



Response to Terrorism and Weapons of Mass Destruction

You are the Provider **1**

Your EMS department is in the process of training for a WMD drill. Each crew is assigned a "patient" to assess and treat. You are told that all of the patients were in a textile warehouse when they were affected by something coming through the air conditioning vents.

Initial Assessment

Appearance
Level of consciousness
Airway
Breathing
Circulation

Recording Time: 0 Minutes

Flushed
Alert and oriented
Open and clear
Tachypneic
Radial pulses present, rapid

1. What is your first priority?
2. What is the route of entry of this toxin?
3. What is your treatment priority?

Introduction

As a result of the increase in terrorist activity, it is possible that you may witness a terrorist event during your career. International terrorists and domestic groups have increased their targeting of civilian populations with acts of terror. The question is not will terrorists strike again, but rather when and where they will strike. EMS providers must be mentally and physically prepared for the possibility of a terrorist event.

The use of weapons of mass destruction, or weapons of mass casualty, further complicates the management of the terrorist incident and places EMT-Bs in greater danger. Although it is difficult to plan and anticipate a response to many terrorist events, there are several key principles that apply to every response. This chapter describes how you can prepare to respond to these events by discussing types of terrorist events, personnel safety, and patient management. We also review the signs and symptoms and treatment for patients who have been exposed to nuclear, chemical, or biologic agents or an explosive attack.

What Is Terrorism?

Terrorist forces have been at work since early civilizations. Today, terrorists pose a threat to nations and cultures everywhere. **International terrorism** has brought a new fear into the lives of many American citizens.

Modern-day terrorism is common in the Middle East, where terrorist groups have frequently attacked civilian populations. In Ireland, terrorist groups have attacked the civilian population for decades about re-



Figure 1 Asahara Shoko, the founder of Aum Shinrikyo. [© NHK/AP Photos.]

ligious issues. In Colombia, political terrorist groups target oil resources as a means to instill fear.

In the United States, **domestic terrorism** has occurred multiple times. The Centennial Park bombing during the 1996 Summer Olympics and the destruction of the Alfred P. Murrah Federal Building in Oklahoma City in 1995 are examples. Only a small percentage of religious, political, and other cause-focused groups actually use terrorism as a means to achieve their goals. These groups include the following:

- 1. Violent religious groups and doomsday cults:** These include groups such as Aum Shinrikyo, who carried out chemical and biologic attacks in Tokyo in 1994 and 1995. Some of these groups may participate in apocalyptic violence **Figure 1 ▲**.
- 2. Extremist political groups:** They may include violent separatist groups and those who seek political, religious, economic, and social freedom, such as many Middle Eastern groups **Figure 2 ▶**.
- 3. Technology terrorists:** These include terrorists who would attack a population's technologic infrastructure as a means to draw attention to their cause, such as cyber-terrorists.
- 4. Single-issue groups:** These include antiabortion groups, animal rights groups, anarchists, racists, and ecoterrorists, who threaten or use violence as a means to protect the environment **Figure 3 ▶**.

Most terrorist attacks require the coordination of multiple terrorists or "actors" working together. However, in a few cases, there has been a single ter-

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Figure 2 Palestinian extremist political groups have been associated with terrorism. [© Oded Balilily/AP Photos.]

rorist who struck with devastating results. Terrorists who acted alone carried out all of the Atlanta abortion clinic attacks, the 1996 Summer Olympics attack, and the Oklahoma City bombing.

Weapons of Mass Destruction

What Are WMDs?

A **weapon of mass destruction (WMD)**, or **weapon of mass casualty (WMC)**, is any agent designed to bring about mass death, mass casualties, and/or massive damage to property and infrastructure (bridges, tunnels, airports, and seaports). These instruments of



Figure 3 Demonstrators being held back by police near the World Bank in Washington, DC. [© Rick Bowmer/AP Photos.]

death and destruction include nuclear, chemical, biologic, and explosive weapons. To date, the preferred WMD for terrorists has been explosive devices. Terrorist groups have favored tactics that use truck bombs or car or pedestrian suicide bombers. Many previous terrorist attempts to use chemical or biologic weapons to their full capacity have been unsuccessful. As an EMT-B, you should understand the destructive potential of these weapons.

The motives and tactics of the modern terrorist groups have begun to change. As with the doomsday cults, many terrorist groups participate in apocalyptic, indiscriminate killing. This doctrine of total carnage would make the use of WMDs highly desirable. WMDs are easy to obtain or create and are specifically geared toward killing large numbers of people. Had the proper techniques been used during the 1995 attack on the Tokyo subway, there may have been tens of thousands of casualties. The fall of the former Soviet Union may have made the technology and expertise to produce WMDs available to terrorist groups with sufficient funding. Moreover, the technical recipes for making nuclear, biologic, and chemical weapons and explosive devices are readily available on the Internet and on terrorist group Web sites.

Chemical Terrorism and Warfare

Chemical agents are manufactured substances that can have devastating effects on living organisms. They can be produced in liquid, powder, and vapor forms depending on the desired route of exposure and dissemination technique. Developed during World War I, these agents have been implicated in thousands of deaths since being introduced on the battlefield, and since then have been used to terrorize civilian populations. These agents include the following:

- Vesicants (blister agents)
- Respiratory agents (choking agents)
- Nerve agents
- Metabolic agents (blood agents)

Biologic Terrorism and Warfare

Biologic agents are organisms that cause disease and are generally found in nature. For terrorist use, however, they are cultivated, synthesized, and mutated in a laboratory. The **weaponization** of biologic agents is performed to artificially maximize the target population's exposure to the germ, thereby exposing the greatest number of people.

The primary types of biologic agents that you may come into contact with during a biologic event include the following:

- Viruses
- Bacteria
- Toxins

Nuclear and Radiologic Terrorism

There have been only two publicly known incidents involving the use of a nuclear device. During World War II, Hiroshima and Nagasaki were devastated when they were targeted with nuclear bombs. The awesome destructive power demonstrated by the attack ended World War II and has served as a deterrent to nuclear war. There are nations that hold close ties with terrorist groups (known as *state-sponsored terrorism*) and have obtained some degree of nuclear capability.

It is possible for a terrorist to secure radioactive materials or waste to perpetrate an act of terror. Such materials are far easier for a determined terrorist to acquire and require less expertise to use than other WMDs. The difficulties in developing a nuclear weapon are well documented. Radioactive materials, however, such as those in radiologic dispersal devices (RDDs), also known as *dirty bombs*, can cause widespread panic and civil disturbances. More on these devices will be covered later in this chapter.

EMT-B Response to Terrorism

Recognizing a Terrorist Event (Indicators)

Most acts of terror are covert, which means that the public safety community generally has no previous knowledge of the time, location, or nature of the attack. This element of surprise makes responding to an event more complex. You must constantly be aware of your surroundings and understand the possible risks for terrorism associated with certain locations, at certain times. It is therefore important that you know the current threat level issued by the federal government through the Department of Homeland Security (DHS)

Figure 4 ▶

The Homeland Security Advisory System alerts responders to the potential for an attack, although the specifics of the current threat will not be given. On the basis of the current threat level, you should take appropriate actions and precautions while continuing to perform daily duties and responding to calls. The system of colors is used to inform the public safety community of the climate of terrorism (derived from intelligence gathering and the amount of terrorist

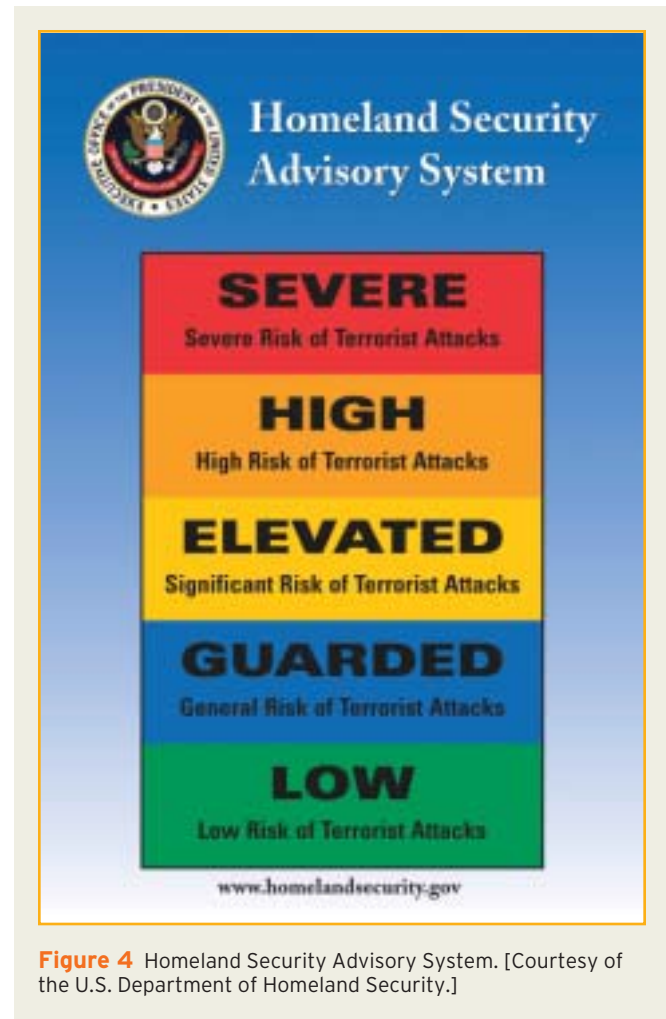


Figure 4 Homeland Security Advisory System. [Courtesy of the U.S. Department of Homeland Security.]

communication) and to heighten the awareness of the potential for a terrorist attack.

The DHS has not issued specific recommendations for EMS personnel to follow in response to the alert system. Follow your local protocols, policies, and procedures. Daily newspapers, television news programs, and multiple Web sites (including the DHS Web site) all give up-to-date information on the threat level. Many EMS organizations are starting to display the advisory system on boards where they can be seen once staff arrives for a shift.

Understanding and being aware of the current threat is only the beginning of responding safely to calls. Once you are on duty, you must be able to make appropriate decisions regarding the potential for a terrorist event. In determining the potential for a terrorist attack, you should observe the following:

- **Type of location.** Is the location a monument, infrastructure, government building, or a specific type of location such as a temple? Is there

a large gathering? Is there a special event taking place?

- **Type of call.** Is there a report of an explosion or suspicious device nearby? Does the call come in to dispatch as someone having unexplained coughing and difficulty breathing? Are there reports of people fleeing the scene?
- **Number of patients.** Are there multiple victims with similar signs and symptoms? This is probably the single most important clue that a terrorist attack or an incident involving a WMD has occurred.
- **Victims' statements.** This is probably the second best indication of a terrorist or WMD event. Are the victims fleeing the scene giving statements such as, "Everyone is passing out," "There was a loud explosion," or "There are a lot of people shaking on the ground." If so, something is occurring that you do not want to rush into, even if it is determined not to be a terrorist event.
- **Preincident indicators.** Is the terror alert level high (orange) or severe (red)? Has there been a recent increase in violent political activism? Are you aware of any credible threats made against the location, gathering, or occasion?

Response Actions

Once you suspect that a terrorist event has occurred or WMDs have been used, there are certain actions to take to ensure that you will be safe and be in the proper position to help the community.

Scene Safety

Ensure that the scene is safe. If you have any doubt that it may not be safe, do not enter. When dealing with a WMD scene, it is safe to assume that you will not be able to enter where the event has occurred—nor do you want to. The best location for staging is upwind and uphill from the incident. Wait for assistance from those who are trained in assessing and



Figure 5 Improper staging of a mass-casualty scene could lead to injury or death of EMS personnel. Wait for assistance from persons who are trained in assessing and managing such scenes. [© Gary Stelzer, Middletown Journal/AP Photos.]

managing WMD scenes **Figure 5 ▲**. Also remember the following:

- Failure to park your vehicle at a safe location can place you and your partner in danger.
- If your vehicle is blocked in by other emergency vehicles or damaged by a secondary device (or event), you will be unable to transport patients **Figure 6 ▶** or escape yourself if needed.

Responder Safety (Personnel Protection)

The best form of protection from a WMD is preventing yourself from coming into contact with the agent. The greatest threats you face in a WMD attack are contamination and **cross-contamination**. Contamination with an agent occurs when you have direct contact with the WMD or are exposed to it. Cross-contamination occurs when you come into contact with a contaminated person who has not been decontaminated.

Notification Procedures

When you suspect a terrorist or WMD event has taken place, notify the dispatcher immediately. Vital information needs to be communicated effectively if you are to receive the appropriate assistance. Inform dispatch of the nature of the event, any additional resources that may be required, the estimated number of patients, and the upwind or optimal route of approach.

It is extremely important to establish a staging area. Be mindful of access and exit routes when you direct units to respond to a location. It is unwise to have units respond to the front entrance of a hotel or apartment building that has had an explosion. Remember that only responders who are trained





Figure 6 Make sure that your vehicle is not blocked in by other emergency vehicles. [© Spencer Grant/ PhotoEdit.]

and who have the proper protective equipment are equipped to handle a WMD incident. These specialized units, traditionally hazardous materials (HazMat) teams, must be requested as early as possible owing to the time required to assemble and dispatch the team and its equipment. Many jurisdictions share HazMat teams, and the team may have to travel a long distance to reach the location of the event. It is always better to be safe than sorry; call the team early, and the outcome of the call will be more favorable.

Establishing Command

The first arriving provider on the scene must begin to sort out the chaos and define his or her responsibilities under the Incident Command System (ICS). If you are first on scene, you may need to establish command until additional personnel arrive. Depending on the

EMT-B Safety

The best form of protection from a WMD agent is preventing yourself from coming in contact with the agent. Use all protective gear provided if you must enter a scene.

circumstances, EMS personnel may function as medical branch officers, triage officers, treatment officers, and transportation or logistic officers. If the ICS is already in place, you should immediately seek out the medical staging officer to receive your assignment.

Secondary Device or Event (Reassessing Scene Safety)

Terrorists have been known to plant additional explosives that are set to explode after the initial bomb. This type of **secondary device** is intended primarily to injure responders and to secure media coverage because the media generally arrive on scene just after the initial response. Do not rely on others to secure your safety. It is every EMT-B's responsibility to constantly assess and reassess the scene for safety. It is easy to overlook a suspicious package lying on the floor while you are treating casualties. Stay alert. Something as subtle as a change in the wind direction during a gas attack or an increase in the number of contaminated patients can place you in danger. Never become so involved with the tasks you are performing that you do not look around and make sure that the scene remains safe.

Chemical Agents

Chemical agents are liquids or gases that are dispersed to kill or injure. Modern-day chemicals were first developed during World War I and World War II. During the Cold War, many of these agents were perfected and stockpiled. Although the United States has long renounced the use of chemical weapons, many nations still develop and stockpile them. These agents are deadly and pose a threat if acquired by terrorists.

Chemical weapons have several classifications. The properties or characteristics of an agent can be described as liquid, gas, or solid material. **Persistency** and **volatility** are terms used to describe how long the agent will stay on a surface before it evaporates. Persistent or nonvolatile agents can remain on a surface for

long periods, usually longer than 24 hours. Nonpersistent or volatile agents evaporate relatively fast when left on a surface in the optimal temperature range. An agent that is described as highly persistent (such as VX, a nerve agent) can remain in the environment for weeks to months, whereas an agent that is highly volatile (such as sarin, also a nerve agent) will turn from liquid to gas (evaporate) within minutes to seconds.

Route of exposure describes how the agent most effectively enters the body. Chemical agents can have a vapor or contact hazard. Agents with a **vapor hazard** enter the body through the respiratory tract in the form of vapors. Agents with a **contact hazard** (or skin hazard) give off little or no vapor and enter the body through the skin.

Vesicants (Blister Agents)

The primary route of exposure of blister agents, or **vesicants**, is the skin (contact). However, if vesicants are left on the skin or clothing long enough, they produce vapors that can enter the respiratory tract. Vesicants cause burnlike blisters on the victim's skin and in the respiratory tract. The vesicant agents consist of sulfur mustard (H), lewisite (L), and phosgene oxime (CX) (the symbols H, L, and CX are military designations for these chemicals). The vesicants usually cause the most damage to damp or moist areas of the body, such as the armpits, groin, and respiratory tract. Signs of vesicant exposure on the skin include the following:

- Skin irritation, burning, and reddening
- Immediate, intense skin pain (with L and CX)

- Formation of large blisters
- Gray discoloration of skin (a sign of permanent damage seen with L and CX)
- Swollen and closed or irritated eyes
- Permanent eye injury (including blindness)

If vapors were inhaled, the patient may experience the following:

- Hoarseness and stridor
- Severe cough
- Hemoptysis (coughing up of blood)
- Severe dyspnea

Sulfur mustard (agent H) is a brownish, yellowish, oily substance that is generally considered very persistent. When released, mustard has the distinct smell of garlic or mustard and is quickly absorbed into the skin and/or mucous membranes. As the agent is absorbed into the skin, it begins an irreversible process of damage to the cells. Absorption through the skin or mucous membranes usually occurs within seconds, and damage to the underlying cells takes place within 1 to 2 minutes.

Mustard is considered a *mutagen*, which means that it mutates, damages, and changes the structures of cells. Eventually, cellular death will occur. On the surface, the patient will generally not show signs or symptoms until 4 to 6 hours after exposure (depending on concentration and amount of exposure)

Figure 7 ▶

A progressive reddening of the affected area occurs, which gradually develops into large blisters. These blisters are similar in shape and appearance to

You are the Provider 2

The scene is safe to enter; all patients have been moved to a staging area in an adjacent field. Your patient is a 28-year-old man. He is complaining of dizziness and headache with some nausea.

Vital Signs

Skin
Pulse
Blood pressure
Respirations

Recording Time: 2 Minutes

Flushed
114 beats/min, regular
164/98 mm Hg
24 breaths/min, labored

4. What type of oxygen does he need? Why?
5. What should you ask about his exposure?
6. Should the patient's clothes be removed? Why or why not?



Figure 7 Skin damage resulting from exposure to sulfur mustard (agent H). [Courtesy of Dr. Saeed Keshavarz/RCCI, Research Center of Chemical Injuries/IRAN.]

those associated with second-degree thermal burns. The fluid within the blisters does not contain the agent; however, the skin covering the area is considered to be contaminated until decontamination has been performed by trained personnel.

Mustard also attacks vulnerable cells within the bone marrow and depletes the body's ability to reproduce white blood cells. As with burns, the primary complication associated with vesicant blisters is secondary infection. If the patient survives the initial direct injury from the agent, the depletion of the white blood cells leaves the patient with decreased resistance to infections. Although sulfur mustard is regarded as persistent, it releases enough vapors when dispersed to be inhaled, creating upper and lower airway compromise. The result is damage and swelling of the airways. The airway compromise makes the patient's condition far more serious.

Lewisite (L) and **phosgene oxime (CX)** produce blister wounds similar to those of mustard. They are highly volatile and have a rapid onset of symptoms, as opposed to the delayed onset seen with mustard. These agents produce immediate, intense pain and discomfort when contact is made. The patient may have a grayish discoloration at the contaminated site. Although tissue damage also occurs with exposure to these agents, they do not cause the secondary cellular injury associated with mustard.

Vesicant Agent Treatment

There are no antidotes for mustard or CX exposure. Antilewisite (also called British antilewisite, or BAL)

is the antidote for agent L and is usually available on a limited basis in the hospital setting. You must ensure that the patient has been decontaminated before ABCs are initiated. The patient may require prompt airway support if any agent has been inhaled, but this should not occur until after decontamination. Follow your local protocols for transport decisions.

Pulmonary Agents (Choking Agents)

The pulmonary agents are gases that cause immediate harm to persons exposed to them. The primary route of exposure for these agents is through the respiratory tract, which makes them an inhalation or vapor hazard. Once inside the lungs, they damage the lung tissue and fluid leaks into the lungs. Pulmonary edema develops, resulting in difficulty breathing. This class of chemical agents consists of chlorine (CL) and phosgene.

Chlorine (CL) was the first chemical agent used in warfare. It has a distinct odor of bleach and creates a green haze when released as a gas. Initially, it produces upper airway irritation and a choking sensation. The patient may later experience the following:

- Shortness of breath
- Chest tightness
- Hoarseness and stridor due to upper airway constriction
- Gasping and coughing

With significant exposures, patients may experience pulmonary edema, complete airway constriction, and death. The fumes from a mixture of household bleach (CL) and ammonia create an acid gas that produces similar effects. Each year, such mixtures overcome hundreds of people when they try to mix household cleaners.

Phosgene should not be confused with phosgene oxime, which is a blister agent. Not only has phosgene been produced for chemical warfare, but it also is a product of combustion, as might be produced in a fire at a textile factory or house, or from metalwork or burning Freon (a liquid chemical used in refrigeration). Therefore, you may encounter a victim of exposure to this gas during a normal call or at a fire scene. Phosgene is a potent agent that has a delayed onset of symptoms, usually hours. Unlike CL, when phosgene enters the body, it generally does not produce severe irritation, which would possibly cause the victim to leave the area or hold his or her breath. In fact, the odor produced by the chemical is similar to that of freshly mown grass or hay. The result is that much more of the gas is allowed to enter the body un-

noticed. The initial symptoms of a mild exposure may include nausea, chest tightness, severe cough, and dyspnea on exertion.

The victim of a severe exposure may present with dyspnea at rest and severe pulmonary edema. The pulmonary edema that is seen with a severe exposure produces such large amounts of fluid from the lungs that the patient may actually become hypovolemic and subsequently hypotensive.

Pulmonary Agent Treatment

The best initial treatment for any pulmonary agent is to remove the patient from the contaminated atmosphere. This should be done by trained personnel in the proper personal protective equipment (PPE). Aggressive management of the ABCs should be initiated, with particular attention to oxygenation, ventilation, and suctioning if required. Do not allow the patient to be active, because activity will increase the effects. There are no antidotes to counteract the pulmonary agents. Supporting the ABCs, allowing the patient to rest in a position of comfort with the head elevated, and initiating rapid transport are the primary goals for prehospital emergency care.

Nerve Agents

The **nerve agents** are among the most deadly chemicals developed. Designed to kill large numbers of people with small quantities, nerve agents can cause

cardiac arrest within seconds to minutes of exposure. Nerve agents, discovered while in search of a superior pesticide, are a class of chemical called organophosphates, which are found in household bug sprays, agricultural pesticides, and some industrial chemicals, at far lower strengths than in nerve agents. Organophosphates block an essential enzyme in the nervous system, which causes the body's organs to become overstimulated and burn out.

G agents came from the early nerve agents, the G series, which were developed by German scientists (hence the G) after World War I and into World War II. There are three G series agents, all designed with the same basic chemical structure with slight variations to produce different properties. The two variations of these agents are lethality and volatility. The following G agents are listed from high to low volatility:

- **Sarin (GB):** Highly volatile colorless and odorless liquid; turns from liquid to gas within seconds to minutes at room temperature; highly lethal, with an LD₅₀ of 1,700 mg/70 kg (about 1 drop, depending on the purity). The LD₅₀ is the amount that will kill 50% of people who are exposed to this level. Sarin is primarily a vapor hazard, with the respiratory tract as the main route of entry. This agent is especially dangerous in enclosed environments such as office buildings, shopping malls, and subway cars. When this agent comes into contact with skin, it is quickly absorbed and evaporates. When sarin

You are the Provider 3

The patient's clothes are removed and he is decontaminated at the site. He is wrapped in a paper gown and loaded into the ambulance. En route to the hospital he begins to vomit. He tells you that there was an odd scent of almonds in the air just before they were evacuated.

Reassessment

Pulse
Blood pressure
Respirations
Breath sounds
Pulse oximetry

Recording Time: 5 Minutes

128 beats/min, regular
172/96 mm Hg
20 breaths/min, labored
Clear bilaterally
95% with oxygen via nonbreathing mask

7. To what type of poison do you think he was exposed?
8. What are the signs and symptoms associated with this type of poisoning in low doses?
9. What makes this type of toxin effective?

is on clothing, it has the effect of off-gassing, which means that the vapors are continuously released (like perfume). This property makes the victim and the victim's clothing contaminated.

- **Soman (GD):** Twice as persistent as sarin and five times as lethal. It has a fruity odor as a result of the type of alcohol used in the agent and generally has no color. This agent is a contact and an inhalation hazard that can enter the body through skin absorption and through the respiratory tract. A unique additive in GD causes it to bind to the cells that it attacks faster than any other agent. This irreversible binding is called aging, which makes it more difficult to treat patients who have been exposed.
- **Tabun (GA):** Approximately half as lethal as sarin and 36 times more persistent; under the proper conditions it will remain present for several days. It also has a fruity smell and an appearance similar to sarin. The components used to manufacture GA are easy to acquire, and the agent is easy to manufacture, making it unique. GA is a contact and an inhalation hazard that can enter the body through skin absorption and through the respiratory tract.
- **V agent (VX):** A clear oily agent that has no odor and looks like baby oil. V agent was developed by the British after World War II and has similar chemical properties to the G series agents. The difference is that VX is more than 100 times more lethal than sarin and is extremely persistent [Figure 8](#). In fact, VX is so persistent that given the proper conditions,

it will remain relatively unchanged for weeks to months. VX is primarily a contact hazard and lets off very little vapor. It is easily absorbed into the skin, and the oily residue that remains on the skin's surface is extremely difficult to decontaminate.

Nerve agents all produce similar symptoms but have varying routes of entry. Nerve agents differ slightly in lethal concentration or dose and also differ in their volatility. Some agents are designed to become a gas quickly (nonpersistent or highly volatile), whereas others remain liquid for a time (persistent or nonvolatile). These agents have been used successfully in warfare and, to date, represent the only type of chemical agent used successfully in a terrorist act. Once the agent has entered the body through skin contact or through the respiratory system, the patient will begin to exhibit a pattern of predictable symptoms. Like all chemical agents, the severity of the symptoms will depend on the route of exposure and the amount of agent to which the patient was exposed. The resulting symptoms are described using the military mnemonic SLUDGEM and the medical mnemonic DUMBELS [Table 1](#). The medical mnemonic is more useful to you because it lists the more dangerous symptoms associated with exposure to nerve agents.

There are only a handful of medical conditions that are associated with the pinpoint constricted pupils (**miosis**) seen with nerve agent exposure. Conditions such as a stroke, direct light to both eyes, and a drug overdose all can cause bilateral constricted pupils. You should, therefore, assess the patient for all of the SLUDGEM/DUMBELS signs and symptoms to determine whether the patient has been exposed to a nerve agent.

Miosis is the most common symptom of nerve agent exposure and can remain for days to weeks. This symptom, along with the others listed in Table 1, will help you recognize exposure to a nerve agent early. The seizures that are associated with nerve agent exposure are unlike those found in patients with a history of seizure. The seizure will continue until death or until treatment is given with a nerve agent antidote (**MARK 1** or **NAAK**).

Nerve Agent Treatment (MARK 1/NAAK)

Death from severe exposure occurs as a result of respiratory complications, which lead to respiratory arrest. Once the patient has been decontaminated, you should be prepared to treat aggressively. You can



Figure 8 VX is the most toxic chemical ever produced. The dot on the penny demonstrates the amount needed for a lethal dose. [Photographed by Kimberly Potvin.]

Table 1 Symptoms of Persons Exposed to Nerve Agents

Military Mnemonic: SLUDGEM	Medical Mnemonic: DUMBELS
Salivation, Sweating	Diarrhea
Lacrimation (excessive tearing)	Urination
Urination	Miosis (pinpoint pupils)
Defecation, Drooling, Diarrhea	Bradycardia, Bronchospasm (spasm of the bronchioles)
Gastric upset and cramps	Emesis (vomiting)
Emesis (vomiting)	Lacrimation (excessive tearing)
Muscle twitching	Seizures, Salivation, Sweating

greatly increase the patient's chances of survival simply by providing airway and ventilatory support. As with all emergencies, securing the ABCs is the best and most important treatment that you can provide. Often patients exposed to these agents will begin having a seizure that will not stop. The patients require administration of nerve agent antidote kits in addition to support of the ABCs.

Fortunately, there is an antidote for nerve agent exposure. MARK 1 kits, also known as nerve agent antidote kits (NAAK), contain two auto-injector medications: atropine and 2-PAM chloride (pralidoxime chloride). In some regions, EMT-Bs may carry MARK 1 kits on the unit and will be called on to administer one or both of the antidotes. These medications are delivered using the same technique as the EpiPen auto-injector. Multiple doses may need to be administered.

Atropine is used to block the nerve agent from affecting the body. However, because the nerve agent may remain in the body for long periods, 2-PAM chloride is used to eliminate the agent from the body. Many of the symptoms described in the DUMBELS mnemonic will be reversed with the use of atropine, but several doses may be needed to see results. If your service carries a nerve agent antidote, refer to your local protocols for dose and use information.

Table 2 has been provided for quick reference and comparison of the nerve agents.

Industrial Chemicals and Insecticides

As previously mentioned, the basic chemical ingredient in nerve agents is an organophosphate. This is a common classification of chemical that is used in lesser concentrations for insecticides. Although industrial chemicals do not have sufficient lethality to be effective WMDs, they are easy to acquire and in-

expensive and would have similar effects as the nerve agents. Crop-duster planes could be used to disseminate these chemicals. You should be cautious when responding to calls where insecticide equipment is stored and used, such as a farm or supply store that sells these products. The symptoms and medical management of victims of organophosphate insecticide poisoning are identical to those of the nerve agents.

Metabolic Agents (Cyanides)

Hydrogen cyanide (AC) and cyanogen chloride (CK) affect the body's ability to use oxygen. **Cyanide** is a colorless gas that has an odor similar to almonds. The effects of the cyanides begin on the cellular level and are rapidly seen at the organ system level. Besides the nerve agents, metabolic agents are the only chemical weapons known to kill within seconds to minutes. Unlike nerve agents, however, these deadly gases are commonly found in many industrial settings. Cyanides are produced in massive quantities throughout the United States every year for industrial uses such as gold and silver mining, photography, lethal injections, and plastics processing. They are often present in fires associated with textile or plastic factories. In fact, cyanide is naturally found in the pits of many fruits in very low doses. There is little difference in the symptoms found in AC and CK. In low doses, these chemicals are associated with dizziness, light-headedness, headache, and vomiting. Higher doses produce symptoms that include the following:

- Shortness of breath and gasping respirations
- Tachypnea
- Flushed skin color
- Tachycardia
- Altered mental status

Table 2 The Nerve Agents

Name	Military Designation	Odor	Special Features	Onset of Symptoms	Volatility	Route of Exposure
Tabun	GA	Fruity	Easy to manufacture	Immediate	Low	Both contact and vapor hazard
Sarin	GB	None (if pure) or strong	Will off-gas while on victim's clothing	Immediate	High	Primarily respiratory vapor hazard; extremely lethal if skin contact is made
Soman	GD	Fruity	Ages rapidly, making it difficult to treat	Immediate	Moderate	Contact with skin; minimal vapor hazard
V agent	VX	None	Most lethal chemical agent; difficult to decontaminate	Immediate	Very low	Contact with skin; no vapor hazard (unless aerosolized)

- Seizures
- Coma
- Apnea
- Cardiac arrest

The symptoms associated with the inhalation of a large amount of cyanide all appear within several minutes. Death is likely unless the patient is treated promptly.

Cyanide Agent Treatment

Cyanide binds with the body's cells, preventing oxygen from being used. Several medications act as antidotes, but most EMS services do not carry them. Once trained personnel in the proper PPE have removed the patient from the source of exposure, even if there is no liquid contamination, all of the patient's clothes must be removed to prevent off-gassing in the ambulance. Trained and protected personnel must decontaminate any patients who may have been exposed to liquid contamination before you can initiate treatment. You should support the patient's ABCs. Mild effects of

cyanide exposure will generally resolve by simply removing the victim from the source of contamination and administering supplemental oxygen. Severe exposure, however, will require aggressive oxygenation and ventilation. Always use bag-mask ventilation or an oxygen-powered ventilator device to ventilate a victim of a metabolic agent. The agent can easily be passed on from the patient to EMT-Bs through mouth-to-mouth or mouth-to-mask ventilation. If no antidote is available, initiate transport immediately.

Table 3 summarizes the chemical agents. The odors of the particular chemicals are provided for informational purposes only. The sense of smell is a poor tool to use to determine whether there is a chemical agent present. Many persons are unable to smell the agents, and the odor could be derived from another source. This information is useful to you if you receive reports from victims claiming to smell of bleach or garlic. You should never enter a potentially hazardous area and "smell" to determine whether a chemical agent is present.

You are the Provider **4**

Upon review of the cases, your patient was treated properly and survived the exposure. Mild effects of cyanide exposure will generally resolve by simply removing the victim from the source of contamination and administering supplemental oxygen. For severe cases, more aggressive airway management is needed.

Table 3 Chemical Agents

Name	Military Designations	Odor	Lethality	Onset of Symptoms	Volatility	Primary Route of Exposure
Nerve agents	Tabun (GA) Sarin (GB) Soman (GD) VX	Fruity or none	Most lethal chemical agents; can kill within minutes; effects are reversible with antidotes	Immediate	Moderate (GA, GD) Very high (GB) Low (VX)	GA—both GB—vapor hazard GD—both VX—contact hazard
Vesicants	Mustard (H) Lewisite (L) Phosgene oxime (CX)	Garlic (H) Geranium (L)	Causes large blisters to form on victims; may severely damage upper airway if vapors are inhaled; severe, intense pain and grayish skin discoloration (L and CX)	Delayed (H) Immediate (L, CX)	Very low (H, L) Moderate (CX)	Primarily contact with some vapor hazard
Pulmonary agents	Chlorine (CL) Phosgene (CG)	Bleach (CL) Cut grass (CG)	Causes irritation choking (CL); severe pulmonary edema (CG)	Immediate (CL) Delayed (CG)	Very high	Vapor hazard
Cyanide agents	Hydrogen cyanide (AC) Cyanogen chloride (CK)	Almonds (AC) Irritating (CK)	Highly lethal chemical gases; can kill within minutes; effects are reversible with antidotes	Immediate	Very high	Vapor hazard

■ Biologic Agents

Biologic agents pose many difficult issues when used as WMDs because they can be almost completely undetectable. Also, most of the diseases caused by these agents will be similar to other minor illnesses commonly seen by EMS providers.

Biologic agents are grouped as viruses, bacteria, and neurotoxins and may be spread in various ways. **Dissemination** is the means by which a terrorist will spread the agent—for example, poisoning the water supply or aerosolizing the agent into the air or ventilation system of a building. A disease vector is an animal that spreads disease, once infected, to another animal. For example, the plague can be spread by infected rats, smallpox by infected persons, and West Nile virus by infected mosquitoes. How easily the disease can spread from one human to another human is called **communicability**. Some diseases, such as those caused by human immunodeficiency virus (HIV), are difficult to spread by routine contact. Therefore, communicability is considered low. In other cases in which communicability is high, such as with smallpox, the person is considered **contagious**. Typically, routine body substance isolation (BSI) precautions are

enough to prevent contamination by contagious biologic organisms.

Incubation describes the period between the person becoming exposed to the agent and when symptoms begin. Although your patient may not exhibit signs or symptoms, he or she may still be contagious.

You need to be aware of when you should suspect the use of biologic agents. If the agent is in the form of a powder, such as in the October 2001 attacks involving anthrax powder mailed in letters, the incident must be handled by HazMat specialists. Patients who have come into direct contact with the agent need to be decontaminated before EMS contact or treatment is initiated.

Viruses

Viruses are germs that require a living host to multiply and survive. A virus is a simple organism and cannot thrive outside of a host (living body). Once in the body, the virus invades healthy cells and replicates itself to spread through the host. As the virus spreads, so does the disease that it carries. Viruses survive by moving from one host to another by using its transport system—vectors.

Viral agents that may be used during a biologic terrorist release pose an extraordinary problem for health care providers, especially those in EMS. Although there are vaccines for some viral agents, there is no treatment for a viral infection other than antiviral medications for some agents. Because of this characteristic, the following viruses have been used as terrorist agents.

Smallpox

Smallpox is a highly contagious disease. The last natural case of smallpox in the world was seen in 1977. Before the rash and blisters show, the illness starts with a high fever, body aches, and headaches. The patient's temperature is usually in the range of 101°F to 104°F. All forms of BSI precautions must be used to prevent cross-contamination to health care providers. Simply by wearing examination gloves, a high-efficiency particulate air (or HEPA)-filtered respirator, and eye protection, you will greatly reduce your risk of contamination.

An easy, quick way to differentiate a smallpox rash from other skin disorders is to observe the size, shape, and location of the lesions. In smallpox, all lesions are identical in their development. In other skin disorders, lesions are in various stages of healing and development. Smallpox blisters begin on the face and extremities and eventually move toward the chest and abdomen. The disease is in its most contagious phase when the blisters begin to form [Figure 9](#). Unprotected contact with these blisters will promote transmission of the disease. There is a vaccine to pre-



Figure 9 In smallpox, all lesions are identical in their development. In other skin disorders, lesions are in various stages of healing and development. [Courtesy of CDC.]

Table 4 Characteristics of Smallpox

Dissemination	Aerosolized for warfare or terrorist uses
Communicability	High from infected individuals or items (such as blankets used by infected patients). Person-to-person transmission is possible.
Route of entry	Through inhalation of coughed droplets or direct skin contact with blisters
Signs and symptoms	Severe fever, malaise, body aches, headaches, small blisters on the skin, bleeding of the skin and mucous membranes. Incubation period is 10 to 12 days and the duration of the illness is approximately 4 weeks.
Medical management	BSI precautions. There is no specific treatment for smallpox victims. Patients should be provided with supportive care (ABCs).

vent smallpox; however, it has been linked to medical complications and, in rare cases, death [Table 4](#). Vaccination against the disease is part of a national strategy to respond to a terrorist threat. Because the vaccine has some risk, only first responders have been offered the vaccine. Should an outbreak occur, vaccine would be offered to people at risk.

Viral Hemorrhagic Fevers

Viral hemorrhagic fevers (VHFs) consist of a group of diseases that include the Ebola, Rift Valley, and Yellow Fever viruses. This group of viruses causes the blood in the body to seep out of the tissues and blood vessels [Figure 10](#). Initially, the patient will have flu-like symptoms that progress to more serious symptoms such as internal and external hemorrhaging. Outbreaks are common in Africa and South America. All BSI precautions must be taken when treating these illnesses. Mortality rates can range from 5% to 90%, depending on the strain of virus, the victim's age and health condition, and the availability of a modern health care system [Table 5](#).

Bacteria

Unlike viruses, **bacteria** do not require a host to multiply and live. Bacteria are much more complex



Figure 10 Viral hemorrhagic fevers cause the blood vessels and tissues to seep blood. The end result is ecchymosis, hemoptysis, and blood in the patient's stool. Notice the severe discoloration in the skin of this patient with Crimean Congo hemorrhagic fever, indicating internal bleeding. [Courtesy of Professor Robert Swanepoel/National Institute for Communicable Disease, South Africa.]

and larger than viruses and can grow up to 100 times larger than the largest virus. Bacteria contain all the cellular structures of a normal cell and are completely self-sufficient. Most important, bacterial infections can be treated with antibiotics.

Most bacterial infections generally begin with flu-like symptoms, which make it difficult to identify whether the cause is a biologic attack or a natural epi-

Table 5 Characteristics of Viral Hemorrhagic Fevers

Dissemination	Direct contact with an infected person's body fluids. It can also be aerosolized for use in an attack.
Communicability	Moderate from person to person, or contaminated items
Route of entry	Direct contact with an infected person's body fluids
Signs and symptoms	Sudden onset of fever, weakness, muscle pain, headache, and sore throat. All of these symptoms are followed by vomiting and as the virus runs its course, internal and external bleeding.
Medical management	BSI precautions. There is no specific treatment for viral hemorrhagic fever. Patients should be provided supportive care (ABCs) and treatment for shock and hypotension, if present.

demic. Biologic agents have been developed and used for centuries during times of war.

Inhalation and Cutaneous Anthrax

Anthrax is caused by deadly bacteria (*Bacillus anthracis*) that lie dormant in a spore (protective shell). When exposed to the optimal temperature and moisture, the germ is released from the spore. The routes of entry for anthrax are inhalation, cutaneous, and gastrointestinal (by consuming food that contains spores)

Figure 11 . The inhalational form, or pulmonary anthrax, is the most deadly and often presents as a severe cold. Pulmonary anthrax infections are associated with a 90% death rate if untreated. Antibiotics can be used to treat anthrax successfully. There is also a vaccine to prevent anthrax infections **Table 6** .

Plague (Bubonic and Pneumonic)

Of all infectious diseases known to humans, none has killed as many as the plague. The 14th century plague that ravaged Asia, the Middle East, and Europe (the Black Death) killed an estimated 33 to 42 million people. Later, in the early 19th century, almost 20 million in India and China died of plague. The plague's natural vectors are infected rodents and fleas. When a person is bitten by an infected flea or comes into contact with an infected rodent (or the waste of the rodent), the person can contract bubonic plague.

Bubonic plague infects the lymphatic system (a passive circulatory system in the body that bathes the tissues in lymph and works with the immune system). When this occurs, the patient's **lymph nodes** (area of the lymphatic system where infection-fighting cells



Figure 11 Cutaneous anthrax. [Courtesy of James H. Steele/CDC.]

Table 6 Characteristics of Anthrax

Dissemination	Aerosol
Communicability	Only in the cutaneous form (rare)
Route of entry	Through inhalation of spore or skin contact with spore or direct contact with skin wound (cutaneous)
Signs and symptoms	Flu-like symptoms, fever, respiratory distress with tachycardia, shock, pulmonary edema, and respiratory failure after 3 to 5 days of flu-like symptoms
Medical management	Pulmonary/Inhalation: BSI precautions, oxygen, ventilatory support if in pulmonary edema or respiratory failure and transport Cutaneous: BSI precautions, apply dry sterile dressing to prevent accidental contact with wound and fluids

are housed) become infected and grow. The glands of the nodes will grow large (up to the size of a tennis ball) and round, forming buboes (Figure 12 ▶). If left untreated, the infection may spread through the body, leading to sepsis and possibly death. This form of plague is not contagious and is not likely to be seen in a bioterrorist incident.

Pneumonic plague is a lung infection, also known as *plague pneumonia*, and results from inhalation of plague bacteria. This form of the disease is contagious and has a much higher death rate than the bubonic form. Pneumonic plague would be easier to disseminate (when aerosolized) and has a higher mortality rate (Table 7 ▶).

Neurotoxins

Neurotoxins are the most deadly substances known to humans. The strongest neurotoxin is 15,000 times more lethal than VX and 100,000 times more lethal than sarin. These toxins are produced from plants, marine animals, molds, and bacteria. The routes of entry are ingestion, inhalation of aerosols, and injection. Unlike viruses and bacteria, neurotoxins are not contagious and have a faster onset of symptoms. Although these biologic toxins have immense destructive potential, they have not yet been used successfully as WMDs.



Figure 12 A. Plague bubo at lymph node under arm.
B. Plague bubo at lymph node on neck. [Courtesy of CDC.]

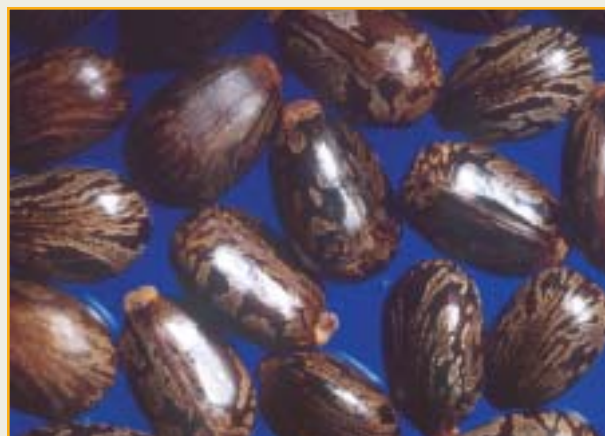
Botulinum Toxin

The most potent neurotoxin is **botulinum**, which is produced by bacteria. When introduced into the body, this neurotoxin affects the nervous system's ability to function. Voluntary muscle control diminished as the toxin spreads. Eventually the toxin will cause muscle paralysis that begins at the head and face and travels downward throughout the body. The patient's accessory muscles and diaphragm become paralyzed, and respiratory arrest occurs

(Table 8 ▶).

Table 7 Characteristics of Plague

Dissemination	Aerosol
Communicability	Bubonic: low, only from contact with fluid in bubo Pneumonic: high, from person to person
Route of entry	Ingestion, inhalation, or cutaneous
Signs and symptoms	Fever, headache, muscle pain and tenderness, pneumonia, shortness of breath, extreme lymph node pain and enlargement (bubonic)
Medical management	BSI, ABCs, provide oxygen, and transport

**Figure 13** These seemingly harmless castor beans contain the key ingredient for ricin, one of the most potent toxins known to humans. [Courtesy of Brian Prechtel/USDA.]**Table 8** Characteristics of Botulinum Toxin

Dissemination	Aerosol or food supply sabotage or injection
Communicability	None
Route of entry	Ingestion or gastrointestinal
Signs and symptoms	Dry mouth, intestinal obstruction, urinary retention, constipation, nausea and vomiting, abnormal pupil dilation, blurred vision, double vision, drooping eyelids, difficulty swallowing, difficulty speaking, and respiratory failure due to paralysis
Medical management	ABCs, provide oxygen and transport. Ventilatory support may be needed due to paralysis of the respiratory muscles. A vaccine is available.

Ricin

Although not as deadly as botulinum, **ricin** is five times more lethal than VX. This toxin is derived from mash left from the castor bean (Figure 13). When introduced into the body, ricin causes pulmonary edema and respiratory and circulatory failure leading to death (Table 9).

The clinical picture depends on the route of exposure. The toxin is quite stable and extremely toxic by many routes of exposure, including inhalation. Perhaps 1 to 3 mg of ricin can kill an adult, and the ingestion of one seed can probably kill a child.

Although all parts of the castor bean are actually poisonous, it is the seeds that are the most toxic. Castor bean ingestion causes a rapid onset of nausea, vomiting, abdominal cramps, and severe diarrhea, followed by vascular collapse. Death usually occurs on the third day in the absence of appropriate medical intervention.

Ricin is least toxic by the oral route. This is probably a result of poor absorption in the gastrointestinal tract, some digestion in the gut, and, possibly, some expulsion of the agent as caused by the rapid onset of vomiting. Ingestion causes local hemorrhage and necrosis of the liver, spleen, kidney, and gastrointestinal

Table 9 Characteristics of Ricin

Dissemination	Aerosol or contamination of a food or water supply by sabotage
Communicability	None
Route of entry	Inhalation, ingestion, injection
Signs and symptoms	Inhaled: cough, difficulty breathing, chest tightness, nausea, muscle aches, pulmonary edema, and hypoxia Ingested: nausea and vomiting, internal bleeding, and death Injection: no signs except swelling at the injection site and death
Medical management	ABCs. No treatment or vaccine exists.

tract. Signs and symptoms appear 4 to 8 hours after exposure.

Signs and symptoms of ricin ingestion are as follows:

- Fever
- Chills
- Headache
- Muscle aches
- Nausea
- Vomiting
- Diarrhea
- Severe abdominal cramping
- Dehydration
- Gastrointestinal bleeding
- Necrosis of liver, spleen, kidneys, and gastrointestinal tract

Inhalation of ricin causes nonspecific weakness, cough, fever, hypothermia, and hypotension. Symptoms occur about 4 to 8 hours after inhalation, depending on the inhaled dose. The onset of profuse sweating some hours later signifies the termination of the symptoms.

Signs and symptoms of ricin inhalation are as follows:

- Fever
- Chills
- Nausea
- Local irritation of eyes, nose, and throat
- Profuse sweating
- Headache
- Muscle aches

- Nonproductive cough
- Chest pain
- Dyspnea
- Pulmonary edema
- Severe lung inflammation
- Cyanosis
- Seizures
- Respiratory failure

Treatment includes respiratory and cardiovascular support. Early intubation, ventilation, and positive end-expiratory pressure, combined with treatment of pulmonary edema, are appropriate. Intravenous fluids and electrolyte replacement are useful for treating the dehydration caused by profound vomiting and diarrhea. **Table 10** summarizes the biologic agents.

Other EMT-B Roles During a Biologic Event

Syndromic Surveillance

Syndromic surveillance is the monitoring, usually by local or state health departments, of patients presenting to emergency departments and alternative care facilities, the recording of EMS call volume, and monitoring the use of over-the-counter medications. Patients with signs and symptoms that resemble influenza are particularly important. Local and state health departments monitor for an unusual influx of patients with these symptoms in hopes of identifying an outbreak early. The EMS role in syndromic surveillance is small yet valuable in the overall tracking of a biologic

Table 10 Biologic Agents

Disease	Transmission		Incubation Period	Duration of Illness	Lethality (approximate case fatality rates)
	Person to Person				
Inhalation anthrax	No		1 to 6 d	3 to 5 d (usually fatal if untreated)	High
Pneumonic plague	High		2 to 3 d	1 to 6 d (usually fatal)	High unless treated within 12 to 24 h
Smallpox	High		7 to 17 d (average 12 d)	4 wk	High to moderate
Viral hemorrhagic fevers	Moderate		4 to 21 d	Death between 7 to 16 d	High to moderate, depending on type of fever
Botulinum	No		1 to 5 d	Death in 24 to 72 h; lasts months if patient does not die	High without respiratory support
Ricin	No		18 to 24 h	Days; death within 10 to 12 d for ingestion	High

terrorist event or infectious disease outbreak. Quality assurance and dispatch operations need to be aware of an unusual number of calls from patients with “unexplainable flu” coming from a particular region or community.

Points of Distribution (Strategic National Stockpile)

Points of distribution (PODs) are strategically placed facilities that have been established for the mass distribution of antibiotics, antidotes, vaccinations, and other medications and supplies. These medications may be delivered in large containers known as “push packs” by the Centers for Disease Control and Prevention National Pharmaceutical Stockpile. These containers have a delivery time of 12 hours anywhere in the United States and contain antibiotics, chemical antidotes, antitoxins, life-support medications, intravenous administration and airway maintenance supplies, and medical-surgical items. In some regions, local and state municipalities have started to stockpile their own supplies to reduce the time delay.

EMS providers may be asked to assist in delivery of the medications to the public (depending on local emergency management planning). Your role may include triage, treatment of seriously ill patients, and patient transport to the hospital. Most plans for PODs include at least one ambulance on standby for the transport of seriously ill patients.

Radiologic and Nuclear Devices

Ionizing radiation is energy that produces ionization, which is the gain or loss of one or more electrons by a neutral atom or particle. This energy can be found in **radioactive material**, such as rocks and metals. Radioactive material is any material that emits radiation. This material is unstable and attempts to stabilize itself by changing its structure in a natural process called decay. As the substance decays, it gives off radiation until it stabilizes. The process of radioactive decay can take minutes to billions of years; meanwhile, the substance remains radioactive.

The energy emitted from a strong radiologic source is **alpha**, **beta**, **gamma (x-rays)**, and **neutron radiation**. Alpha is the least harmful penetrating type of radiation and cannot travel fast or through most objects. A sheet of paper or the skin easily stops it. Beta radiation is slightly more penetrating than alpha and requires a layer of clothing to stop it. Gamma rays, or x-rays, are far faster and stronger

than alpha and beta rays. These rays easily penetrate through the human body and require several inches of lead or concrete to prevent penetration. Neutron energy is the fastest moving and most powerful form of radiation. Neutrons easily penetrate through lead and require several feet of concrete to stop them

Figure 14 ▶

Sources of Radiologic Material

There are thousands of radioactive materials found on the earth. These materials are generally used for purposes that benefit humankind, such as medicine, killing germs in food (irradiating), and construction work. Once radiologic material has been used for its purpose, the material remaining is called radiologic waste. Radiologic waste remains radioactive but has no more usefulness. These materials can be found at hospitals, colleges and universities, and chemical and industrial sites.

Not all radioactive material is tightly guarded, and the waste is often not guarded. This makes use of radioactive material and substances appealing to terrorists.

Radiologic Dispersal Devices

A **radiologic dispersal device (RDD)** is any container that is designed to disperse radioactive material. This would generally require the use of a bomb, hence the nickname **dirty bomb**. A dirty bomb has the potential to injure victims with not only the radioactive material, but also the explosive material used to deliver it. Just the thought of an RDD creates fear in a population, which is the terrorist’s goal. In reality, the destructive capability of a dirty bomb is limited to the explosives attached to it. Therefore, if the explosive is sufficient to kill 10 people without radioactive material, it will also kill 10 people with the radioactive material added. There may be long-term injuries and illness associated with the use of an RDD, yet not much more than what the bomb alone would create. For this reason, the dirty bomb is considered an ineffective WMD.

Nuclear Energy

Nuclear energy is artificially made by altering (splitting) radioactive atoms. The result is an immense amount of energy that usually takes the form of heat. Nuclear material is used in medicine, weapons, naval vessels, and power plants. Nuclear material gives off all forms of radiation, including neutrons (the most

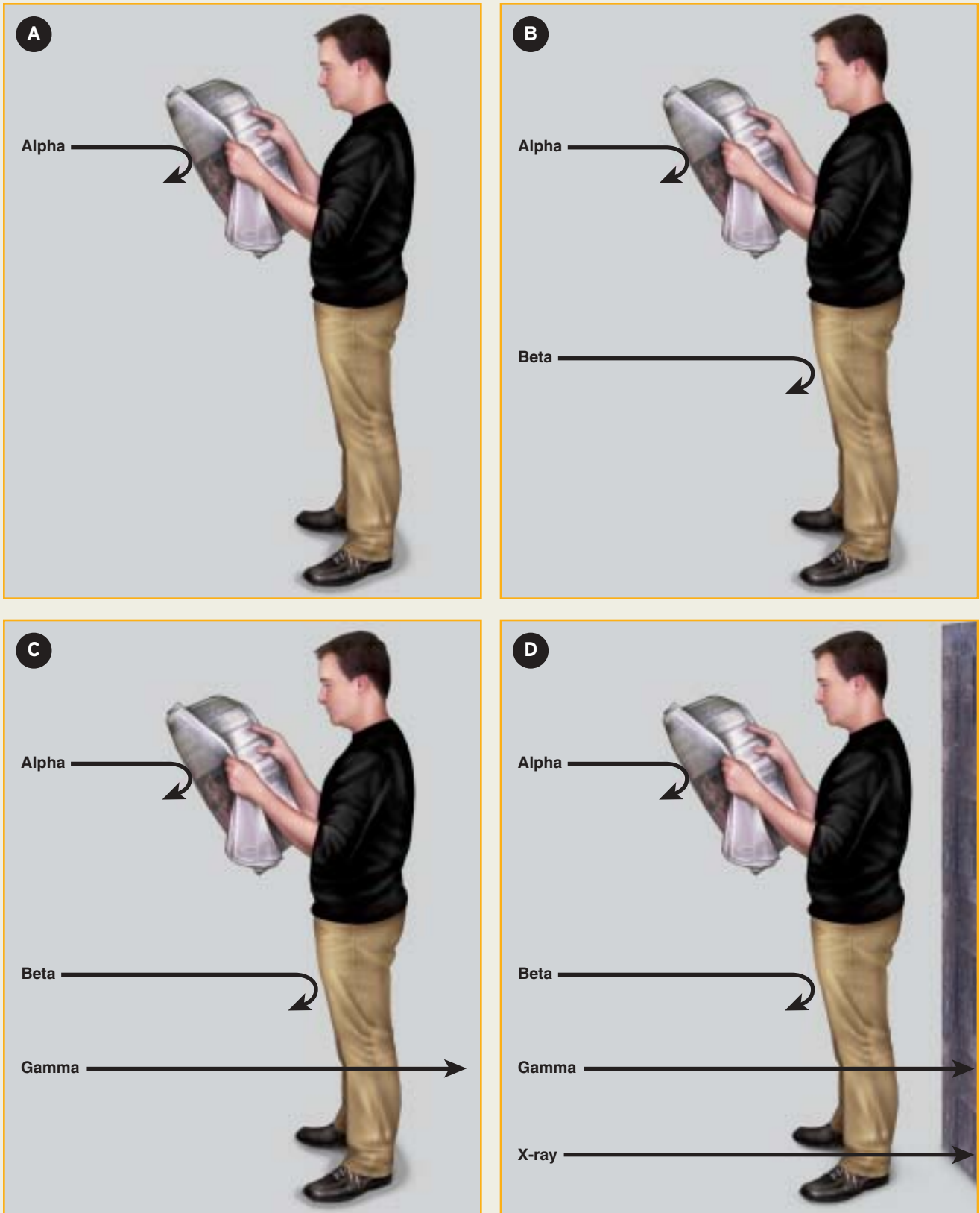


Figure 14 The penetrating potential of four types of radiation. **A.** Alpha. **B.** Beta. **C.** Gamma. **D.** X-ray.

deadly type). Like radioactive material, when nuclear material is no longer useful, it becomes waste that is still radioactive.

Nuclear Weapons

The destructive energy of a nuclear explosion is unlike that of any other weapon in the world. That is why nuclear weapons are kept only in secure facilities throughout the world.

Unfortunately, however, due to the collapse of the former Soviet Union, the whereabouts of many small nuclear devices is unknown. These small suitcase-sized nuclear weapons are called **special atomic demolition munitions (SADM)**. The SADM, or “suitcase nuke,” was designed to destroy individual targets, such as important buildings, bridges, tunnels, and large ships. As of 1998, it was estimated that as many as 80 of these weapons were missing. No other information or updates on the whereabouts of these devices have been made public.

Symptomatology

The effects of radiation exposure vary depending on the amount of radiation that a person receives and the route of entry. Radiation can be introduced into the body by all routes of entry and can go through the body (irradiation). The patient can inhale radioactive dust from nuclear fallout or from a dirty bomb, or radioactive liquid can be absorbed through the skin. Once in the body, the radiation source irradiates the person from within rather than from an external source (such as radiographic equipment). Some common signs of acute radiation sickness are listed in **Table 11**. Additional injuries will occur with a nuclear blast, such as thermal and blast trauma, trauma from flying objects, and eye injuries.

Table 11 Common Signs of Acute Radiation Sickness

Low exposure	Nausea, vomiting, diarrhea
Moderate exposure	First-degree burns, hair loss, depletion of the immune system (death of white blood cells), and cancer
Severe exposure	Second- and third-degree burns, cancer, and death

EMT-B Safety

The best way to protect yourself from the effects of radiation is to use time, distance, and shielding.

Medical Management

Being exposed to a radiation source does not make a patient contaminated or radioactive. However, when patients have a radioactive source on their body (such as debris from a dirty bomb), they are contaminated and must initially be cared for by a HazMat responder. Once the patient is decontaminated and there is no threat to you, you may begin treatment with the ABCs and treat the patient for any burns or trauma.

Protective Measures

There are no suits or protective gear designed to completely shield from radiation. People who work in high-risk areas wear some protection (lead-lined suits); however, this equipment is not available to EMT-Bs. The best way to protect yourself from the effects of radiation is to use time, distance, and shield yourself in level C protection from the source.

- **Time.** Radiation has a cumulative effect on the body. The less time that you are exposed to the source, the less the effects will be. If you realize that the patient is near a radiation source, leave the area immediately.
- **Distance.** Radiation is limited in how far it can travel. Depending on the type of radiation, often moving only a few feet is enough to remove you from immediate danger. Alpha radiation cannot travel more than a few inches. You should take this into account when responding to a nuclear or radiologic incident and make certain that responders are stationed far enough from the incident.
- **Shielding.** As discussed earlier, the path of all radiation can be stopped by a specific object. It will be impossible for you to recognize the type of radiation being emitted or even the direction from which it is coming. Therefore, you should always assume that you are dealing with the strongest form of radiation and use concrete shielding (such as buildings or walls) between yourself and the incident.

You are the Provider **Summary**

The first priority in dealing with any situation in which there may be a WMD is to ensure scene safety. Transport only those patients who have been properly decontaminated and alert the emergency department so that they may be adequately prepared to deal with the exposure.

1. What is your first priority?

Scene safety.

2. What is the route of entry of this toxin?

Inhalation.

3. What is your treatment priority?

Airway and breathing, especially because this is an inhaled toxin.

4. What type of oxygen does he need? Why?

He needs to be ventilated, but will probably not tolerate it due to his mental status. Use a nonrebreathing mask at 15 L/min and 100% oxygen.

5. What should you ask about his exposure?

What was the length of exposure? Did he see or smell anything? Are there any burning or other sensations around the nose or mouth?

6. Should the patient's clothes be removed? Why or why not?

Yes. Even if there is no liquid contamination, all of the patient's clothes must be removed to prevent off-gassing in the ambulance.

7. To what type of poison do you think he was exposed?

Cyanide gas.

8. What are the signs and symptoms associated with this type of poisoning in low doses?

Dizziness, light-headedness, headache, and vomiting.

9. What makes this type of toxin effective?

Cyanide binds with the body's cells, preventing oxygen from being used.

Prep Kit

Ready for Review

- As a result of the increase in terrorist activity, it is possible that you could be involved in a terrorist event. You must be mentally and physically prepared for that possibility.
- The use of weapons of mass destruction or mass casualty further complicates management of the terrorist incident. Be aware of your surroundings at all times. The best form of protection from a WMD agent is to avoid contact with the agent.
- Types of groups that tend to use terrorism include violent religious groups and doomsday cults, extremist political groups, technology terrorists, and single-issue groups.
- A WMD is any agent designed to bring about mass death, mass casualties, and/or massive damage to property and infrastructure (bridges, tunnels, airports, and seaports). The WMDs can be nuclear, chemical, biologic, and explosive weapons.
- Chemical agents are manufactured substances that can have devastating effects on living organisms. They can be produced in liquid, powder, and vapor forms, depending on the desired route of exposure and dissemination technique. These agents consist of vesicants, respiratory, nerve, and metabolic agents.
- Biologic agents are organisms that cause disease. They are generally found in nature and can be weaponized to maximize the number of people exposed to the germ. These types of agents include viruses, bacteria, and toxins.
- Nuclear and radiologic weapons can create a massive amount of destruction. These weapons include radiologic dispersal devices (RDDs), also known as dirty bombs.
- Be aware of the current threat level issued by the federal government through the Department of Homeland Security (DHS). This threat level can be severe, high, elevated, guarded, or low.
- On the basis of the current threat level, take appropriate actions and precautions. Be aware of established policies that your organization may have regarding the current threat level.
- Indicators that may give you clues as to whether the emergency is the result of an attack include the type of location, type of call, number of patients, victims' statements, and preincident indicators.
- If you suspect that a terrorist or WMD event has occurred, ensure that the scene is safe. If you have any doubt about its safety, do not enter. Wait for assistance.
- Notification of the dispatcher is essential. Inform dispatch of the nature of the event, any additional resources that may be required, the estimated number of patients, and the upwind or optimal route of approach.
- Establish a staging area, and be mindful of access and exit routes.
- The first arriving provider on the scene must begin to sort out the chaos and define his or her responsibilities under the Incident Command System (ICS).
- If the ICS is already in place, you should immediately seek out the medical staging officer to receive your assignment.
- Terrorists may set secondary devices to explode after the initial bomb, to injure responders and secure media coverage. Constantly assess and reassess the scene for safety.
- Persistent or nonvolatile agents can remain on a surface for long periods. A highly persistent agent can remain in the environment for weeks to months.
- Nonpersistent or volatile agents evaporate relatively fast when left on a surface in the optimal temperature range. A highly volatile agent will turn from liquid to gas (evaporate) within minutes to seconds.
- Route of exposure is how the agent most effectively enters the body.
- A vesicant is an agent that enters through the skin and causes burnlike blisters on the victim's skin and, if vapors are inhaled, in the respiratory tract.
- Vesicant agent treatment includes decontamination first, then the ABCs.
- Pulmonary agents are gases that cause immediate harm by damaging the lung tissue.
- Pulmonary agent treatment is to remove the patient from the contaminated atmosphere and support the ABCs. This should be done by trained personnel in the proper PPE.
- Nerve agents are among the most deadly chemicals developed and can cause cardiac arrest within seconds to minutes of exposure.
- Securing the ABCs is the best and most important treatment you can provide for patients exposed to nerve agents. Patients with continued seizures require administration of nerve agent antidote kits in addition to support of the ABCs.
- Metabolic agents, or cyanides, affect the body's ability to use oxygen and are commonly found in many industrial settings.

Technology

Interactivities

Vocabulary Explorer

Anatomy Review

Web Links

Online Review Manual

- Before treatment begins, the patient exposed to a metabolic agent must be removed from the source of exposure by trained personnel in the proper PPE, all of the patient's clothes must be removed, and the patient must be decontaminated. Then support the patient's ABCs, and request ALS immediately.
- Biologic agents include viruses such as smallpox and viral hemorrhagic fevers, bacteria such as anthrax and plague, and neurotoxins such as botulinum toxin and ricin.
- Ionizing radiation can enter the human body and cause damage.
- Treatment for radiation exposure should begin with making sure the patient is not contaminated. If the patient is contaminated, he or she must be initially cared for by a HazMat responder.
- There are no suits or protective gear designed to completely shield from radiation. Protect yourself by leaving an area where a radiation source is present, staying as far away as possible, and using concrete shielding when possible.

Vital Vocabulary

- alpha** The type of energy emitted from a strong radiologic source; the least harmful penetrating type of radiation, it cannot travel fast or through most objects.
- anthrax** A deadly bacterium (*Bacillus anthracis*) that lies dormant in a spore (protective shell); the germ is released from the spore when exposed to the optimal temperature and moisture; routes of entry are inhalation, cutaneous, and gastrointestinal (from consuming food that contains spores).
- bacteria** The single-celled microorganisms that reproduce by binary fission; reproduce rapidly; some can form spores (encysted variants) when environmental conditions are harsh.
- beta** The type of energy emitted from a strong radiologic source; slightly more penetrating than alpha, it requires a layer of clothing to stop it.
- botulinum** A potent neurotoxin produced by bacteria; in the body, it affects the nervous system's ability to function, and causes botulism.
- bubonic plague** The type of plague transmitted by infected fleas and characterized by acute malaise, fever, and the formation of tender, enlarged, inflamed lymph nodes that appear as lesions, called buboes; an epidemic spread throughout Europe in the Middle Ages, causing more than 25 million deaths, also called the Black Death.
- chlorine (CL)** The first chemical agent ever used in warfare; has a distinct odor of bleach and creates a green haze when released as a gas; initially produces upper airway irritation and a choking sensation.
- communicability** Describes how easily a disease spreads from one human to another human.
- contact hazard** A hazardous agent that gives off little or no vapors; the skin is the primary route for this type of chemical to enter the body; also called a skin hazard.
- cross-contamination** The contamination that occurs when a person is contaminated by an agent as a result of coming into contact with another contaminated person.
- cyanide** An agent that affects the body's ability to use oxygen; a colorless gas that has an odor similar to almonds; effects begin on the cellular level and are rapidly seen at the organ system level.
- dirty bomb** A bomb that is used as a radiologic dispersal device (RDD).
- dissemination** In terrorism, the means with which a terrorist will spread a disease, for example, by poisoning the water supply or aerosolizing an agent into the air or ventilation system of a building.
- domestic terrorism** The terrorism carried out by citizens of the country being attacked.
- G agents** Early nerve agents developed by German scientists after World War I and into World War II; the three such agents are sarin, soman, and tabun.
- gamma (x-rays)** The type of energy emitted from a strong radiologic source that is far faster and stronger than alpha and beta rays; rays easily penetrate through the human body and require several inches of lead or concrete to prevent penetration.
- incubation** In disease, the period from exposure to a disease to the time when symptoms begin.
- international terrorism** The terrorism that is carried out by terrorists in a country other than their own; also known as cross-border terrorism.
- ionizing radiation** Energy that produces ionization (the gain or loss of one or more electrons by a neutral atom or molecule).
- LD₅₀** The amount of an agent or substance that will kill 50% of the people exposed to this level.
- lewisite (L)** A blistering agent that has a rapid onset of symptoms and produces immediate, intense pain and discomfort on contact.
- lymph nodes** Areas of the lymphatic system where infection-fighting cells are housed.
- MARK 1** A nerve agent antidote kit containing two auto-injector medications, atropine and 2-PAM chloride (pralidoxime chloride); also known as a nerve agent antidote kit (NAAK).
- miosis** Constriction of the pupils.
- NAAK** A nerve agent antidote kit containing two auto-injector medications, atropine and 2-PAM chloride (pralidoxime chloride); also known as a MARK 1 kit.
- nerve agents** A class of chemicals called organophosphates; they function by blocking an essential enzyme in the nervous system, which causes the body's organs to become overstimulated and burn out.

neurotoxins Biologic agents that are the most deadly substances known to humans; they include botulinum toxin and ricin.

neutron radiation The type of energy emitted from a strong radiologic source; the fastest moving and most powerful form of radiation; neutrons easily penetrate through lead and require several feet of concrete to stop them.

persistency The term used to describe how long a chemical agent will stay on a surface before it evaporates.

phosgene A pulmonary (or choking) agent that is a product of combustion, such as might be produced in a fire at a textile factory or house or from metalwork or burning Freon; a very potent agent with a delayed onset of symptoms, usually hours.

phosgene oxime (CX) A blistering agent that has a rapid onset of symptoms and produces immediate, intense pain and discomfort on contact.

pneumonic plague A lung infection, also known as plague pneumonia, that is the result of inhalation of plague bacteria.

points of distribution (PODs) Strategically placed facilities established for the mass distribution of antibiotics, antidotes, vaccinations, and other medications and supplies.

radioactive material Any material that emits radiation.

radiologic dispersal device (RDD) Any container that is designed to disperse radioactive material.

ricin The neurotoxin derived from mash that is left from the castor bean; causes pulmonary edema and respiratory and circulatory failure, leading to death.

route of exposure Manner by which a toxic substance enters the body.

sarin (GB) A nerve agent that is one of the G agents; a highly volatile colorless and odorless liquid that turns from liquid to gas within seconds to minutes at room temperature.

secondary device An additional explosive used by terrorists, which is set to explode after the initial bomb.

smallpox A highly contagious disease; it is most contagious when blisters begin to form.

soman (GD) A nerve agent that is one of the G agents; twice as persistent as sarin and five times as lethal; has a fruity odor as a result of the type of alcohol used in the agent and is a contact and an inhalation hazard that can enter the body through skin absorption and through the respiratory tract.

special atomic demolition munitions (SADM) Small suitcase-sized nuclear weapons designed to destroy individual targets, such as important buildings, bridges, tunnels, and large ships.

sulfur mustard (agent H) A vesicant; a brownish, yellowish, oily substance that is generally considered persistent; has the distinct smell of garlic or mustard and, when released, is quickly absorbed into the skin and/or mucous membranes and begins an irreversible process of damaging the cells.

tabun (GA) A nerve agent that is one of the G agents; 36 times more persistent than sarin and approximately half as lethal; has a fruity smell and is unique because the components used to manufacture the agent are easy to acquire and the agent is easy to manufacture.

V agent (VX) One of the G agents; it is a clear, oily agent that has no odor and looks like baby oil; more than 100 times more lethal than sarin and extremely persistent.

vapor hazard An agent that enters the body through the respiratory tract.

vesicants Blister agents; the primary route of entry for vesicants is through the skin.

viral hemorrhagic fevers (VHFs) A group of diseases that includes the Ebola, Rift Valley, and Yellow Fever viruses, among others; the viruses cause the blood in the body to seep out of the tissues and blood vessels.

viruses Germs that require a living host to multiply and survive.

volatility Term used to describe how long a chemical agent will stay on a surface before it evaporates.

weapon of mass casualty (WMC) Any agent designed to bring about mass death, mass casualties, and/or massive damage to property and infrastructure (bridges, tunnels, airports, and seaports); also known as a weapon of mass destruction (WMD).

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weaponization The creation of a weapon from a biologic agent generally found in nature and that causes disease; the agent is cultivated, synthesized, and/or mutated to maximize the target population's exposure to the germ.

Assessment in Action

Terrorism has an even larger role in our country than we thought possible. It is imperative that we stay as up to date as possible in this area.

1. The greatest threats you face in a WMD attack are contamination and _____.
 - A. exposure
 - B. cross-contamination
 - C. inhalation injuries
 - D. secondary devices
2. Weapons of mass destruction include:
 - A. nuclear weapons.
 - B. biological weapons.
 - C. explosive weapons.
 - D. all of the above.
3. Which of the following is an agent designed to bring about mass death, casualties, or damage to property?
 - A. terrorist
 - B. biological warfare
 - C. weapons of mass destruction
 - D. contamination
4. _____ radiation is the least harmful type of penetrating radiation.
 - A. Alpha
 - B. Beta
 - C. Gamma
 - D. Neutron
5. _____ can cause cardiac arrest within seconds to minutes of exposure.
 - A. Chemical agents
 - B. Vesicants
 - C. Nerve agents
 - D. Biologic agents
6. Liquids or gases that are dispersed to kill or injure are:
 - A. biologic agents.
 - B. chemical agents.
 - C. nuclear agents.
 - D. inhalation agents.

Challenging Questions

7. What is the procedure for reporting a suspected terrorist or WMD event?