is possible. Totally encapsulates personnel and has its own internal air supply.
- *Level B:* Has a hood but does not totally encapsulate personnel. Is splash resistant to most chemicals. Has its own internal air supply.
- *Level C:* Has a hood but does not totally encapsulate personnel. Is less resistant to chemical penetration than previous levels. Equipped with a respirator that can filter out most chemical contaminants and biological and radioactive substances.
- *Level D:* Used when there are no chemicals or agents that can affect the respiratory system or penetrate through the skin. Generally consists of a jumpsuit or scrub suit.

Source: **http://www.firstrespondernetwork.com**.

After exposure to any type of chemical, biological, or radioactive agent, personnel must go through a decontamination procedure. These procedures vary widely, depending on the type of agent. They range from simply removing clothes and showering with water to extensive treatment with various neutralizing agents. Most emergency response teams have a decontamination tent that provides some privacy and contains the equipment necessary for thorough decontamination.

The Postimpact Phase

The postimpact phase may begin as little as 72 hours after the disaster and in some cases may last considerably longer.[8] It may continue for years, as in the aftermath of Hurricane Sandy on the East Coast, Hurricane Katrina in New Orleans, and the attacks on the World Trade Center on 9/11. The activities focus on recovery, rehabilitation, and rebuilding. One vital step during the postimpact phase is the evaluation of the disaster preparations and of how rescue and recovery efforts could be improved.

Many Roles for the Nurse

Every disaster poses its own unique challenges. The role of the nurse in a specific disaster depends on its nature and on the type and numbers of injuries. Although most nurses have some familiarity with the role of nurses when they provide aid in a disaster, they may assume many other roles and function outside their usual practice setting in meeting the needs of the disaster victims.[6] Nurses must be able to perform under stressful and sometimes physically dangerous conditions.

After the hurricanes in Florida in 2005, large numbers of disabled and elderly clients who had been living in nursing homes and extended care facilities were displaced to schools and shelters. Nurses assumed the primary responsibility for caring for these individuals who, because they could not care for themselves and lacked essential medications, needed care at a level above what rescue workers could provide.

Triage Nurse

When the number of injured is very high, more than 1,000, the incident is classified as a mass casualty, and multiple agencies, from the local to federal, become involved. Nurses also can provide direct treatment, which may be brief or may be involved in more complex roles, such as mobile surgical units (**Box 26.2**).

However, in the early stages of many disasters, nurses may find a lack of essential resources both in the field and in the emergency department. Nurses have a long history of being able to improvise and get by with what is available, and a disaster will certainly challenge their creativity. When there are large numbers of victims in major disasters, nurses are often responsible for triage (from the French word meaning "to sort"), assessing victims and prioritizing care for the best use of resources. Mass casualty situations require a different type of thinking than is usually used in everyday health care. The traditional classification of victims into low risk, intermediate care, and immediate care is reordered. The overriding goal in a disaster is to provide the best care possible for the greatest numbers of victims. Often this involves providing only palliative care to those with critical injuries, allowing more resources to be used for those with a better chance of surviving the disaster.

Box 26.2 Responsibilities of the Disaster Nurse

Short-Term

- 1. Performs triage at the scene or in the emergency department.
- 2. Provides emergency medical assistance at the scene or in the emergency department. Special attention is given to vulnerable groups, such as handicapped people, children, and the elderly.
- 3. Provides assistance in the mobilization of necessary resources such as food, shelter, medication, and water.
- 4. Works in collaboration with existing disaster organizations and uses available resources.

Long-Term

- 1. Provides assistance with resettlement programs and psychological, economic, and legal needs.
- 2. Partners with independent, objective media; local and national branches of government; international agencies; and nongovernmental organizations.
- 3. Warns clients to be aware that many scam artists are present after any disaster and what factors to consider in detecting a scam.

Triage is performed either in the field or in the emergency department. In the field, usually few medical resources are available, quick evacuation is not possible, and no one knows how soon higher level medical care will arrive. Standard triage systems were developed for fewer numbers of victims who could be moved quickly to a health-care facility; however, they fall short when there are many victims who must remain in the disaster zone for a longer period of time.

The Medical Disaster Response (MDR) system was designed to quickly evaluate and classify victims immediately after a disaster who cannot be evacuated for a substantial period of time. It requires the specialized training of local health-care providers, particularly nurses and first responders. It relies upon a dynamic triage methodology that allows for ongoing triage that may last for hours or even days. The goal is to maximize victim survival and make the best use of existing resources.

Classification Systems

The MDR system is based on the traditional “simple triage and rapid treatment” (START) method but is modified to use palpation of the radial pulse in place of the more difficult capillary refill assessment along with respiratory rate and basic neurological assessment (can the victim respond to commands). It is also combined with the “secondary assessment of victim endpoint” (SAVE) system of triage that was developed to better use limited resources for victims who were most likely to survive and recover. Trauma statistics serve as the basis for the SAVE system, which attempts to determine which victims will best survive with the various types of injuries they have suffered. The formula used is:

Probability of survival (%) = benefit ÷ available recourses.

If it is determined that a victim has a 50 percent or greater chance of surviving, they receive treatment. Basically, the person conducting the triage makes a cost-benefit analysis in deciding which victims will benefit most for the limited resources on hand. The system places all victims into one of three categories:

- Category 1: Those who will die anyway, no matter what resources are used to help them
- Category 2: Those who will survive whether or not they are treated
- Category 3: Those who can be helped and will gain long-term benefit from intervention and use of resources

The key to the success of the system is to identify and treat those who fall into category 3 as quickly as possible. The first and second category victims will receive only palliative care. Colored tags are also affixed to the victims based on their physical condition and injuries:

- **Green (category 2):** Victims who are able to get up and walk around and require minimal or no treatment to save life or limb.
- **Red (category 3):** Victims who require help breathing or assistance with their airways or whose respiratory rate is greater than 30 breaths per minute. Also included in this group are clients who are breathing but have no pulse at the wrist (radial pulse) and victims who are unable to respond to commands. Some of these victims can be saved and require immediate intervention, but they require the use of a large quantity of already scarce resources.
- **Yellow (category 3—nonurgent):** Those victims who do not meet the criteria for the red category but are not able to walk. These individuals require intervention but usually can tolerate some delay in treatment.
- **Black (category 1):** Those victims who are so severely injured that they have no chance for survival— fatalities.

Other factors that enter into the decision-making process include the victim's age and severity of any preexisting conditions. For example, an elderly victim with a head injury and a Glasgow Coma Scale score of 5 (out of a possible 15—unresponsive to all stimuli) who is wearing a MedicAlert bracelet that says he is on anticoagulant medications would require the use of significant medical resources and would still not likely survive the injury. He would receive a black tag and be placed in the “expectant area.” However, a middle-aged adult with 20 percent second-degree burns of the legs would require minimal treatment with dressings and pain medications and has an excellent chance of surviving with full recovery would receive a yellow

tag and be moved to a “treatment” area. Victims need to be reassessed frequently because conditions change and they may need to be moved to another area. The MDR-SAVE methodology is a systematic approach to use triage as a tool to maximize victims’ survival in the immediate aftermath of a catastrophic disaster.

“When the number of injured is very high, more than 1,000, the incident is classified as a mass casualty, and multiple agencies, from the local to federal, become involved.”

BIOTERRORISM

Biological weapons include any organism (e.g., bacteria, viruses, or fungi) or toxin found in nature that can be used to kill or injure people. Toxins are poisonous compounds produced by organisms, such as the botulism toxin. Bioterrorism is the use of microorganisms with the deliberate intent of causing infection to achieve military or political goals.[10]

An Acute Health Issue

Biological weapons are one category of weapons of mass destruction because of their ability to disable or kill large numbers of people at one time. Unfortunately, biological weapons are relatively easy and inexpensive to produce. Biological agents can be spread through the air, through water, or in food. It is also possible to use robotic delivery of agents by remote-control devices such as model airplanes. Most frightening of all, biological agents can be spread by “suicide coughers” who have purposely been given the disease and spread it from person to person in a crowded space such as a subway or an airport. After being released, microorganisms can go undetected for an extended period because their effects are not immediate and the initial symptoms are often nonspecific or “flulike.” Person-to-person transmission may continue for days or even weeks before the source is detected and a specific disease-causing organism is identified.

The vulnerability of the United States to a biological attack became painfully apparent with the delivery of anthrax spores through the postal system as an infective agent after the 9/11 attacks. The need to protect a vulnerable American population from further terrorist attacks became an acute public health issue.[11] Also, the offensive biological weapons programs of the former Soviet Union produced some deadly weaponized biological agents that cannot be located; this knowledge has increased the national anxiety level concerning bioterrorism in the United States. Since 1998, the American Nurses Association (ANA) has worked in conjunction with the American College of Emergency Physicians (ACEP) to develop strategies for health-care providers to use in responding to nuclear, biological, and chemical incidents.

Early Recognition

For nurses and other clinicians, the key to an effective response is training in the early recognition of a bioterrorist attack. Some biological agents can be detected in the environment using high-tech detection devices (sniffers). Several of the portable sniffer models include the Biological Aerosol Warning System (BAWS), which was used in Iraq, and the Portable Biofluorosensor (PBS).[12] Even newer technology may also play a part in the future of early

detection of biological agents. The latest research is focused on developing tiny electronic chips containing living nerve cells that could be worn like a radiation-detection badge. It would warn of the presence of a wide range of bacterial and viral organisms. Another experimental device that would help identify specific pathogens such as botulism and smallpox consists of fiberoptic tubes coated with antibodies. Light-emitting molecules would shine through the antibodies, and the different colors produced would indicate which organism is present.

However, biological agents are most often identified by specific blood tests and cultures or the report of a health-care provider of a particular set of symptoms indicative of a particular disease. Another early warning sign is an unusually large number of ill or dead animals found throughout the community, particularly birds. They are often the first ones to catch lethal illnesses. Health-care providers must be able to identify victims early and recognize the patterns of the disease. If there are a large number of people with the same unusual symptoms, reports of dead animals, or other inconsistent findings, a biological warfare attack should be suspected. Early detection of a biological agent in the environment allows for early and specific treatment and enough time to treat others who were exposed. Currently, the U.S. Department of Defense is evaluating devices to detect clouds of biological warfare agents in the air at higher altitudes.

Are Nurses Ready?

Studies conducted over the past decade provide data indicating that nurses are still not as well prepared as they should be to respond to biological warfare agents.[10] Nurses have been and will remain the frontline first responders to all emergency situations, including a biological attack. Nurse preparedness can only increase through improved education and training in early recognition, detection, and treatment of infected persons. To help achieve this goal, several computerized education programs have been developed to raise the knowledge level of nurses and other first responders.

To educate nurses about bioterrorism, the Centers for Disease Control and Prevention (CDC) have produced online teaching and learning modules. A more comprehensive education program has been developed by the University of California–Los Angeles, in conjunction with content experts. It consists of six interactive case studies that require participants to use their knowledge to identify each biological agent. Pretest and post-test results indicate a marked increase in participant knowledge and ability to detect and distinguish among various biological agents.[10]

Recognizing and treating outbreaks as early as possible is critical for rapid implementation of measures to prevent the spread of disease. Response to bioterrorist attacks is similar to the traditional public health response when communicable disease outbreaks occur naturally, but the focus must be on early detection. However, early recognition is challenging because terrorists may use weaponized biological agents that cause highly variable initial symptoms or symptoms that are ignored until they become debilitating.

Clinical Presentation

Nurses and other clinicians must be familiar with the specific symptoms and clinical syndromes caused by bioterrorism agents (**Box 26.3**). One of the first indications of a biological attack is an increase in the number of individuals seeking care from public health agencies, primary care

providers, and EDs. Because many of these agents are viruses, the early symptoms often look like a case of the flu. Hospitals, doctors, nurses, and public health professionals will be on the front lines of any attack. A heightened level of suspicion, plus knowledge of the relevant epidemiological clues, should help in the recognition of changes in illness patterns.[6]

Box 26.3 Epidemiological Clues to a Biological Attack

- • Many clients with the same disease, indicating the sudden development of a large epidemic
- • Multiple clients with unusually severe symptoms or diseases with unusual routes of exposure
- • Diseases occurring where they normally do not, or during the wrong season, or at a time when the normal vector is absent (e.g., West Nile virus in the winter—no mosquitoes)
- • Multiple simultaneous epidemics of different diseases
- • Outbreak of zoonotic disease (diseases transferred from animals to humans)
- • Larger than normal numbers of sick, dying, or dead animals in the community
- • Unusual strains of contagious organisms or large numbers of antibiotic-resistant organisms
- • Higher rates of disease than would normally be seen in persons exposed to the organism
- • Reports of a credible threat of a biological attack by official authorities
- • Direct evidence of biological attack

Biological Agents

The CDC has developed a list of biological agents that are considered the most likely to be used in a bioterrorist attack (**Table 26.1**). Infective agents were included for their ability to produce widely disseminated infections, high mortality rates, potential for major public health impact, and ability to cause panic and social disruption. Those that require special action for public health preparedness were also included. Category A agents possess the highest immediate risk for use as biological weapons; category B agents pose the next highest risk. Category C agents have a potential for use but are not considered an immediate risk as biological weapons.

Table 26.1 Critical Biological Agent Categories for Public Health Preparedness

Category	Biological Agent	Disease
A: Highest immediate risk	*Variola major*	Smallpox

Category	Biological Agent	Disease
	Bacillus anthracis	Anthrax
	Yersinia pestis	Plague
	Clostridium botulinum (botulinum toxins)	Botulism
	Francisella tularensis	Tularemia
	Filoviruses and arenaviruses (Ebola and Lassa viruses)	Viral hemorrhagic fevers
B: Next-highest risk	*Coxiella burnetii*	Q fever
	Brucella species	Brucellosis
	Burkholderia mallei	Glanders
	Burkholderia pseudomallei	Melioidosis
	Alphaviruses	Encephalitis (VEE, EEE, WEE)
	Rickettsia prowazekii	Typhus fever
	Toxins (e.g., ricin, staphylococcal enterotoxin B)	Toxic syndromes
	Chlamydia psittaci	Psittacosis
	Food-safety threats (e.g., *Salmonella* species, *Escherichia coli* 0157:H7)	Salmonellosis, diarrheal illness, sepsis, hemolytic uremic syndrome
	Water-safety threats (e.g., *Vibrio cholerae, Cryptosporidium parvum)*	Cholera, cryptosporidiosis
C: Potential, but not an immediate risk	Emerging-threat agents (e.g., Nipah virus, hantavirus)	

EEE = eastern equine encephalitis; VEE = Venezuelan equine encephalitis; WEE = western equine encephalitis.

Effective Response

In the event of a widespread bioterrorism attack, nurses in all levels and types of health-care settings will likely become involved. To develop a prompt and effective response, nurses and other health-care providers must know the modes of transmission, incubation periods, symptoms, and communicable periods of these diseases as outlined by the CDC.[11]

Identification and Management

Once a potential outbreak is detected, it must be brought to the attention of the appropriate health-care agencies or specialist in infective diseases. The CDC is always called in and may “take over” the hospital to prevent the further spread of the biological agent. In cases of suspected bioterrorism, they are given the authority of federal law enforcement personnel.

All nurses should have accurate around-the-clock information on the resources available for their geographic area. Once appropriate notifications have been made, nurses will use their skills of clinical evaluation and history taking to identify the infective organism, mode of transmission, and source of exposure. In addition, nurses play a critical role in managing postexposure prophylaxis and its complications, as well as psychological and mental health problems brought on by the event.

What Do You Think?

Have you received any specialized training in disaster or bioterrorism preparedness? If you have, how does it make you better able to care for victims of disaster or bioterrorism? If you do not eventually receive this training, is it something that you think is important enough to seek out on your own? Do you feel prepared to care for these victims?

Response Training

The American College of Emergency Physicians (ACEP), in alliance with the ANA, submitted a list of recommendations to the Health and Human Services Office of Emergency Preparedness in April 2001. Included was the recommendation that all basic nurse education programs include information on how to respond to mass casualty events. The task force also recommended that self-study modules and other types of specialty programs be developed for ED nurses that would contain more in-depth information on the detection and management of bioterrorism. (For more information, go to **http://www.acep.org** for recent updates.)

The ANA is actively involved in developing ways to better prepare nurses to respond to bioterrorist events. In collaboration with the Department of Health and Human Services (DHHS), they established the National Nurses Response Teams (NNRT). This joint effort was unveiled at the ANA's 2002 biennial convention.

Activation and Deployment

In the event that the president declares a bioterrorism state of disaster, the NNRT will be activated to respond by providing mass immunization or chemoprophylaxis to a population at risk. The NNRT, under the auspices of the DHHS, will be quickly deployed in response to a major national event.

The goal of the ANA and federal officials is to recruit 10 regional teams of 200 nurses. The ANA is working to recruit these nurse teams and will provide ongoing education to the NNRT in disaster response. The DHHS is responsible for the screening and processing of potential nurse team members after they have been recruited by the ANA.

When the NNRT teams are deployed, the members become “federalized,” and the federal government will pay their salaries, reimburse them for travel, and cover their housing costs during the duty period. In case of a terrorism disaster, the deployment will be limited to 2 weeks to minimize the impact on the nurses’ employers.

The nursing profession faces serious challenges in the response to threats of bioterrorism. The nation is counting on nurses to play a vital role in bioterrorism preparedness and response. The public depends on nurses to be the frontline responders and to protect them from the effects of bioterrorism. Nurses must be able to communicate medical information and educate the public quickly after a crisis. It is imperative that the nursing profession train nurses in appropriate, effective responses to ensure the best outcome in a frightening, unfamiliar event.

“Since 9/11, the need to protect a vulnerable American population from further terrorist attacks has become an acute public health issue.”

MRC

Nurses interested in working with disaster victims might want to consider joining the Medical Reserve Corps (MRC). It is a nationwide network of community-based response units sponsored by the office of the surgeon general of the United States. As a national network of local groups of volunteers committed to improving the health, safety, and resiliency of their communities, anyone can join. The largest single group of volunteers in the MRC is nurses. Each MRC unit is organized and trained to address a wide range of challenges, from public health education to disaster response. The training is specific for the types of disasters that are seen in the units’ communities and range from setting up aid stations and administering immunizations to the after care of displaced elderly victims. After a nurse volunteer has been trained and certified, they can respond to a variety of different types of disasters, including those that are out of state. Normally, nurses are not allowed to practice nursing in states in which they are not licensed. Because MRC certification is national, states have agreed to allow certified nurses to practice within their boundaries during disaster events. For more information, please visit **http://www.naccho.org/topics/emergency/mrc/** or **http://www.medicalreservecorps.gov/** .

CHEMICAL WEAPONS

Although the Chemical Weapons Convention of 1993 banned, under the legal threat of punishment, the worldwide production, stockpiling, and use of chemical weapons, a number of countries, including the United States, maintain large aging stockpiles of these horrific weapons. Their storage and use is generally rationalized as a means of defending the country against attack from a hostile aggressor.

Definition

Chemical weapons (CW) are generally defined as devices that use any one of a number of chemicals mixed in such a way as to inflict death or harm to human beings. CWs, along with biological and nuclear devices, generally fall into a class of weapons know as *weapons of mass*

destruction. CWs take many forms, including gas, liquids, and solids, that often kill or destroy targets other than the one intended.[13]

There are two general classes of CWs— unitary and binary agents. Unitary chemical agents are effective by themselves and do not require any other substances to be mixed with them to make them lethal. These agents are highly volatile (unstable and return to a gas state quickly) and are the types of agents most commonly stockpiled by nations in their weapons arsenals and preferred by terrorists. Binary CWs only become lethal when two non-dangerous chemicals are mixed together to create a third dangerous chemical.[14] These are more difficult to manufacture and more complicated to activate. However, the reason passengers can no longer take liquids, contained in more than 3-ounce increments, on airplanes is because of a plot by terrorists in Great Britain to use binary agents poured into shampoo bottles and then mixed when they were on the plane with the intention of bringing down international flights.

"Many CWs kill in a matter of minutes while others can take hours or even days, providing the victims with a chance of survival if quickly decontaminated and treated with the appropriate antidote, if one is available."

Horrific Results

The first widespread military use of CWs was during World War I. The injuries caused by them were so horrific that, although most major countries now have stockpiles of them, they have been very reluctant to use them. There was some use of CW by Japan against the Chinese at the beginning of World War II, but after seeing the effects, they were not used again. The Aum Shinrikyo cult used sarin, a deadly colorless, odorless nerve gas, on a Tokyo subway in 1995, killing 12 people and injuring more than 5,500.[13] In addition, Saddam Hussein used CWs against the Kurds in the northern part of Iraq. Parts of the country became a desert because CW annihilated all living things and made the area uninhabitable for decades due to contamination of water and food supplies. The half-life of many CWs can last a few years or even decades.

More recently, there were substantiated reports that CWs were used in Syria in 2013 on a limited scale, although it is unclear who actually used them. Experts believed for many years that the Syrian government had a stockpile of CWs, although they consistently denied it. Investigations seemed to point to one of the groups of rebel terrorists fighting against the government had obtained CWs on the black market and used them. Later that year, U.S. vice president Joseph Biden brokered a deal whereby the Syrian government would turn over all the chemical weapons stockpiles that they claimed they never had to Russia for permanent destruction.

Russia reluctantly acknowledged that some of their CWs went missing after the fall of the Soviet Union and may very well have gotten into the hands of terrorists groups. Letters sent to the U.S. president and several high-ranking government officials in the spring of 2013 were laced with ground caster beans, the key ingredient in the deadly poison ricin. If the terrorist bombers at the 2013 Boston Marathon had incorporated chemical agents into their backpack bombs, the death toll and number of injured would have been even more devastating.

Since the September 11, 2001, terrorist attacks on America, the threat of chemical weapons has become an immeasurable concern for both citizens and the government. The government has made preparations to protect the population against CWs and has taken measures to ensure that there is a plan for action in response to a CW attack. The technology to produce CWs is widely

available, and key chemicals are available at the tens of thousands of chemical manufacturing plants in the United States and Europe alone.

In 1997, in an attempt to stop the spread and use of CWs, the U.S. Senate ratified a global chemical weapons ban treaty signed by more than 80 other nations. However, terrorists groups do not abide by these treaties and, because of the abysmal effects and fear generated by CWs, seem eager to obtain and use them on Western populations.

Types of Chemical Weapons

The three major groups of chemical weapons are nerve agents, blister agents, and choking agents. They are generally dispensed as aerosols, liquids, or vapors that enter the body through the eyes, lungs, or skin. There are also blood agents, which are inhaled. Their overall effectiveness in killing people can be affected by how old the agent is, its purity, weather conditions such as temperature and humidity, strength and direction of the wind, size of the environment where they are released, and how they are introduced into the environment.[13] Many CWs kill in a matter of minutes; others can take hours or even days, providing the victims with a chance of survival if quickly decontaminated and treated with the appropriate antidote, if one is available. Although symptoms vary based on the class of agent, some general symptoms to look for include immediate failure of the respiratory or nervous system (paralysis), severe skin irritations and blisters, headaches, irregular heartbeat or palpitations, vomiting, and convulsions (**Box 26.4**).

Nerve Agents

The nerve agents are among the most toxic of all CWs. They are particularly deadly when released in an enclosed area such as a subway train or an airplane. Their initial development was just before World War II for the purpose of controlling insect infestations on farms. Chemically related to the organophosphorus insecticides that are in wide use today, they work by inhibiting the production of acetylcholinesterase throughout the nervous system and causing paralysis of smooth muscles. German scientists of the 1930s soon recognized the lethal potential of these chemicals and began producing concentrated weaponized forms of the substance that could be used on the battlefield and in the gas chambers of the concentration camps.[15]Causing an excessive accumulation of acetylcholine in the nerve endings of the parasympathetic system, nerve agents inhibit the smooth muscles all along the vagus nerve (cranial nerve X), including the iris of the eye, ciliary bodies in the bronchial tree and gastrointestinal tract, bladder, and blood vessels. They also paralyze the salivary glands and secretory glands of the gastrointestinal tract, the respiratory tract, and eventually the cardiac muscle tissue. Although respiratory symptoms are generally the first to appear after inhalation of nerve agent vapors, if ingested, gastrointestinal symptoms are usually the first to appear. The early symptoms often mimic a heart attack, manifesting with tightness in the chest, shortness of breath, elevated blood pressure, and abnormal heart rhythms. As the effect of the toxin becomes more systemic, the victim will experience increased fatigue and generalized weakness, which increases with activity. Soon after, involuntary muscular twitching, scattered involuntary muscle contractions, and intermittent muscle cramps develop. The skin may be pale due to vasoconstriction. Left untreated or treated

too late, nerve agents lead to organ failure, complete shutdown of the nervous system, and death.[13]

Box 26.4 Classes of Chemical Agents

Nerve Agents	Blister Agents	Respiratory Agents
Tabun (GA)	Sulfur mustard (Yperite) (HD)	Phosgene (CG)
Sarin (GB)	Nitrogen mustard (HN)	Diphosgene (DP)
Soman (GD)	Lewisite (L)	Chlorine (Cl)
Cyclosarin (GF)	Phosgene oxime (CX)	Chloropicrin (PS)
Methylphosphonothioic acid (VX)		

The primary treatment is immediate decontamination and the administration of atropine sulfate IV as soon as possible. Atropine blocks the effects of the parasympathetic system and helps breathing by drying secretions and dilating the airways. Atropine also suppresses other symptoms of nerve agents, including nausea, vomiting, abdominal cramping, low heart rate, and sweating. Atropine, however, does not prevent or reverse paralysis. Another medication, pralidoxime chloride, may also be given. It belongs to a family of compounds called *oximes* that bind to organophosphate-inactivated-acetylcholinesterase, thereby "regenerating" or "reactivating" acetylcholinesterase and allowing the synapses to function again.[14] Unfortunately, if it is not given soon after exposure, it may not be able to break the molecular bonds in the synapse and it will be ineffective. If treated early, the serious signs and symptoms of nerve agent toxicity rarely last more than a couple of hours.

Generally, if the victim survives the initial exposure and peak toxic effects, the symptoms usually disappear within 1 day, and the survival rate is excellent. Victims who were exposed but show no symptoms are usually observed for at least 18 hours because some signs and symptoms can show up later.

"Decontamination of the victims as soon as possible is essential to reducing their exposure to the toxins and providing appropriate medical treatment, such as specific antidotes, that will increase their chances for survival."

Blister Agents

Blister agents, sometimes called *vesicants*, burn and blister the exposed skin on any part of the body they contact. With enough exposure or if inhaled in large quantities, they can kill people, but they are more often used to produce large numbers of serious casualties that need extensive care, thus taking away needed resources for fighting. They also force the enemy to wear full protective equipment, making their ability to fight more cumbersome and less effective. When thickened and applied to land, ship decks, or the surfaces of aircraft or vehicles, blister agents become a persistent hazard that makes it challenging to defeat enemies.[15]

Although exposed skin is usually the first area of the body affected, blister agents also can cause major damage to the eyes, mucous membranes, linings of the lungs, and blood-forming organs. In addition, when ingested, they cause vomiting and diarrhea. The most feared and oldest of the blister agents is mustard gas. It is easily made, very stable chemically, remains dangerous on surfaces almost indefinitely, and there is no effective treatment for it even today, making it hard to decontaminate.[13] It was first used in World War I, and the gruesome burns it produced frightened even the people who released it.[15]

Another problem is that exposure to mustard gas is not always evident right away because of the latent and symptom-free period that may occur after skin exposure. This may result in delayed decontamination or failure to decontaminate at all. However, it must be removed from the skin quickly and efficiently. After even as little as a 2-minute exposure, a drop of mustard on the skin can cause serious blisters and burns.

Initial treatment, as with all chemical agents, is immediate decontamination. The chemical chlorination has proven somewhat effective in disabling mustard and several other of the blister agents. There is no practical drug treatment available for preventing the internal effects of mustard. Infection is the most serious complication after exposure to blister agents. Although there is little agreement on the best way to treat exposure to blister agents, most mustard gas victims survive but have protracted and painful recovery periods with the need for multiple skin grafts.

Choking Agents

Choking or respiratory agents work by attacking the tissues of the lungs and produce massive pulmonary edema. The most dangerous of this group of toxins is phosgene and the one that terrorists are most likely to use. Phosgene was used for the first time in 1915, and it accounted for 80 percent of all the deaths attributed to CWs during World War I. Initial symptoms include coughing, choking, a feeling of tightness in the chest, nausea and occasionally vomiting, headache, and excessive tear production.[15]

When delivered in very high concentrations, a painful and agonizing death can occur within several hours. With lower concentrations, death usually occurs in 12 to 24 hours. There is no specific antidote or treatment. Respiratory support by ventilation with positive end expiratory pressure (PEEP) can usually maintain adequate oxygenation of the body. Use of osmotic diuretics can reduce the fluid load in the lungs. Other supportive measures commonly used for persons in pulmonary edema may be helpful. If the victim survives the initial exposure, they usually begin to recover within 48 hours, although there may be permanent lung damage. Respiratory infection is the dreaded major complication. If victims survive longer than 48 hours, they usually make a full recovery.[13]

"It is more likely that any individual would be exposed to a chemical agent from an industrial accident or vehicular mishap."

General Principles of CW Preparation

In reality, many of the measures used by nurses and first responders for preparation and protection for bioterrorism are also effective with CWs. It's imperative that nurses and

emergency personnel wear personal protective suits when dealing with chemical contamination due to the persistent nature of some of the agents. Decontamination of the victims as soon as possible is essential to reducing their exposure to the toxins and providing appropriate medical treatment, such as specific antidotes, that will increase their chances for survival.[13]

Personal Protective Equipment

First responders and emergency room personnel are at serious risk for exposure to the chemically contaminated areas (known as *hot zones*). The victims themselves automatically become hot zones and the hot zones can move if the victim is not completely decontaminated. If first responders are unprotected, direct contact to the CW or inhalation of vapors automatically makes them victims as well. If a liquid chemical agent was used, handling the skin and clothing of victims exposes rescue personnel to the same chemical.[13]

Full level D hazardous material (hazmat) suits should be worn until the source of contamination has been completely eliminated. A hazmat suit is an impermeable whole-body garment that is worn as protection against a variety of hazardous materials. To protect against chemical exposures, these suits are made of barrier materials like Teflon, heavy PVC plastic, corrosive-resistant synthetic rubber, or Tyvek (a brand name for cloth made from flash-spun high-density polyethylene fibers).

The high-level suits have self-contained, filtered breathing systems to eliminate any exposure to airborne toxins. These are similar to the suits used for bioterrorism, except they are more resistant to the corrosive effects of some chemical agents. Also, biological protective suits must have fully sealed systems and positive-pressure breathing systems to prevent entry of the biological agent, even if the suit is punctured or torn. Although hazmat suits are mostly used by firefighters, researchers, personnel responding to toxic spills, specialists cleaning up contaminated facilities, and workers in toxic environments, most health-care facilities have them available for personnel who are likely to come into contact with hazardous chemicals.

Decontamination

Decontamination is the physical and chemical removal of toxic agents from people's skin, clothing, equipment, and any environmental surfaces where they were disseminated. Hazardous chemicals remaining on clothing, skin surfaces, and even in the respiratory system can be a source of exposure to others.[13] This is called *secondary exposure* and is the most common type of exposure experienced by first responders and emergency room personnel. Immediate decontamination is a major treatment priority for those with CW exposure. It should include:

- • Removing all contaminated clothes and jewelry from the victim and washing the unclothed body thoroughly with warm water and soap.
- • Avoiding the use of very hot water and excessively vigorous scrubbing because they may actually force more of the chemical into the skin.
- • Decontaminating all victims who have been exposed, even if it is unknown whether it was a vapor or liquid. Vapor exposure alone may not require decontamination; however, some vapors cling to clothing and skin and can be inhaled from these surfaces.

- • Decontaminating victims as close as possible to the site of exposure. This minimizes the time of exposure and prevents moving the hot zone to another area. Most hospitals that are certified to treat chemical exposures have policies and procedures about where victims may be decontaminated. Usually it is an area outside the emergency department where a tent is set up to perform initial decontamination before people and equipment are allowed entry. Portable decontamination equipment with showers and runoff water collection systems are commercially available. Some larger facilities have in-house decontamination areas with showers, special ventilation, and various decontamination rooms. All hospitals should have the capacity to safely decontaminate at least one person at a time.[13,14]

Supportive and Specific Therapy

Health-care providers should follow the ABCs of emergency care: airway, breathing, and circulation. Keeping the airway open and making sure victims are able to breathe or are well oxygenated is always the first priority. Intubation and oxygen delivery equipment must be available. Until the specific agent is identified, health-care providers should treat the most serious and life-threatening symptoms first. However, laboratory tests used to identify specific chemical agents are not available in all hospitals. Confirmation of the chemical agent may take several hours or even days. Once the agent has been identified, specific antidotes known to be effective should be used.[13]

The Centers for Disease Control and Prevention is the authority on chemical weapons and their treatments. They have information on treatment options and a decision tree that can be used for deciding what treatments are most likely to be successful. For more information, go to **http://www.cdc.gov/nceh/demil/articles/initialtreat.htm**.

The Odds Are Good

Realistically, the chances of being exposed to CWs or chemical agents is miniscule. Although some terrorist organizations have been successful in obtaining and releasing chemical agents, the reality is that making effective delivery systems is extremely difficult. It is more likely that any individual would be exposed to a chemical agent from an industrial accident or vehicular mishap. There are numerous chemical factories across the nation right now creating chemical toxins that are more deadly than any ever used in weapons. Because of the volatile nature of the chemicals they make, these chemical factories have a disturbing tendency to explode from time to time and spread the toxins over wide areas. Toxic chemicals are regularly shipped by trains and tractor-trailers to all parts of the country. It is not unusual to see a train accident where the large black tank cars lie broken on their sides near a populated area. The chemicals they contain are often highly toxic.

Dangerous Aging Weapons

An even more concerning situation is the aging stockpiles of chemical weapons owned by the U.S. military. Many of these weapons were manufactured over 60 years ago and put into containers that were made to last only a few years. Because of the corrosive nature of these chemicals, many of the containers are developing leaks, exposing personnel to the toxic agents.

The only sure way to dispose of these toxins is by burning them at extremely high temperatures, 2,500 to 3,000 degrees, thereby reducing them to their basic elements and rendering them harmless. Unfortunately, there are only a few of these disposal plants for chemical weapons in the country. Disposal of the many aging chemical warheads would require shipping them cross-country by rail or truck to the disposal sites. The dangers of accidents and widespread contamination make this method of eliminating them very dangerous. Some companies have developed large “indestructible” stainless steel tanks located in stable underground salt caves that can theoretically keep these weapons in safe storage for centuries. Unfortunately, the jury is still out on how safe these tanks and salt caves really are.

Nurses must be prepared to deal with all types of disaster. Education for disaster preparedness needs to start in nursing school and continue throughout the nurses’ career. It would be highly unlikely that a nurse would not experience some type of disaster during his or her career. Knowledge and skills development are the best preparation.

Issues Now

Disaster Preparedness for ... Scam?

The sirens were blaring and the emergency radio was shouting “SEEK SHELTER NOW!” The whole family and two dogs scrambled for the storm shelter. We barely got the door closed and bolted down when there was a big crash, a roaring sound (it really does sound like a train), banging and scraping, and the shelter door started to partially lift up. After what seemed like hours (in reality about 5 minutes), there was only dead silence. We carefully pushed up the heavy shelter door, and all we could see was an empty foundation slab, glistening wet from the rain. I guess our house isn't in Kansas anymore!

OMG, what do we do now? We had our disaster plan and supply kit, so at least we had a place to start. I think I went through the five stages of grief in about 10 minutes. It really didn't start to sink in until several days later. I'm going to need to call the insurance company, I thought. I've never even filed a claim for a broken window before. I wonder how you do that. What about the utilities? Do I have to pay for them even though there's no house anymore? Do you still have to pay real estate taxes and fees for garbage pickup? My HD 70-inch flat-screen is sticking out of the side of the neighbor's garage—I don't think we'll get many cable channels there! When are the FEMA guys going to show up?

As I picked through what was left of my belongings, trying to find anything of value, an official-looking, nicely dressed, clean-cut young man walked up to me.

“Hi!” he said.

“Hi!” I answered.

“It looks like that tornado got you real good,” he remarked.

“Yeah, me and everyone else on the block,” I replied.

“I see you're trying to clean up some. Are you finding anything interesting?” he asked.

“I guess you could say that,” I answered. “The real interesting stuff is from my neighbors’ houses across the street and next door. I guess it all got mix-mastered into one big pile. I'm trying to keep the piles separated. I have no idea where some of the stuff came from.”

“Are you still able to work?” he asked.

“I teach, or used to teach, at the high school you walked past on your way here,” I said.

“There's not much left of that either, is there,” he observed. “That sure must have affected your income.”

“It's not too bad. I usually have the summers off anyway, and my husband is an administrator at a local college who works all year round,” I explained.

“That gives you some advantage over some people since you must be used to dealing with paperwork. Are you making any progress with all the paperwork involved after something like this?” he asked.

“I was just thinking about that. I really don't even know where to start with it,” I said.

“Maybe I can help. I work with a company associated with the National Relief Agency that specializes in helping disaster victims plow through the mountain of paperwork after tornadoes, floods, and other disasters,” he said.

He handed me a nice professional-looking red-white-and-blue business card with an official-looking government seal printed on it and National Relief Agency across the top. It had his name, address, phone number, and an e-mail address on it ending in .gov. It even had “BBB Approved” on the bottom of the card.

“How does it work?” I asked, seeing my first glimmer of hope in many days.

“Well, we take care of pretty much everything, from getting your utilities turned off to filing for FEMA assistance. We'll even help file for your building permit when it is time to rebuild. All I need is some basic information, like your name and address,” he answered.

“That sounds almost too good to be true. But I think I need some time to think about it,” I responded.

“Oh, that may be a problem,” he said. “You see, we're a small company and in order to provide the personal service our clients deserve and expect, we only accept a limited number and then cut off enrollment. Actually, I was authorized to accept only one new client today and then we were not going to accept any more for 2 or 3 months until we clear some of our earliest enrollees. You understand, don't you?”

“I think so, but how much does it cost?” I asked suspiciously.

“We ask for $1,000 up front. There may be some additional fees later. However, most of that money is used to pay for costs that you would have spent anyway, such as fees for filing for FEMA assistance, insurance company adjustor fees, any fees charged by utilities for turning off their services, building permit fees, and other stuff like that. We will also work with your insurance company to get you the best settlement possible. We work out of a lawyer's office, and insurance companies don't like dealing with lawyers,” he explained.

“So let me get this straight,” I said cautiously. “If I don't sign up with you today, it will be several months before I can do so again?”

“Well, it looks like there might be a lot of other people around here that probably would be interested in this type of program,” he answered.

“Well, um, I don't know … I guess. Okay, let's do it,” I said excitedly. I pride myself on always being able to make decisions quickly.

“All you have to do is fill out this one information form and a credit card authorization form,” he said.

He removed the forms from his coat pocket and handed them to me. I retrieved the photocopy of the credit cards I had in my emergency kit and filled in the information and signed it. The other form required some basic information, including my Social Security number and bank account number so that, he told me, money from FEMA and the insurance settlement could be direct-deposited into my account. How thoughtful and convenient! He gave me a handwritten receipt and promised he would get started on the paperwork that afternoon. Finally, someone was actually helping me and I felt I could see the light at the end of the tunnel!

No, probably not so much. The light you see at the end of the tunnel is the light on the locomotive of the Scam-line express, roaring down the tracks to flatten your hopes and dreams. It is most likely that you will never see or hear from this person again and never see your money again either. And just wait and see what happens when the identity theft starts kicking in. After disasters, scam artists show up like flies at a picnic and there are as many different scams as there are flies. The Better Business Bureau has dubbed these scam artists “storm chasers” because they show up after every major storm or disaster. By the way, although the letters BBB can stand for Better Business Bureau, unless the name is spelled out, the letters probably stand for something else (Big Blue Buttons, Big Best Barbeque, Bob's Best Bikes, etc.).

There were so many scams after Hurricane Katrina that the Department of Justice created a new agency, the National Center for Disaster Fraud, a central information clearinghouse for more than 20 federal agencies where people can report suspected fraudulent activities tied to disasters of all types. Here are some things to keep in mind to keep from being scammed:

- • There are *never* fees to apply for FEMA or SBA assistance or to receive property damage inspections. If someone is asking for money, it's a scam.
- • Utilities do not charge for turning *off* services. Some charge a small fee for turning them back on, although in disaster situations they often waive the fees.
- • If someone claims to be from the government, always ask to see a government-issued photo ID and take a picture of it with your cell phone. In fact, they should volunteer to show you an ID.

- • Business cards are not official IDs. With all the online do-it-yourself business card companies these days, it is very easy to make professional-looking business cards that say just about anything, sometimes free for the first 250 cards.
- • Government workers or people associated with government agencies will *never* ask for payment to perform their duties or offer to increase your assistance grant for a fee.
- • If private insurance adjusters and local building code inspectors visit your property, they, too, should provide identification on demand. They do not charge fees.
- • Never hire a laborer or contractor on the spot; good ones don't need to solicit work door to door. Also, check with your neighbors to see if they suffered damage similar to what is being cited at your place.
- • For major repairs, get at least three estimates, based on the same specifications and materials. Check their references, licensing, and registration information with the National Association of State Contractors Licensing Agencies (NASCLA), and read reviews posted by the Better Business Bureau.
- • Require written contracts that specify work to be done, materials to be used, start and end dates, responsibility for hauling away debris, and costs broken down by labor and materials. Verify that the contractor's name, address, phone number, and license number are included, as well as any verbal promises and warranties.
- • Never sign a contract with blank spaces. Unscrupulous contractors sometimes enter unacceptable terms later on.
- • Never give out Social Security numbers, credit card numbers, bank account numbers, or personal information about your finances. Employees of legitimate organizations will never ask for them.
- • Read the fine print. Some shady contracts include clauses allowing substantial cancellation fees if you choose not to use the contractor after your insurance company has approved the claim. Others require you to pay the full price if you cancel after the cancellation period has expired.
- • Ask your contractor to provide proof of his or his company's current insurance that covers workers compensation benefits, property damage, and personal liability. Depending on the size of the job, you may want a performance bond, which protects you if work isn't done according to the contract. Contractors don't like to get these.
- • You'll probably be asked to pay an upfront deposit to cover initial materials—one-quarter to one-third is reasonable upon delivery of materials to your home and once work begins. Get a signed receipt for the money you paid.
- • Never pay in full in advance, and don't pay cash. Have the contract specify a schedule for releasing payments, and before making the final payment, ask the contractor to provide proof that all subcontractors have been paid—if not, you could be liable for their fees.
- • If you suspect anyone—whether an inspector, contractor, disaster survivor, or someone posing as one—of fraudulent activities in relation to a natural or man-made disaster, call FEMA's toll-free Disaster Fraud Hotline at 866-720-5721, or local law enforcement officials.
- • If it sounds too good to be true, it probably is.

- • If someone uses high-pressure sales tactics, requires full payment up front, asks you to get necessary permits, or offers to shave costs by using leftover materials from another job, it's a scam.

We generally think of the elderly as being most susceptible to scam artists, but these crooks are so slick that anyone can fall for their sales pitches. They know that people who are under stress are much more vulnerable to scams than those who feel secure. Many postdisaster victims have a mild form of post-traumatic stress disorder (PTSD) that may last for many months or even years after the disaster. Making people aware of scams, although not usually thought of as a nursing function, certainly falls into the category of caring.

Sources: Alderman J. Avoiding post-disaster scam artists. Huffington Post, 2013. Retrieved June 2013 from **http://www.huffingtonpost.com/jason-alderman/avoiding-post-disaster-sc_b_2916643.html**; Kirchheimer S. Avoid post-disaster scams. AARP. Retrieved June 2013 from **http://www.aarp.org/money/scams-fraud/info-08-2012/avoiding-post-disaster-scams.html**; National Center for Disaster Fraud. Department of Justice, 2013. Retrieved June 2913 from **http://www.justice.gov/criminal/oilspill/about/ncdf.html** and **http://www.justice.gov/opa/pr/ 2012/November/12-crm-1308.html**

Conclusion

The plain and simple truth is that nurses need to be prepared for all types of disasters, including bioterrorism, natural disasters, and chemical weapon exposure. These types of events have unfortunately become a part of post-9/11 life. The tragic events of that day in New York City; Washington, DC; and Pennsylvania revealed how poorly prepared the United States was to deal with disasters. In response, legislation was enacted on federal and state levels that began to address the many issues associated with terrorist acts. Large sums of money were expended to purchase equipment and train health-care workers to be better able to deal with a variety of potential disasters.

Collaboration between groups that often had little to do with each other in the past became an essential component of these plans. The Department of Health and Human Services and the ANA have been working closely to educate nurses in disaster and bioterrorism responses. Although much better preparation was demonstrated in the aftermath of the EF-5 Oklahoma tornadoes in 2013 than in 2005 with the repercussions of Hurricane Katrina, there is still room for improvement. Nurses have dealt with disasters for many years in emergency rooms and working with first responders in the field. Most of their knowledge was accumulated on the job after years of experience. It is essential that the principles involved in disaster preparation and emergency aftercare be taught to the nurse before graduation from nursing school.

Critical - Thinking Exercises

- • Obtain the policy and procedure manuals from your nursing school and your primary clinical location. Try to find the procedures for disaster preparedness (note: sometimes these are separate documents). Compare the school's and

the facility's policies with each other and the plan in this chapter. How do they compare? Where are the areas that need improvement?

- • If you don't have a disaster plan or kit yet for your family, put one together. Show your family and ask for their input.
- • Volunteer to work with your local Red Cross chapter. Write a report about what they do and how they are funded.
- • Read or reread the Issues Now box “Disaster Preparation for a … Scam?” In the conversation, identify the warning signs, if any, that this was likely a scam. What should the person have done?
- • Look up the word *acetylcholinesterase*. Prepare a short presentation to the class about how nerve agents affect the sympathetic and parasympathetic nervous systems. Explain why atropine is an effective antidote.

References

1.
McCabe OL, Barnett DJ, Taylor HG, Links JM. Ready, willing, and able: A framework for improving the public health emergency preparedness system. *Disaster Medicine & Public Health Preparedness,* 4(2):161–168, 2010.

2.
Plan and prepare. Federal Emergency Management Agency, 2013. Retrieved June 2013 from **http://www.fema.gov/what-mitigation/plan-prepare**

3.
Disaster Preparation. General Preparedness Information Flyer, 2013. Retrieved June 2013 from **http://nbcert.org/DisasterPreparation.htm**

4.
Disaster preparedness for healthcare and communities. Response Systems, 2013. Retrieved June 2013 from **http://www.disasterpreparation.net/**

5.
Fire extinguisher types (what type should I use?). Fire Extinguisher 101, 2013. Retrieved June 2013 from **http://www.fire-extinguisher101.com/**

6.
Debisette AT, Martinelli AM, Couig MP, Braun M. US Public Health Service Commissioned Corps Nurses: Responding in times of national need. *Nursing Clinics of North America,* 45(2):123–135, 2010.

7.
James JJ, Benjamin GC, Burkle FM, Gebbie KM, Kelen G Subbarao I. Disaster medicine and public health preparedness: A discipline for all health professionals. *Disaster Medicine & Public Health Preparedness*, 4(2):102–107, 2010.

8.
Sherly W. Phases of a disaster. Healthy Living. Retrieved June 2013 from **http://www.ehow.com/list_6732381_phases-disaster-management.html**

9.
National Incident Management System. FEMA, 2013. Retrieved June 2013 from **http://www.fema.gov/national-incident-management-system**

10.
Nyamathi AM, Casillas A, King ML, et al. Computerized bioterrorism education and training for nurses on bioterrorism attack agents. *Journal of Continuing Education in Nursing,* 41(8):375–384, 2010.

11.
Goodhue CJ, Burke RV, Chambers S, Ferrer RR, Upperman JS. Disaster Olympix: A unique nursing emergency preparedness exercise. *Journal of Trauma Nursing,* 17(1):5–10, 2010

12.
Biological detection systems. National Criminal JusticeReference Service. Retrieved June 2013 from **http://www.ncjrs.gov/pdffiles1/nij/190747-b.pdf**

13.
Federation of American Scientists. Types of chemical weapons. Retrieved May 2013 from **http://www.fas.org/programs/bio/chemweapons/cwagents.html**

14.
Organization for the prohibition of chemical agents. Retrieved May 2013 from **http://www.opcw.org/about-chemical-weapons/types-of-chemical-agent/**

15.
Arnold JL, White S, Talavera F, Roberge RJ. Chemical warfare. eMedicineHealth, 2013. Retrieved May 2013 from **http://www.emedicinehealth.com/chemical_warfare/page7_em.htm**