# NEW JERSEY HAZMAT EMERGENCY RESPONSE COURSE

**STUDENT GUIDE FOR COURSE NUMBER: 06085**

## LEVEL 1 - FIRST RESPONDER
## DOMESTIC PREPAREDNESS
# CBRNE AWARENESS

*PRESENTED THROUGH:*
**NEW JERSEY STATE POLICE-HOMELAND SECURITY BRANCH**
**SPECIAL OPERATIONS SECTION, TECHNCIAL RESPONSE BUREAU**
**HAZARDOUS MATERIALS RESPONSE UNIT (HMRU)**

BENCHMARKED FROM THE DEPARTMENT OF DEFENSE
"DOMESTIC PREPAREDNESS TRAINING PROGRAM"

4th Edition 0404

# CBRNE; Awareness

# Course Introduction

**Module 1:** Course Introduction (Awareness Training - course # 06085)

**Training Objectives:**

At the conclusion of this course, students will be able to demonstrate a knowledge of the role of Level 1 trained responders in dealing with a Nuclear, Biological, Chemical agent attack.

**Student Materials:**

Awareness Student Guide

**CBRNE; Awareness**



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**The Federal Bureau of Investigation (FBI) defines terrorism as: "The unlawful use of force against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in the furtherance of political or social objectives."**

For years, we have viewed terrorism as something that happens in other countries. If Citizens of the United States were victims of terrorist attacks, they must have been overseas or on international flights or cruises in dangerous areas. The events at the World Trade Center in New York and Oklahoma City have shattered this view forever. The citizens and facilities that we are charged to protect can become the targets of international AND domestic terrorists at any time.

Terrorist attacks with conventional weapons such as firearms, explosives or incendiary devices seems the most likely scenario but we must also plan for the possibility of nuclear, chemical and biological.

While federal agencies will have primary responsibility for the investigation of terrorist attacks, local law enforcement and emergency management will have the vital role of first responder when their local setting becomes the target.

As an emergency responder in your community, you need to be aware of protocols to identify that a problem exists, isolate the problem, gather basic information, and report what you have found. Remember that if you are the "first on the scene" at an attack, your actions are critical in initiating a proper response.

Every county and municipality in New Jersey should have a viable plan for countering terrorism as part of the response roles outlined in its EOP. Hopefully, there will never be a need for that it to go into effect but the realization that there is a working plan that will aid in saving the lives of those you serve can be the stable rock on which to rebuild shattered lives.

The Domestic Preparedness Training Program only addresses Nuclear material, and Biological and Chemical (CBRNE) agents/devices. They can also be referred to as Weapons of Mass Destruction (WMD). The two terms are synonymous.

CBRNE weapons differ from other terrorist weapons in that they employ military chemical and biological warfare agents or radioactive materials as a primary ingredient. You will learn more about these in the next few modules, but for a brief definition:

Chemical agents are supertoxic chemicals used for the purpose of poisoning victims. They are similar to hazardous industrial chemicals, but hundreds of times more toxic. Contrast this with bombing an oil refinery to create a massive fire, which constitutes a terrorist attack, but not an CBRNE attack.

Biological agents are living germs that will cause disease in people. Some of these are deadly to animals as well, though they are not the primary targets. Toxins are a special type of poisonous chemicals categorized as biological agents because they were created by living organisms. They generally behave like chemical agents and serve the same function, to poison people.

Radiological materials can pose both an acute and long term hazard to humans. In may ways, they behave like some of the chemical agents in that they cause cell damage. A major difference is that the radiological agents do not necessarily have to be inhaled or come in contact with the skin to do damage. Some types of radiation, (like x-rays), can penetrate significant layers of protective material.

We want to build on the knowledge you already possess by comparing HAZMAT incidents with CBRNE Terrorism incidents.

Everyday HAZMAT Incident (HMI) vs. CBRNE Terrorism Incident (CBRNETI):

Let us look at how an everyday HAZMAT incident differs from an CBRNE terrorism incident and explore the challenges and consequences presented by those differences.

**Supertoxic Material**

(1) Sarin is close to 200 times more toxic than chlorine.
(2) Sarin is approximately 60 times more toxic than methylisocyanate (“extraordinary” HAZMAT incident in Bhopal, India).
(3) To really understand the potential impact of CBRNE hazards lets look at the Bhopal, India HAZMAT Incident:
  (a) 200,000 casualties affected
  (b) 10,000 severely affected
  (c) 3,300 deaths
(4) Small quantities of CBRNE agents have the capability to produce large numbers of casualties (symptomatic and psychological).

**Hazard Identification**

Early identification of the CBRNE agent is crucial to the safety and health of both responders and victims.

Victims’ signs and symptoms must be reported immediately to the incident commander and/or EMS officer in charge.

Only advanced detection and identification devices (GC/MS, MINICAMS, Real Time Analytical Platform) detect at the lowest threshold concentrations for chemical agents.

A key point is that an CBRNE terrorism incident may or may not result in mass casualties and fatalities, although at the very least mass casualties are likely. However, large numbers of psychological casualties are virtually a given and therefore, regardless of the effectiveness of the attack, and number of people actually exposed to the agent, you will be facing a mass casualty situation.

**Mass Casualties/Many Fatalities**

In the vast majority of cases, an everyday hazardous material incident does not result in mass casualties or fatalities but an CBRNE terrorism incident has the potential to create mass casualties or fatalities. In the Tokyo incident (sarin) there were 5,500 casualties, most psychological.

An CBRNE terrorism incident will create large numbers of psychological effects on casualties, thus magnifying the mass casualties situation.

**Mass Decontamination**

An everyday HAZMAT incident requires the decontamination of only a few people. An CBRNE terrorism incident will require the decontamination of numerous individuals, perhaps hundreds or even thousands. Mass decontamination may require assigning some of the first responders to perform this very important task. The HAZMAT team in turn will be committed to establishing separate decontamination areas for victims and emergency responders.

**Unusual risk to emergency responders and civilians.**

CBRNE agents are extremely toxic, most are heavier than air and may be persistent or non-persistent. CBRNE agents toxicity means downwind hazard could be a greater risk than HAZMAT.

**Crime scene/evidence preservation**

An everyday HAZMAT incident may be labeled an environmental crime scene. An act of CBRNE terrorism is a federal crime, therefore, the site of the incident mandates a crime scene designation and evidence preservation. These are key actions to be able to apprehend and prosecute the perpetrator(s).

**Major interaction and coordination with local, state and federal agencies** may be required in an everyday HAZMAT incident, but most definitely will be required during an CBRNE terrorism incident due to the complexity of the situation and the public interest. An CBRNE terrorism incident will require the Incident Commander to effectively use the Incident Command System and to assign areas of responsibility to other responding personnel. In a CBRNE terrorism incident the Incident Commander will be faced with managing and coordinating multiple agencies - some requested, some not. One liaison officer and several assistants may be needed to serve on the Incident Commander's command staff to assist in the management and coordination of all the responding agencies.

The staging area(s) manager(s) will have to control a much larger number of resources than during an everyday HAZMAT incident.

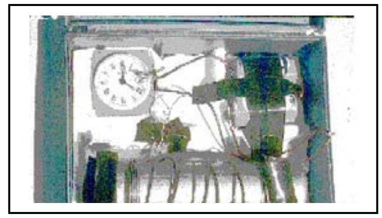
**Scene communication overload**

Communication overload will be the most significant challenge during/after an CBRNE terrorism incident. The Incident Commander must deal with communication overload immediately or they will soon become overwhelmed. While cellular phones may be useful during the early moments, cell sites could quickly become jammed by media use and others.

**Chaos, mass hysteria**

There will be more chaos and hysteria in an CBRNE terrorism incident than on an everyday HAZMAT incident. Fire companies and HAZMAT units, alone, will be unable to maintain scene safety and security at an CBRNE terrorism incident. The importance of the local police department managing scene control in an CBRNE terrorism incident cannot be over emphasized.

**Resources immediately overwhelmed**



In an everyday HAZMAT incident, intervention can be handled methodically and deliberately by the HAZMAT team but the number of victims involved in an CBRNE terrorism incident would physically overwhelm most HAZMAT teams.

An CBRNE terrorism incident will demand immediate intervention on the part of the first responders, if lives are to be saved. Resources include: fire companies, HAZMAT teams, EMS responders, law enforcement units, hospitals, protective equipment, decontamination equipment, pharmaceuticals, cover for victims after decontamination, transportation for victims, etc..

**Secondary Devices**

Always assume in a terrorism incident that a secondary device is present. The threat of secondary devices presents unique tactical considerations.

**Pre-incident Indicators**

Before a terrorism incident the law enforcement community, especially the FBI, may have some indications and intelligence information about the possibility of a terrorism act. Someone may call the authorities to alert that a terrorism act is about to occur. Possibility of a hoax, or even a diversion to tie up resources.

**Course Goals**

a. To review some recent history and point out that these CBRNE weapons have been used, including in the Tokyo Subway attack in March of 1995.
b. To recognize the signs and symptoms of CBRNE poisoning because these frequently will be the first indication you'll have of an attack.
c. To understand and recognize the potential types of dissemination devices that might be used, so you are better equipped to recognize a potential threat situation.
d. To describe the proper initial response actions for emergency responders at either a suspected or actual CBRNE incident site.

**Administrative Notes**

Because of the origin, much of the material we shall cover is military in nature. This is mostly true because, until now, responding to the employment of these agents was only a military mission resulting from a military operation. Unfortunately, this is no longer the case, and other individuals may now possess these weapons.

The modules that will be presented during this course are only designed to address those issues that are peculiar to a response to an incident involving a weapon of mass destruction. As such, they will not, in most cases, dwell on material you have already been taught.

**Overview**

The course will concentrate on six blocks of instruction:

a. "The Threat" will focus on the danger posed by terrorists.

b. "An Introduction to Chemical Agents" will provide an overview of those chemical compounds that have been weaponized by various nations for the purpose of causing death on the battlefield. The signs, symptoms, and characteristics of the agents will be highlighted.

c. "An Introduction to Biological Agents" will focus on those biological agents that have been weaponized, and will address their signs, symptoms, and characteristics.

d. "An Introduction to Radiological Material" will address the characteristics of radioactive material and discuss the signs and symptoms of radiological poisoning.

e. "Recognizing Dissemination Devices" will discuss the types of devices that one might see used for the employment of weapons of mass destruction. Ideal targets for each type of weapon, size of the device, and advantages/disadvantages of each will be addressed.

f. "Responder Actions" will focus on those defensive actions a responder, at the awareness level should take if CBRNE were to be employed.

# Domestic Preparedness; Awareness
# The CBRNE Terrorism Threat

**Module 2:** The CBRNE Terrorism Threat

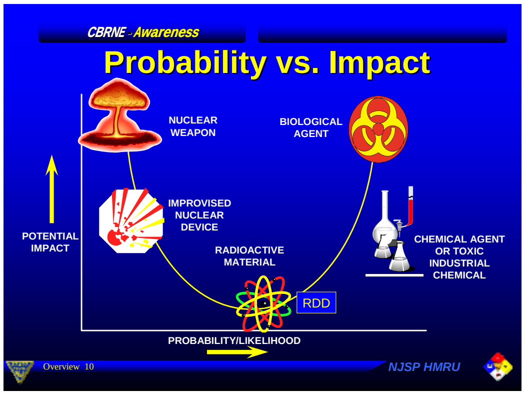
**Training Objectives:**

Students will be able to:

1. List several recent terrorist incidents involving CBRNE material.
2. Describe some reasons terrorists might consider using CBRNE materials.
3. List sources and hazards of CBRNE weapons.
4. Identify likely targets and indicators of a terrorist CBRNE attack.
5. Describe potential outcomes of a terrorist CBRNE attack.

The March 1995 nerve agent attack by terrorists in the Tokyo subway system has heightened concern among government and public safety officials regarding the potential for similar attacks in the United States. Until the March 1995 attack, most of the effort toward preventing or responding to terrorist activity within transportation facilities or other areas where crowds gather was focused on hostage taking, bombing, the use of firearms, and sabotage. The Tokyo incident raised the specter and demonstrated the potential of a new and insidious form of terrorism, with which few in the government and public safety organizations were prepared to cope.

**Probability of CBRNE Weapons vs. Potential Impact**




CBRNE weapons can include nuclear weapons, radiological material, and chemical and biological agents. The conventional wisdom is that a nuclear weapon will be very difficult for a terrorist group to obtain. However, radioactive material, chemical agents or biological agents are relatively easy to obtain, and thus pose a greater threat. Note that the availability and the potential impact of chemical and biological threat materials are both high, with potentially devastating impact. This course will not address either nuclear weapons or improvised nuclear devices. We will focus on the most likely terrorist weapons: radioactive material, chemical weapons, toxic industrial chemicals and biological agents.

**CBRNE Terrorist Incidents Since 1970**

Terrorist activities involving CBRNE agents have been on the increase since the 1970s. This ignores hoaxes, such as the letter which was alleged to contain Anthrax, sent in April 1997 to B'nai B'rith headquarters in Washington, D.C. You must initially respond to hoaxes and HAZMAT bombs in the same way. There was only one reported CBRNE event in the 70s, three in the 80s, and an exponential increase of events in the 90s. Some incident highlights:

Tokyo Subway incident: March 20, 1995, Aum Shinrikyo cult executed a well-thought-out attack on the Tokyo subway system. The plan as executed involved placing plastic bags concealed inside of newspaper containing Sarin (a nerve agent) in 5 separate subway cars at 5 separate sites. All 5 trains were scheduled to converge in the center of Tokyo at the height of the morning rush hour. Once placed inside the subway cars, the bags were punctured, allowing the nerve agent to leak out and evaporate. The bottom line: 12 dead; 5510 treated, including 135 firefighters and 30 EMS. The good news was that this was poor quality nerve agent (25% pure), only about 20 pounds total, and poorly disseminated.

In 1972, members of a U.S. Fascist group called Order of the Rising Sun were found in possession of 30-40 kilograms of typhoid bacteria cultures, with which they planned to contaminate water supplies in Chicago, St. Louis, and other large Midwestern cities.

In 1984, two members of an Oregon cult headed by Bhagwan Shree Rajneesh cultivated Salmonella (food poisoning) bacteria and used them to contaminate restaurant salad bars in an attempt to affect the outcome of a local election. Although some 751 people became ill and 45 were hospitalized, there were no fatalities.

In March 1995, four members of the Minnesota Patriots Council, a right wing militia organization advocating violent overthrow of the U.S. government, were convicted of conspiracy charges under the Biological Weapons Anti-terrorism Act for planning to use ricin, a lethal biological toxin. The four men, Douglas Baker, Richard Oelrich, Dennis Henderson, and Leroy Wheeler allegedly conspired to assassinate federal agents who had served papers on one of them for tax violations.

In May 1995, Larry Wayne Harris, a member of the neo-Nazi organization Aryan Nations, was arrested in Ohio on charges of mail fraud and fraud by wire after allegedly misrepresenting himself when ordering three vials of freeze-dried *Yersinia Pestis*, the bacteria which causes bubonic plague, from a Maryland biological laboratory.

In December 1995, Thomas Lewis Lavy from Arkansas was charged with possession of the toxin ricin in violation of the Biological Weapons Anti-terrorism Act of 1989. In 1993, Canadian customs officials had intercepted a stack of currency with a white powder interspersed between the bills. Suspecting cocaine, customs had the material analyzed, and discovered that it was not cocaine but ricin. Lavy was arrested and the next day, hanged himself in his jail cell.

November 1995, a Chechan separatist organization left a 30 pound package of radioactive Cesium and explosives in a Moscow park. The organization informed Russian Independent Television that this was one of 4 such packages smuggled into Russia. Since the location of the first package was disclosed before it detonated, it is thought that the attempt was to establish their credibility for a possible future extortion attempt.

In June 1996, German authorities arrested a Slovak engineer on suspicion of smuggling a 6.1 pounds of uranium into Germany. The material was seized from a safety deposit box in Ulm, in southern Germany.

In April 1997, Russian police arrested a group which tried to sell 11 pounds of uranium-235 stolen from a production plant in Kazakstan. It takes several pounds of enriched uranium to make a nuclear weapon.

**Groups that Threaten**

There are six basic types of terrorists or terrorist groups capable of using CBRNE weapons.

The lone individual, such as the “Unabomber”, is by far the most difficult to detect. They are a wild card, striking without a predictable motive or pattern; copying a previous event for the publicity, or just acting on a whim. Fortunately so far, individual terrorists have been the least successful. Lacking the funding, organization, and sophistication of larger groups, they account for many of the recently failed attempts and hoaxes.

Local terrorist groups and non-aligned groups form the larger threat of domestic CBRNE terrorism, as they can have the funding, organization, and ability to build or purchase CBRNE weapons. The primary differences between them are the cause, the home base, and the source of their funding. Local terrorist groups have one distinct advantage over foreign organizations: The members fit into the local society and are often unnoticed until they strike.

On the other hand, internationally sponsored groups will have access to technologies, facilities and technical support not available to non-aligned groups. However, the state sponsors risk severe repercussions should their involvement be determined.

Doomsday cults, such as the Aum Shinrikyo, the group that conducted the sarin attack in Tokyo, obviously pose a major threat stemming from the fanaticism of their members, if such organizations embrace terrorism as means to an end.

The current threat from rebels/insurgents within the U.S. is held to be low.

**Terrorism in New Jersey?**

New Jersey is no stranger to terrorism. Several, recent, high profile cases, have involved this state.

In April 1988 - Japanese Red Army member Yu Kikumura was arrested by the NJSP after being stopped for a routine traffic violation. While initiating the traffic citation, the trooper noticed what appeared to be explosive material in Kikumura's vehicle. Further inspection revealed three homemade bombs. Investigation continued, and it was learned that Kikumura had traveled approximately 7,000 miles in the United States, purchasing components, to build his devices, and when stopped, he was en route to blow up the military recruiting station in Times Square, NYC.

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In February 1993 - A Middle East Terrorist Cell use 1200 lbs of explosives to kill 6, injure 1000, and create over $1 billion in property damage, at the World Trade Center, NYC.

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Investigation reveled the cell was based in NJ, the explosives manufactured in NJ, and that most of the planning and coordination, took place in NJ. As a result of raids in NJ, several hundred pounds of explosives, cached by the group, was recovered and destroyed.

**Why CBRNE Terrorism?**

Terrorist groups can perceive several advantages of the use of CBRNE weapons in populated areas:

Small quantities of chemical or biological agents are relatively easy to manufacture. Although not quite "high school" science, chemical and biological weapons can be made from readily available components by individuals with knowledge gained at the college level. During most processing stages, only simple handling precautions are required. Even when the final products are made, readily available environmental protection (HAZMAT) gear is all that is required for the most toxic chemicals. Biological agents pose even less of a manufacturing safety problem than chemical agents.

They are available. Radiological materials are found in many facilities, such as research labs and in industry. In fact most every home has radioactive material (in smoke detectors). Toxic chemicals, and the materials to make chemical warfare agents, are readily available in school laboratories, are legitimately used in industry, and are used in various research facilities. Libraries contain the "recipes" required. Biological pathogens can be obtained from nature, hospital labs and university research facilities, among other places.

They are cheap. CBRNE weapons are called "the poor man's atomic bomb." A program to produce a fissionable device would probably cost hundreds of millions of dollars; obtaining material from black market sources would cost less, but still in the millions. One of the reports quotes testimony before a UN panel that, "for a large-scale operation against a civilian population, [manufacturing enough agent to cause] casualties might cost about...$600 per square kilometer with nerve gas and $1 with biological weapons."

Small quantities can have a tremendous effect. An often quoted example is that, "one small vial holds enough to kill every person on the earth."

In practice, however, dissemination methods are not nearly that efficient. For comparison purposes, a fragmentation hand grenade has an effective casualty radius of 15 meters. The same quantity of chemical agent (about 1.7 pounds), disseminated in a practical way, could fill a 600 foot long subway platform with a concentration which would injure or kill every person who remained on the platform for two minutes. It would take much less than an ounce of biological material to result in the same hazard. A radiological agent, spread in the same location, while it would likely not cause immediate injury, could have the potential to shut down the facility until it could be thoroughly removed.

They are not detected by methods used for explosives and firearms. Terrorist actions to date have resulted in the use of metal detectors and x-ray devices in transportation facilities and other areas where crowds gather. CBRNE weapons can be transported in glass or plastic containers configured to look like ordinary items. The fact that some of the devices in the Tokyo incident were carried in what appeared to be lunch boxes is indicative of the problem with detection.

They can be used covertly with little signature over periods of hours or even days. A clever person can easily devise methods to disseminate a chemical, biological or radiological weapon which results in little, if any, signature. The first indication of a chemical attack may be when people start to collapse, as in the Tokyo incident. The first indication of a biological attack may be when people begin to develop symptoms of disease hours or days after an infectious dose is ingested. There may never be an obvious indication of a radiological attack.

They can be spread throughout large areas by natural convection or air-currents. CBRNE agents as dust or vapors move with the air. Ventilation systems in buildings or transportation facilities may actually become part of the dissemination system, carrying CBRNE agents far from the initial source. One author reported a test in which harmless biological organisms introduced into the Seventh and Eighth Avenue subways in New York City were detected at the extremities of the system within minutes.

They require decontamination, tying up of resources, and increasing media attention. Once disseminated, CBRNE agents can remain in the air as vapor or aerosols, or settle on surfaces. In each case a hazard can remain for hours to days or weeks if untreated, or for years in the case of some biological materials. This requires that facilities be monitored and decontaminated before being returned to service. Decontamination is a tedious, time-consuming and resource intensive process, which requires that personnel doing the work be fully protected from the effects of the agent.

Their psychological impact will extend far beyond their actual effect. The mere thought of imminent exposure to a chemical or biological agent, or radiation, causes a terror reaction in many people. The pictures of Israeli civilians boarded up in their houses, fearful of Iraqi chemical attacks during the Gulf War, is an example of the kind of fear these weapons can arouse.

It is difficult for civil government agencies to prepare for CBRNE terrorist incidents. Most civil agencies now have some kind of HAZMAT response team available. While these teams and their equipment can form the core of an element that responds to a terrorist CBRNE incident, they are likely to be challenged beyond their current capability in terms of knowledge, manpower and equipment. The numbers of potential casualties and the extent of the areas involved can very quickly overwhelm the capabilities of any response organization. All responders (police, medical, fire) will need to be fully trained and equipped in the handling of such incidents, with these courses as your starting point.

CBRNE Terrorism provides the next level of escalation. As counter terrorist actions by government and law enforcement authorities are implemented, it becomes increasingly difficult for terrorists to act with impunity. Furthermore, as the populace is becoming somewhat used to terrorist actions; there is frequently a flurry of media and government attention for a time, and then people tend to forget about it. Terrorists seek to take actions which generate greater fear and attention. Because of the mass casualty potential (in the thousands, not hundreds), and the sometimes inordinate fear of the public regarding chemical and biological weapons and radiation, their use by terrorists will enhance the impact of a terrorist event. Such an event can move a group from relative obscurity to the center stage, which in many instances is their primary objective.

**Limitations of the Use of CBRNE Materials**

Despite the advantages, there are also limitations and disadvantages to the use of CBRNE weapons from a terrorist's perspective. It is important to understand these as well, because they can impact the development of response plans.

Chemical weapons must be used in relatively large quantities. When used in open areas, CBRNE agents are subject to dispersion by the wind. For chemicals, which are pound for pound a thousand times less toxic than biological agents, this requires quantities measured in pounds and gallons for massive effect. Such a requirement creates manufacturing and handling problems, and increases the risk of detection. Yet many potential CBRNE agents, such as chlorine and phosgene, are shipped by the rail car or tanker truck load.

Delayed effects can detract from the intended impact. Terrorist activities occur for the purpose of making a public political statement. Determining whether an outbreak of disease or illness is the result of natural causes or terrorism is difficult and time consuming. This uncertainty as to the cause, and the time delay in seeing any effect, can detract from the potency of the political statement or the credibility of the claim. This may be outweighed by the fear that is created. Even a hoax instills considerable fear.

Use of CB weapons may be counterproductive. To a certain degree, there is a balance between the magnitude of the terrorist act and the support or attention which it generates. Terrorism by the Irish Republican Army (IRA) brought attention to their complaints and allowed them to gain sympathy and support from a number of sources. Use of weapons abhorred by the public may isolate a terrorist organization from its potential support. So far, this has not deterred those who have already attempted to use chemical or biological weapons.

Production of CBRNE Agents and Devices is Inherently Hazardous to the Terrorist. Production of chemical or biological agents, or use of radioactive material, is not without risk to the potential terrorist. Radiation is difficult to shield, biological agents may infect the grower, and chemical agents may kill or injure the producer. However, the technically proficient terrorist will recognize the hazards and can take steps to insure his own safety.

Development of effective CBRNE weapons requires numerous difficult steps. One report listed 16 steps required to plan and execute a biological terrorist attack which would kill millions, each step of which would pose difficulty for the terrorist group. Problems cited ranged from lack of knowledge, difficulty in obtaining equipment and materials, safety, risk of detection, and difficulty in preservation and dissemination. The bad news: The information, equipment and skills to accomplish these processes are readily available.

**CBRNE Agent Sources**

A likely source of chemical and biological agents is the home lab. This can mean low concentration, impure, inexpensive materials or fairly potent agents, depending on the process used to produce and purify them. In some cases, that process is as simple as an improperly processed canned good (botulinum toxin) or very complex (nerve gas).
Many terrorists rely on a real laboratory to produce the agent, and attempt to either buy it on the open market or steal it.

Stealing CBRNE agents is easier from industries that use poisonous chemicals in bulk and ship or store the chemicals in relatively accessible areas.

Terrorists are less likely to obtain CBRNE agents from the military, although foreign military equipment can be obtained for use as dissemination devices. With the breakup of the Soviet Union, there are many establishments in the CBRNE business looking for a new market among the unscrupulous.

Medical and university research facilities are possible sources for small quantities of hard to obtain chemical or biological materials, and these are often poorly protected from theft. The man in Ohio who obtained bubonic plague bacteria bought it from a biological research supplier.

**Indicators of CBRNE Attack (Primary)**

As stated earlier, you may respond to an incident such as a fire or explosion long before you know it is also an CBRNE incident.

The first indication that you may have an CBRNE attack will be the observed symptoms of the agent in the victims. Chemical agents have unique symptoms that differentiate them from other illnesses; we will elaborate on this in the next hour. Keep in mind that most biological agents and many chemical agents do not exhibit these symptoms until several hours after the initial exposure. Radiological agents will not result in symptoms appearing for days, and more likely years.

Another strong indication that this is not a natural occurrence is the massive number of casualties, all having severe cases of the same disorder.

Casualties downwind of an area or limited to specific enclosed areas also indicate a wind-borne hazard.

Someone may find the actual dissemination device if it did not explode, or may view the device functioning. Any unusual spraying or low-order explosion surrounded by a cloud is a tell-tale sign of an CBRNE release.

A warning of impending attack or a proclamation of credit may indicate the attack included an CBRNE agent, even if there were no immediate symptoms observed.

**Secondary Indicators of CBRNE Attack**

Animals fall victim to the same effects of the attack as humans, and they are more likely to die of untreated injuries near to the place they were exposed.

The casualties who are close enough to become ill may have observed the attack as it occurred. For example, people in the Tokyo subway who were exposed to the nerve gas reported that suddenly everything became dark. In the next hour, you will see this is one of the symptoms of nerve agent poisoning. Even a consensus that “nothing” unusual happened might attest to the delayed effects of an CBRNE agent.

You may see something that appears to be out of place in the immediate area. Some agent residue may be left behind as unusual smells or unexplained liquid spills. Concentrated liquid agent poses a grave risk to first responders who have not yet established the extent of the attack.

**Outcomes of a Terrorist CBRNE Event**

A well planned and executed terrorist CBRNE attack may result in thousands of casualties, many of whom can carry residual contamination on their clothing into the ambulances. A similar event using biological agents could result in the infection of tens of thousands.

The presence of CBRNE agents in a terrorist act will overwhelm all factions of the emergency response system; medical, fire, police, HAZMAT teams, communications, support and clean-up will be most heavily burdened.

The immediate area will have to be evacuated, tying up traffic and shutting down facilities for prolonged periods of time. Some contaminated facilities may not be certified as safe to reoccupy for weeks, if ever.

In a large event, mass fear can lead to panic extending throughout the city or state.

Fear leads to widespread panic, which can result in the public losing faith in the ability of the government to protect their safety and welfare.

You as first responders may bear the brunt of the reaction by the angry crowds as to why you did not protect them better. In the long term, this may stall or reverse your initiatives to increase the funding, equipment or manpower necessary to provide that protection. Finally, there will be a flood of news reporters to the scene.

**Fallacies**

There are three common perceptions about CBRNE weapons that we can now debunk:

**(1) It can't happen to us:** Yes, it can happen to you. It already has in many states and in foreign nations. And it will continue to happen, so long as it is easy for terrorists to do. Your preparedness will mitigate many adverse effects of the CBRNE attack when it does happen.

**(2) CBRNE is so deadly, the victims will all die anyway:** CBRNE Weapons are not a doomsday machine. The vast majority of people within the entire area affected by an CBRNE event are not going to be seriously injured. Many won't show any symptoms at all. This does not lessen the severity of the injuries for those unlucky enough to become casualties, however most of the survivors should eventually recover with proper medical treatment.

**(3) There is nothing we can do:** Yes, there is something you can do; everything you already know how to do in your normal mission as responders. Dealing with CBRNE agents as a part of the terrorist attack will certainly make that job harder, but not impossible.

**Review Questions**

1) Have terrorist attacks in the U.S. ever involved CBRNE agents?

2) What type of terrorist would use CBRNE weapons: individuals, hate groups, or internationally sponsored groups?

3) What are the immediate effects of CBRNE agents? Far reaching effects?

4) What is the most likely source of CBRNE agents for a terrorist?

5) What are the most likely targets of an CBRNE attack?

6) What are the primary indicators of a terrorist CBRNE attack?

7) What are the potential outcomes of a well executed CBRNE attack?

**Key Points:**
Terrorist groups today have the organization, funds, motivation and zeal to use CBRNE weapons. That civil authorities are ill prepared to address this threat will not diminish it. We can't wish away their capabilities, but we can prepare for the threat, with these courses to help you.

The specter of CBRNE weapons being used in our cities instills fear and a perception of ineptitude in the government, (including you as its representatives), that will far outlast the consequences of an actual attack and far exceed the boundaries of the affected area. Though the immediate effects will be devastating, the legal, safety, chronic health, and environmental implications are staggering.

Small chemical and biological agent devices are relatively easy to build and could be used by terrorists most effectively in enclosed spaces such as stadiums, buildings and subways.

Key to early recognition of an CBRNE attack is your familiarity with the symptoms of the chemical and biological agents terrorists are likely to use.

The ability of the emergency response system to cope with mass casualties will make the difference in providing timely care needed to help the victims of an CBRNE attack.

Responders must prepare to meet the challenge by preparing now.

# Domestic Preparedness; Awareness Chemical Agents

**Module 3:** Chemical Agents

**Training Objectives:**

Students will be able to:

1. Demonstrate an ability to recognize signs and symptoms of chemical agent exposure.

2. Describe how to protect oneself against chemical agents.

3. Demonstrate a knowledge of terms, symbols, definitions and characteristics of chemical agents.

This module will introduce you to some of the chemical agents which either the United States or other nations have expressed interest in as potential battlefield agents. We're looking at these agents because a potential terrorist would most likely find these same agents attractive to use in a domestic terrorist attack. Why?

a. Because they are extremely toxic.
b. Many are either readily available, or not that difficult to make.
c. There is a lot of information available on them.

**General Characteristics of Chemical Agents**
Responding to a chemical terrorist incident is very similar to a HAZMAT incident.

We'll be using military terms because they are the same terms you will see and use with many of the detection instruments and detectors. Also, many of the federal response teams use these terms.

Chemical agents are generally liquid when containerized; some boil at low temperatures and become gases. They are normally disseminated as aerosols or as a gas and will dissipate with time. They are influenced by weather conditions (temperature, wind speed, wind direction, humidity and air stability). You can protect yourself against chemical agents, and can successfully treat, and decontaminate exposed victims.

**Concentration will Vary within a Cloud**
Whenever there is a release, the agent cloud will vary in concentration. As a result, not all individuals within the cloud will be subjected to the same concentration, and therefore will not be subject to the same dose. Many victims will receive lesser doses and their symptoms will vary.

**Classes of Chemical Agents**
Chemical agents are classified according to how they affect you. If you attend the technician level of training, we will be more specific on the physiological actions.

a. Choking Agents
b. Blood Agents
c. Blister Agents
d. Nerve Agents

Incapacitating agents (CS, CN, OC) will not be discussed, as they should be well-known to the you and are unlikely to have a significant effect if used by a terrorist.

Key terms to be used with the summary charts that follow.

**Volatility/Persistency:** Volatility is important because it gives you an indication of how rapidly an agent will evaporate. The more volatile an agent is, the more rapidly it will evaporate. Evaporation will cause the agent to become a true gas or vapor and reduce the liquid hazard. Temperature, wind speed and humidity at the incident site, influence how rapidly an agent will evaporate.

This evaporation process is also referred to as persistency, or the amount of time an agent will remain a threat in the incident site. A non-persistent agent will not remain at the incident site as long as a persistent agent. Obviously, if an agent is released inside an enclosed space, weather will not play a role and the persistency will normally increase.

Most of the agents we will discuss will be disseminated as gasses or vapors and are heavier than air.

**Common Name:** Each of the agents has a complex chemical name based on its composition and formula. They also have a common name that you need to recognize.

**Military Designation/Symbol:** Each of the agents have been given a symbol. This is not a chemical symbol or formula, but rather a shorthand way of designating the agent. You need to learn these symbols.

**Rate of Action/Onset Time:** The rate of action or onset time is the period of time that elapses before a victim begins to show or feel the symptoms of the particular agent. With some agents, this time will be just a few seconds, in other cases it could be minutes to hours.

Knowing onset time is important because it tells you how much time you have to react.

**Symptoms:** Each of the agents will cause the victim to exhibit symptoms. In many cases these symptoms can be recognized and provide an indicator of the type of agent.

**Route of Entry:** The route of entry is how the agent gets into your body. Most of the agents will enter through the respiratory tract, that is, through inhalation. Some of the agents can also attack through skin and eye.

**Toxicity:** Toxicity is the term used to indicate how much of a substance (in this case, one of the agents), it takes to cause a specified effect such as incapacitation or death. The amount of agent is takes to cause an effect is also referred to as a dose.

**Respiratory lethality** or toxicity can be expressed in parts per million (ppm). **PPM** is an expression of concentration (C) or how many parts of a given substance are mixed in a million parts of air. If an individual is exposed to this concentration for a period of time (t), usually expressed in one (1) minute, then he or she will receive a dosage. The exact ppm concentration required to cause lethality is a variable, depending on breathing rate, overall health, etc. Taking into consideration these variables, the term $LCt_{50}$ is the expression used to indicate a given ppm concentration expected to be Lethal to 50 percent of those exposed for 1 minute. **$ICT_{50}$** would express the same, except "I" is the Incapacitating dosage.

**Skin lethality** is expressed as **$LD_{50}$** and will normally be expressed in grams or milligrams per individual.

How Much (Or How Little) is 1 Part Per Million? To give you an example of how small an amount we are talking about: 1 drop of liquid from an eye dropper is 1 millionth of a tank of gas in an average compact car (13 gallon tank), or 1/8 inch is 1 millionth of a mile.

A milligram is 1/1000 of a gram and there are 28.3 grams in an ounce.

**Choking Agents**

There are two choking agents: Phosgene (CG) and Chlorine (Cl). Both are commercially available agents and could be obtained and used by a terrorist. They have low boiling points, so once released under normal conditions they will rapidly become a gas. This also makes them non-persistent, meaning they will not remain in an area for any length of time.

These agents were used in World War I very effectively. Many soldiers became victims when they did what they had been trained to do; jump in a foxhole or other depression when they were receiving incoming artillery. Because Phosgene is heavier than air, it settled in these same depressions and if the soldier was not masked, he fell victim to the Phosgene while avoiding the shrapnel.

Phosgene smells like newly mown hay, and everyone recognizes Chlorine, like a swimming pool, but this is not a good way of detecting it. Possibly the casualties might mention the odor. Once inhaled they are immediately very irritating to the respiratory tract. Victims may be coughing or appear to be choking but it could be 2-3 hours later before the victims begin to show serious symptoms.

Choking agents are very irritating to the throat and lungs. When the agent comes in contact with the fluids in the lining of the throat and lungs, it hydrolyzes to Hydrochloric acid (HCl) which in turn burns the throat and lungs, which in turn secrete more fluid. As the air sacs in the lungs fill with fluid, they prevent an oxygen transfer to the blood stream and you ultimately die of oxygen starvation. This process is frequently referred to as "Dry Land Drowning". As choking agents are a respiratory problem, you will need good respiratory protection like your SCBA.

There is no absorption through the skin, although if you get the liquid on you, it will burn and should be flushed off immediately.

Exposure to a high concentration of chlorine vapor can also react with body moisture, causing serious burns and degradation to clothing.

Self aid is simply getting yourself out of the contaminated area. Decontamination is flushing with water.

**Phosgene (CG)** is a chemical agent with a normally short duration of effectiveness. It was used extensively during World War I, causing more than 80% of the chemical agent casualties, and is widely used today as an industrial chemical.

(1) Chemical name: Carbonyl Chloride
(2) Formula: $COCl_2$
(3) Vapor density: 3.4 (relative to air (1.0))
(4) Freezing point: -128°C
(5) Boiling point: 7°C
(6) Vapor pressure: At +20°C: 1,173 mm Hg
At 0°C: 555 mm Hg
At -10°C: 365 mm Hg

(7) Rate of hydrolysis: Poor; but rain destroys effectiveness
(8) Hydrolysis products: Hydrogen chloride, Carbon dioxide, acidic when wet
(9) Action on metals: Generally none; but, hydrolysis product can be corrosive
(10) Odor: Newly mown hay
(11) $LCt_{50}$: 3,200 mg-min/$m^3$
(12) $ICt_{50}$: 1,600 mg-min/$m^3$
(13) Rate of detoxification: Not detoxified, cumulative effect
(14) Onset time to effects: Immediate reaction to high concentrations. Delayed reaction (3 hours) to lower concentrations.
(15) Physiological action: Reacts solely on the lungs resulting in capillary damage by filing the alveolar sacks with watery fluid. Most deaths occur within 24 hours.
(16) Protection required during emergency response: Level A - Acid resistant gloves and suit with SCBA

**(NOTE: Awareness trained responders do not have the training necessary to safely wear this equipment)**

(17) Persistency: Short; vapor may persist in low places under calm or light winds

**Chlorine (Cl)** is a chemical agent with a normally short duration of effectiveness. It was used during World War I, causing 10-15% of the chemical agent casualties, and is widely used today as an industrial chemical.

(1) Chemical name: Chlorine
(2) Formula: $Cl_2$
(3) Vapor density: 2.49 (relative to air (1.0))
(4) Freezing point: -101°C
(5) Boiling point: -34.5°C
(6) Vapor pressure: At +20°C: 4,800 mm Hg
(7) Rate of hydrolysis: Slow
(8) Hydrolysis products: Hydrochloric acid; hydrochlorous acid
(9) Action on metals: Generally none if dry; very corrosive if moist
(10) Odor: Bleach
(11) $LCt_{50}$: 19,000 mg-min/$m^3$
(12) $ICt_{50}$: 1,800 mg-min/$m^3$
(13) Rate of detoxification: Rapid
(14) Onset time to effects: Immediate reaction to high concentrations. Delayed reaction to lower concentrations.
(15) Physiological action: Reacts with moisture to liberate the oxygen and form hydrochloric acid that inflame body tissues. Contact with lungs may produce pulmonary edema. In cases where exposure is unmitigated, irritation of the eyes and the mucous membranes of the nose and throat are produced, followed by a cough, a feeling of suffocation, and later pain, a feeling of constriction of the chest, edema, and death.
(16) Protection required during emergency response: Level A - Acid resistant gloves and suit with SCBA (neoprene is recommended by the ACGIH),

**(NOTE: Awareness trained responders do not have the training necessary to safely wear this equipment).**

(17) Persistency: Short; vapor may persist in low places under calm or light winds

**Blood Agents**

There are two Blood agents: Hydrogen Cyanide (AC) and Cyanogen Chloride (CK). Both are commercially available and used in various manufacturing processes so, like the choking agents, would be obtainable by a terrorist. Both would probably be weaponized or packaged as liquids but will rapidly vaporize once released into the atmosphere and be true gases at normal temperatures. AC is lighter than air and unlike the other agents, will rise. CK is heavier. Both are non persistent. Both smell like bitter almonds.

They are inhalation threat agents and once inhaled will take effect immediately. Victims will appear flushed (reddish skin), have red lips (blue in African-American or other dark-skinned people), be gasping for air, may appear to be gulping air, frothing or vomiting and then unconsciousness and death. This process will occur very rapidly.

Blood agents affect the body by attacking the enzyme cytochromeoxidase and basically blocking the normal transfer of oxygen from the blood stream to the individual body cells. Victims appear red because of the overabundance of oxygen in the blood.

Because they are inhalation threat agents, you will need a good protective mask, or SCBA will protect you.

There is no absorption through the skin, although if you get liquid on your skin and it doesn't immediately evaporate, flush it off with water.

First Aid is to either mask the victim or get them out of the area. Antidotes are available for use by medical personnel. No decontamination is necessary.

Hydrogen cyanide has a low flash point (64° F) so if released by an explosive device it could burn off.

The body can detoxify Hydrogen cyanide more rapidly than most agents, so the $LCt_{50}$ is dependent on both the concentration and the length of exposure, but is generally around 3,600 ppm or 2000 mg-min/$m^3$.

**Hydrogen Cyanide (AC)**

(1) Chemical name: Hydrogen cyanide or hydrocyanic acid
(2) Formula: HCN
(3) Vapor density: .93 (relative to air (1.0))
(4) Freezing point: -14°C
(5) Boiling point: 26°C
(6) Vapor pressure: At +25°C: 740 mm Hg
(7) Rate of hydrolysis: Rapid in 5% solution of NaOH, slow in acids.
(8) Hydrolysis products: Ammonia, formic acid, amorphous brown solids.
(9) Action on metals: None
(10) Odor: Bitter almonds, or peach kernels
(11) $LCt_{50}$: Respiratory: 2,000-4,000 mg-min/$m^3$
(12) $ICt_{50}$: Respiratory: Varies with concentration, but less than the $LCt_{50}$
(13) Rate of detoxification: Very fast (.017mg/kg/min)
(14) Onset time to effects: Very fast

(15) Duration of effectiveness: Very short. This is an extremely volatile agent. May persist for one to two days.
(16) Physiological symptoms: Lips take on a pinkish color (bluish coloring in African-American or other dark-skinned people ), breathing becomes more difficult as the body becomes unable to absorb oxygen from the blood; possible vomiting; unconsciousness; flushed hot and dry skin; violent convulsions; cessation of regular breathing; occasional gasps; dilation of the pupils. Death occurs within 15 minutes if kept in contact with a lethal concentration.
(17) Protection required: SCBA, and protective clothing specifically recommended by manufacturer.

**(NOTE: Awareness trained responders do not have the training necessary to safely wear this equipment).**

**Cyanogen chloride (CK)** is a heavier than air blood agent that has been assessed as having a capability to break down charcoal protective mask filters after repeated exposures to high concentrations.

(1) Chemical name: Cyanogen chloride
(2) Formula: $CNCl$
(3) Vapor density: 2.1 (relative to air (1.0))
(4) Freezing point: -6°C
(5) Boiling point: 13°C
(6) Vapor pressure: At +25°C: 1,000 mm Hg
(7) Rate of hydrolysis: Very slow
(8) Hydrolysis products: Hydrochloric acid and Cyanic acid (Hydrogen cyanate).
(9) Action on metals: None
(10) Odor: Faint bitter almonds, or peach kernels; tearing may make the odor unnoticeable
(11) $LCt_{50}$: Respiratory = 11,000 mg-min/m$^3$
(12) $ICt_{50}$: Respiratory = 7,000 mg-min/m$^3$
(13) Rate of detoxification: Very fast (.02-.1 mg/kg/min)
(14) Onset time to effects: Very fast
(15) Persistency: Short; dissipates quickly
(16) Physiological symptoms: Lips take on a pinkish coloring (bluish coloring in African-American or other dark-skinned people), breathing becomes more difficult as the body becomes unable to absorb oxygen from the blood, patient chokes, breathing rate slows, and is accompanied by a strongly irritating tearing effect on the eyes. Death occurs within 15 minutes if kept in contact with a lethal concentration.
(17) Protection required: SCBA and protective clothing specifically recommended by manufacturer.

**(NOTE: Awareness trained responders do not have the training necessary to safely wear this equipment).**

**Blister Agents**
There are a number of Blister Agents; H Blister agents (referred to as Mustard agents), Lewisite (L), and Phosgene Oxime (CX). Mustard is the most likely, as it is the easiest to produce.

These agents are normally disseminated as liquids. Under normal temperatures they have low volatility so they are persistent. Mustard freezes at around 58°F so it probably won't be used outdoors during colder periods of the year.

Mustard has a definite odor of garlic and appears as an oily liquid. It is primarily designed for liquid skin contact, however, the vapors are extremely effective in the lungs and, in sufficient concentration, will cause blistering of the skin.

Although the agents attack immediately upon contact, you will not feel anything with the Mustards and may not realize you have been contaminated. The agent is absorbed rapidly into the skin. A few hours later you will notice a reddening of skin where the contamination occurred and later the formation of a large well defined blister, hence the name.

The exact mechanism the blister agents use to create blisters is not fully understood; however, there is no doubt that they do in fact cause blisters. This irritation and blistering can be caused by direct contact with liquid or with high vapor concentrations. The eyes and respiratory tract are very vulnerable. In the case of respiratory burning, the entire respiratory route is susceptible and the agent causes severe tissue irritation. The tissue in turn secretes fluids to attempt to counter this irritation, which in turn results in disruption of the oxygen transfer that normally occurs in the lungs, similar to choking agents. Victims are also very susceptible to pneumonia.

The fluid from breaking blisters does not create new blistering, however, the open sores which result are susceptible to infection and take a long time to heal.

**Blisters**
For our purposes, the only major difference between the Mustards (H) and Lewisite or Phosgene Oxime is that L and CX cause immediate pain upon skin contact.

Blister agents affect both the respiratory tract and the skin so full protection is required.

First Aid involves getting the agent off any exposed skin as quickly as possible and then flushing with water. Decontamination is basically the same, removal followed by flushing with water.

**Levinstein mustard (H) and distilled mustard (HD).**
(1) Chemical name: 2,2=-dichloro-diethyl sulfide
(2) Formula: $(ClCH_2CH_2)_2S$ (H contains approximately 30% sulfur impurities)
(3) Vapor density: 5.4 (relative to air (1.0)).
(4) Freezing point: 14°C
(5) Boiling point: 227.8°C
(6) Vapor pressure: At +25°C: .11 mm Hg
(7) Rate of hydrolysis: Very slow

(8) Hydrolysis products: Hydrochloric acid and thiodiglycol
(9) Action on metals: Very little
(10) Odor: Garlic
(11) $LCt_{50}$ (at 25°C, decreases as temperature rises):
Respiratory: 1,500 mg-min/$m^3$
Percutaneous vapor: 10,000/mg-min/$m^3$
Percutaneous liquid: 7 g/person
(12) $ICt_{50}$ (at 25°C, decreases as temperature rises):
Respiratory: undetermined
Percutaneous vapor: 2,000 mg-min/$m^3$
Eye: 150 mg-min/$m^3$
(13) Rate of detoxification: Effects are cumulative
(14) Onset time: Very slow. Symptoms occur only after 4-6 hours; can be delayed up to 24 hours.
(15) Persistency: Days to weeks
(16) Physiological symptoms: Mustard acts first as a cell irritant and later as a cell poison. It destroys the cellular DNA across large areas of tissue, with the body responding by secreting large amounts of interstitial fluid and causing the formation of blisters. Local action may result in conjunctivitis; a reddening of the skin followed by the formation of blisters; and inflammation of the nose and throat, brachia, bronchi, and lung tissue. Healing is delayed because of mustard interfering with blood vessel function and the presence of large amounts of dead tissue serving as a good growth medium for bacteria.
(17) Physical protection required: SCBA and Level A protective clothing.
**(NOTE: Awareness trained responders do not have the training necessary to safely wear this equipment).**

**Lewisite (L)**
(1) Chemical name: Dichloro (2-chlorovinyl) arsine
(2) Formula: $ClCHCHAsCl_2$
(3) Vapor density: 7.2 (relative to air (1.0)).
(4) Freezing point: 18°C
(5) Boiling point: 190°C
(6) Vapor pressure: At +25°C: 0.58 mm Hg
(7) Rate of hydrolysis: Rapid in the liquid or vapor state
(8) Hydrolysis products: Hydrogen chloride and chlorovinyl-arsenous oxide products. The later is a blister forming solid that is not washed away by rain. Alkaline hydrolysis destroys blister forming properties.
(9) Action on metals: None if dry, but hydrolysis products can be corrosive
(10) Odor: Geraniums
(11) $LCt_{50}$ (at 25°C, decreases as temperature rises):
Respiratory: 1,400 mg-min/$m^3$
Percutaneous vapor: 100,000 mg-min/$m^3$
Percutaneous liquid: Unknown ($LD_{50}$ 6mg/kg in rabbits)
(12) $ICt_{50}$ (at 25°C, decreases as temperature rises):
Respiratory: No data
Percutaneous vapor: 1,500 mg-min/$m^3$
Eye: Below 300 mg-min/$m^3$

(13) Rate of detoxification: The body does not detoxify L.
(14) Onset time: Rapid
(15) Persistency: Days
(16) Physiological symptoms: Produces effects similar to mustard but additionally acts as a systemic poison causing pulmonary edema, diarrhea, restlessness, weakness, subnormal temperature, and low blood pressure. First and foremost L is a blister agent, then a toxic lung irritant, and finally a systemic poison. In its liquid form, L will cause immediate eye irritation and permanent loss of vision if not decontaminated within one minute. L produces immediate strong stinging sensation of the skin, with reddening beginning in 30 minutes. Blistering will appear after 30 hours.
(17) Physical protection required: SCBA and Level A protective clothing.

**(NOTE: Awareness trained responders do not have the training necessary to safely wear this equipment).**

**Phosgene oxime (CX)** - colorless prismatic crystals.

(1) Chemical name: Dichloroformoxime
(2) Formula: $Cl_2CNOH$
(3) Vapor density: 3.9 (relative to air (1.0))
(4) Freezing point: 40°C
(5) Boiling point: 129°C
(6) Vapor pressure: At +25°C: 11.2 mm Hg
(7) Rate of hydrolysis: Very slow. Reacts violently in alkaline solution
(8) Hydrolysis products: Carbon dioxide, hydrochloric acid, hydroxyl amine
(9) Action on metals: Corrosive to most metals
(10) Odor: Disagreeably penetrating
(11) $LCt_{50}$ (at 25°C, decreases as temperature rises):
    Respiratory: 3,200 mg-min/$m^3$
    Percutaneous vapor: unknown
    Percutaneous liquid: unknown
(12) $ICt_{50}$ (at 25°C, decreases as temperature rises):
    Respiratory: undetermined
    Percutaneous vapor: undetermined
    Eye: more than 3 mg-min/$m^3$
(13) Rate of detoxification: Cumulative effects
(14) Onset time: Extremely rapid
(15) Persistency: Days to weeks
(16) Physiological symptoms: Produces instant almost intolerable skin pain and local tissue destruction immediately on contact. It will cause violent irritation to the mucous membranes of the eyes and nose. When CX comes in contact with the skin, the area becomes blanched within 30 seconds and is surrounded by a red ring. A weal forms in about 30 minutes with the tissue turning brown in 24 hours. A scab will form within a week and fall off in three weeks. Itching will sometimes occur during healing, delaying the process for up to two months.
(17) Physical protection required: SCBA and Level A protective clothing.

**(NOTE: Awareness trained responders do not have the training necessary to safely wear this equipment).**

**Nerve Agents**

Nerve agents are our biggest fear. They are not as readily available as the choking agents, but are much more toxic. Some of the agents are not that difficult to produce.
There are four agents: Tabun (GA), Sarin (GB), Soman (GD) and VX. Each are extremely fast acting. The G agents are generally volatile and will evaporate, so they're non-persistent, while VX has a low volatility and is primarily a liquid hazard. The G agents are both an inhalation threat and a skin contact threat (liquid on skin). VX evaporates about as quickly as motor oil, so it is primarily a skin contact threat but if in aerosol form will also be a inhalation threat.

When pure, the G agents are both colorless and odorless, however there may be a slight fruity odor. VX is also odorless but may have a slight yellow color, and the smell of sulfur.

As the name implies, these agents affect the nervous system.
There is an antidote available.

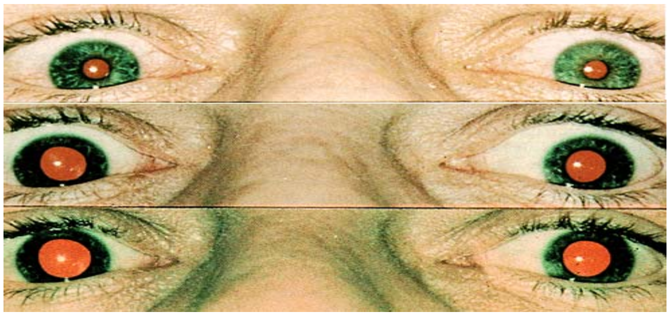
Nerve agents attack or interfere with the normal chemistry at the nerve/muscle junction. Muscles work by contracting and relaxing. To stimulate contraction the nerve endings activate a chemical called acetylcholine, which acts as an electrical conductor to bridge the gap between the nerve ending and the muscle. Following the contraction, the muscle body secretes an enzyme called acetylcholinesterase which neutralizes the acetylcholine, breaking the electrical contact, and the muscle relaxes. Nerve agents inhibit or capture the acetylcholinesterase, thus preventing it from neutralizing the acetylcholine. Thus the muscle is receiving a constant stimulation and tires. This constant stimulation is what causes the muscles to twitch. At the same time this is happening, fluids are building up in the tracheal area and there is broncho-constriction making it more difficult to breathe.

Death usually results from cardiopulmonary failure.

The symptoms are fairly recognizable; running nose, drooling, dimness of vision (pin pointing of eyes), difficulty breathing/tightness of the chest, nausea, muscle jerking or twitching, involuntary urination/defecation, coma and death. Depending on the concentration and exposure time, these can all occur in a very few minutes.

**Pinpointing of Pupils**

Here are examples of eye pupils under the following circumstances: pupils in reduced light (bottom), pupils under regular lighting conditions (middle), and pinpointed pupils as a result of nerve agent exposure (top). Pinpointed pupils can also result from Heroin overdoses, without tearing or drooling. Exposure to pepper spray will result in copious flow of tears or drool without pinpointing of pupils.



The term **SLUDGE-M** is a good way to remember nerve agent symptoms.

- **S** Salivation
- **L** Lacrimation (Tearing)
- **U** Urination
- **D** Defecation
- **G** Gastrointestinal (increase in secretions into GI tract)
- **E** Emesis (vomiting)
- M Miois (Twitching)

Protection from these agents requires Level A protective gear (full respiratory and skin protection). Operations in the Hot Zone require full Level A. There are antidotes available and decontamination will work if you get it off your skin quickly. Flushing with water will help, but dilute bleach solutions are better.

Like choking agents, nerve agents are heavier than air. The G agents are fairly non-persistent, but VX is very persistent.

There is a first aid antidote. Decontamination is flushing with water or dilute bleach.

Clothing contaminated with nerve agents can "off gas", creating a problem for unprotected individuals around contaminated clothing.

General: While the nerve agents differ in their structure and route of entry to the body, they all have the same physical action on man in that they upset the balance between the sympathetic and parasympathetic nervous systems. Normally, muscle contraction is initiated by a discharge of acetylcholine from the nerve ending. Muscle relaxation is then brought about by a discharge of acetylcholinesterase to react with and neutralize the effect of the acetylcholine. When a nerve agent is introduced into the system, it reacts with and ties up the acetylcholinesterase and permits the accumulation of acetylcholine and the resulting continual muscle stimulation.

**Tabun (GA)** is generally believed to be the first of the nerve agents developed. The derivative of the agent symbol (GA) results from its country of origin, Germany, and its order of discovery. GA is a colorless to brownish liquid, emitting a slightly fruity odor.

(1) Chemical name: O-ethyl N, N-dimethylphosphoramidocyanidate
(2) Formula: $(CH_3)_2N(C_2H_5O)CNPO$
(3) Vapor density: 5.63 (relative to air (1.0))
(4) Freezing point: -49°C
(5) Boiling point: 246°C
(6) Vapor pressure: At +25°C: .070 mm Hg
(7) Rate of hydrolysis: Reacts slowly with water, but fairly rapidly with strong acids and alkalis. Hydrolysis may be catalyzed by phosphates.
(8) Hydrolysis products: Hydrogen cyanide, dimethylamine and other products
(9) Action on metals: None
(10) Odor: None when pure; fruity.

(11) $LCt_{50}$:
Respiratory: 135-200 mg-min/$m^3$
Percutaneous liquid: 1.5 gm/person
Percutaneous vapor: 30,000 mg-min/$m^3$
(12) $ICt_{50}$: Respiratory: ~50 mg-min/$m^3$
(13) Rate of detoxification: Slow
(14) Onset of effects: Very fast
(15) Persistency: Heavy concentrations of liquid agent may persist for one to two days
(16) Physiological symptoms: Whether inhaled, absorbed through the skin, or ingested, the symptoms of GA poisoning are basically the same: running nose; tightness of the chest; dimness of vision and pinpointing of the pupils; difficulty in breathing; drooling and excessive sweating; nausea; vomiting, cramps, and involuntary urination and defecation; twitching, jerking, and staggering; and headache, confusion, drowsiness, coma and convulsions followed by a cessation of breathing and death. Symptoms appear more slowly from a percutaneous route of entry, with a lethal dose causing death within two hours. Respiratory doses can cause death within one to ten minutes.
(17) Protection required: Level A - SCBA and protective clothing. **(NOTE: Awareness trained responders do not have the training necessary to safely wear this equipment).** Protective clothing will off-gas GA for approximately 30 minutes after contact with the vapor.

**Sarin (GB)** is the agent that was employed in the Tokyo subway attack, and until the United States renounced use of chemical agents in time of war, was the U. S. Standard A non-persistent nerve agent. It is a colorless liquid with a faint odor of Juicy Fruit chewing gum.
(1) Chemical name: O-Isopropyl methylphosphonofluoridate
(2) Formula: $(CH_3)(C_3H_7O)FPO$
(3) Vapor density: 4.86 (relative to air (1.0))
(4) Freezing point: -56°C
(5) Boiling point: 147°C
(6) Vapor pressure: At +25°C: 2.2 mm Hg
(7) Rate of hydrolysis: Hours to two days depending on acidity
(8) Hydrolysis products: Hydrofluoric acid under acidic conditions. Isopropyl alcohol and polymers under alkaline conditions.
(9) Action on metals: Slightly corrosive to steel
(10) Odor: None when pure; fruity
(11) $LCt_{50}$:
Respiratory: 70-100 mg-min/$m^3$
Percutaneous liquid: 1.7 gm/person
Percutaneous vapor: 15,000 mg-min/$m^3$
(12) $ICt_{50}$: Respiratory: 35-75 mg-min/$m^3$
(13) Rate of detoxification: Very slow; essentially cumulative
(14) Onset time: Very fast
(15) Persistency: Evaporates as rapidly as water. May persist for one to two days.
(16) Physiological symptoms: Whether inhaled, absorbed through the skin, or ingested, the symptoms of GB poisoning are basically the same: running nose; tightness of the chest; dimness of vision and pinpointing of the pupils; difficulty in breathing; drooling and excessive sweating; nausea; vomiting, cramps, and involuntary urination and defecation; twitching, jerking, and staggering; and headache, confusion, drowsiness,

coma and convulsions followed by a cessation of breathing and death. Symptoms appear more slowly from a percutaneous route of entry, with a lethal dose causing death within two hours. Respiratory doses can cause death within one to ten minutes.

(17) Protection required: Level A - SCBA and protective clothing. **(NOTE: Awareness trained responders do not have the training necessary to safely wear this equipment).** Protective clothing will off-gas GB for approximately 30 minutes after contact with the vapor.

**Soman (GD)** is a colorless liquid with no reported odor and may be thickened to increase persistency. Because of the interaction between GD and the acetylcholinesterase the poisoning is generally assumed to be irreversible after two minutes.

(1) Chemical name: Methylpinacolyloxyfluorophosphine oxide
(2) Formula: $(CH_3)(C_6H_{13}O)FPO$
(3) Vapor density: 6.3 (relative to air (1.0))
(4) Freezing point: -42°C
(5) Boiling point: 198°C
(6) Vapor pressure: At +25°C: 0.40 mm Hg
(7) Rate of hydrolysis: Hours to two days depending on acidity. 5 minutes in 5% solution of NaOH.
(8) Hydrolysis products: Essentially hydrofluoric acid
(9) Action on metals: Slightly corrosive to metals
(10) Odor: Camphor when pure; fruity
(11) $LCt_{50}$:
Respiratory: 70-100 mg-min/$m^3$
Percutaneous liquid: 0.35 gm/person
Percutaneous vapor = 15,000 mg-min/$m^3$
(12) $ICt_{50}$: Respiratory: similar to GB
(13) Rate of detoxification: Very slow; essentially cumulative
(14) Onset time: Very fast
(15) Persistency: Heavy concentrations of unthickened agent may persist for one to two days. Thickened agent may last for over one week.
(16) Physiological symptoms: Whether inhaled, absorbed through the skin, or ingested, the symptoms of GD poisoning are basically the same: Running nose; tightness of the chest; dimness of vision and pinpointing of the pupils; difficulty in breathing; drooling and excessive sweating; nausea; vomiting, cramps, and involuntary urination and defecation; twitching, jerking, an staggering; and headache, confusion, drowsiness, coma and convulsions followed by a cessation of breathing and death. Symptoms appear more slowly from a percutaneous route of entry, with a lethal dose causing death within two hours. Respiratory doses can cause death within one to ten minutes.
(17) Protection required: Level A - SCBA and protective clothing. **(NOTE: Awareness trained responders do not have the training necessary to safely wear this equipment).** Protective clothing will off-gas GD for approximately 30 minutes after contact with the vapor.

**VX** was the U. S. Standard A persistent nerve agent.

(1) Chemical name: O-ethyl S-(2-diisopropylamino) ethyl methylphosphonothiolate
(2) Formula: $C_{11}H_{26}NO_2PS$
(3) Vapor density: 9.2 (relative to air (1.0))

(4) Freezing point: -39°C
(5) Boiling point: 298°C
(6) Vapor pressure: At +25°C: .0007 mm Hg
(7) Rate of hydrolysis:
Alkaline solutions = minutes.
Acidic solutions = hours to days.
(8) Hydrolysis products: Toxic products in alkaline solutions
(9) Action on metals: None noted.
(10) Odor: None.
(11) $LCt_{50}$:
Respiratory: 30 mg-min/$m^3$
Percutaneous liquid: 0.01 gm/person
Percutaneous vapor: 6-360 mg-min/$m^3$
(12) $ICt_{50}$:
Respiratory: 24 mg-min/$m^3$
Percutaneous liquid: .005 gm/person (.0714 mg/kg)
(13) Rate of detoxification: Very slow; essentially cumulative
(14) Onset time: Very fast
(15) Persistency: Heavy concentrations may persist for one week.
(16) Physiological symptoms: Whether inhaled, absorbed through the skin, or ingested, the symptoms of VX poisoning are basically the same: running nose; tightness of the chest; dimness of vision and pinpointing of the pupils; difficulty in breathing; drooling and excessive sweating; nausea; vomiting, cramps, and involuntary urination and defecation; twitching, jerking, an staggering; and headache, confusion, drowsiness, coma and convulsions followed by a cessation of breathing and death. Symptoms appear more slowly from a percutaneous route of entry, with a lethal dose causing death within two hours. Respiratory doses can cause death within one to ten minutes.
(17) Protection required: Level A - SCBA and protective clothing. **(NOTE: Awareness trained responders do not have the training necessary to safely wear this equipment)**. Protective clothing will off-gas for approximately 30 minutes after contact with the agent.

**Relative Lethality in Relation to Chlorine**

This is a graphic representation of the approximate lethality of the agents we have discussed relative to chlorine in terms of respiration.

If we use Chlorine as a baseline:

a. Cyanogen chloride is twice as toxic
b. Phosgene is 6 times more toxic
c. Hydrogen cyanide is 7 times more toxic
d. Mustard is 13 times more toxic
e. Sarin is 200 times more toxic
f. VX is 600 times more toxic

For skin toxicity, 1 to 2 grams of Mustard or Sarin, or 10 milligrams of VX. Less than a pinhead of Mustard is required to achieve a small blister.

**Review Questions:**

Read the agents or characteristics in the numbered left column and match them with the lettered words or statement in the right column.

| | |
|---|---|
| 1. Evaporates quickly | A. Hydrogen cyanide |
| 2. Evaporates slowly | B. Reddish skin |
| 3. Hydrogen cyanide (AC) | C. Mustard |
| 4. Blood agent name | D. Respiratory and skin hazard |
| 5. Nerve agent name | E. No immediate pain, blisters appear in 6-12 hours |
| 6. Blister agent name | F. Non-persistent |
| 7. Happens with L and CX | G. Pinpointing of eyes |
| 8. All agents | H. Lighter than air |
| 9. Nerve and blister agents | I. Inhalation threat |
| 10. Nerve agent symptoms | J. Settles or lingers in low areas |
| 11. Symptom of blood agent | K. Persistent |
| 12. All agents heavier than air | L. Immediate pain on contact |
| 13. Symptom of mustard agent | M. Sarin |

**Key Points**

These agents were deliberately developed to cause injury or death to individuals and they are very toxic, however, they can be detected, they can be protected against, victims can be treated and they can be decontaminated.

# Domestic Preparedness; Awareness
# Biological Agents

**Module 4:** Biological Agents

**Training Objectives:**

Students will be able to:

1. Describe "universal precautions" as they apply to a biological terrorism incident.

2. Describe the hazards and indicators of a biological incident.

The time was April, 1979. The place Sverdlovsk, Russia. Sverdlovsk (now Ekaterinburg) is located about two and one-half miles from a then Soviet military facility. On this particular day, the wind was blowing such that Sverdlovsk was downwind from the military facility. It was probably just another day in the lives of the people of Sverdlovsk, or so they thought.

A few days later, some of the townsfolk started developing fevers, chills and generally not feeling well; some were complaining about chest pains. As time passes, more individuals started displaying these same symptoms and some of the earlier victims died.

What happened? Attending medical personnel diagnosed this occurrence as an outbreak of anthrax. The initial new releases coming from the Soviets said the anthrax outbreak was the result of ingesting contaminated meat purchased on the black market.

Eventually 77 cases of anthrax were reported, with 66 deaths resulting. The autopsies listed the cause of death as inhalation anthrax.

In 1992, President Boris Yeltsin admitted that the nearby military installation had been part of an offensive biological weapons program and that an epidemic had been caused by a non-intentional release of 1 to 2 kilograms of anthrax spores.

This is a classic example of what a biological agent can do.

**Characteristics**
As we look at biological agents, you will seem some similarities with what we discussed earlier with chemical agents, but you will also note some significant differences.

From a responder's point of view, the biggest difference is time. Unlike chemical agents, most of which have an immediate effect, most biological agents all have a delayed effect ranging from several hours to days, and in some cases weeks. Therefore, when you respond to a biological incident, there may be no casualties and nothing significant unless you or someone else happens to witness the actual release or some type of suspected dissemination device has been located.

As a responder, you need to understand some of the basic characteristics of these potential biological agents and how to protect yourself.

**Biological agents:**
Are not dermally active: Unlike the nerve and blister agents, biological agents cannot penetrate healthy unbroken skin. (An exception is T-2 Mycotoxin, which causes skin damage). To cause disease, most biological agents must be inhaled or ingested. Our skin provides a good barrier to most agents, in contrast to some chemical agents which can cause toxic reactions and symptoms if placed on the skin.

Are non-volatile: Biological agents will be disseminated as either liquid or solid aerosols, where the biological materials will be subjected to the environment. Many biological agents are living organisms and adverse temperature and humidity will affect them. Sunlight, in particular ultraviolet rays, will kill many of them. In this environment, most will only last a few hours or days. Because of this, use of biological agents is more likely at night or in enclosed areas.

By weight, biological agents are generally more toxic than chemical agents. For example, Ricin, one of the toxins I'll mention, is 2 to 3 times more toxic than VX and *Botulinium*, another toxin, is 5000 to 10,000 times more toxic than VX.

Are invisible to our senses. We cannot see, taste or smell them.

Range of effects: Biological agents have a variety of effects depending on the organism and how it affects us, the dose we receive and the route of entry. This range can run from skin irritation through death.

Obtained from nature: Each of the biological agents has a natural host. In some instances, with little training or equipment, a small amount of culture or material can be "grown" into larger quantities which are then placed in a dissemination device.

Relatively easy to produce: This ties to the last characteristic. The key term here is relatively. As I said, if you can obtain a culture of one of the organisms and know how to "grow" or culture it, (provide a suitable environment, provide nutrients, allow it to reproduce etc.) you can increase the quantity using basic procedures with easily obtainable equipment.

**Incubation Period:**
The time period between when a victim is subjected to the agent and when the symptoms begin to appear. The incubation period is the time when the agent is reproducing in the body and defeating its natural defense systems. It can range from a period as short as a few hours to days and in some cases weeks. Even toxins, which do not grow and reproduce, may take hours to produce symptoms.

Biological agents can be categorized by type of organism or product, i.e., bacteria, viruses, and toxins.

**Bacteria and Viruses**
Both bacteria and viruses are living organisms and as such, require an environment in which to live and reproduce.

They can enter the body through inhalation or ingestion, through a break in the skin, or through other body openings or orifices. In a deliberate use, inhalation through the lungs is usually the targeted portal of entry.

Once the organism invades the body, they begin to grow and reproduce. They can also produce toxins which may poison your body. Your body has built-in defense mechanisms, but if they are overwhelmed or not effective, then the specific symptoms associated with the particular organism or disease begins to appear. Fever, vomiting, and diarrhea are frequently early symptoms. Depending on the particular disease, the effects will continue to develop and can in many cases completely disrupt normal body functions and cause death.

Some bacteria and viruses can cause epidemics, by being transmitted from one infected individual to another. This is true of only a few of the agents such as pneumonic plague (bacteria), smallpox and viral hemorrhagic fevers (viruses).

**Toxins**

Toxins are poisonous substances produced as a by-product of pathogens or plants and even some animals. Snake venom is a good example of a toxin. They are not living organisms, but in fact chemical compounds, often proteins or protein-like materials. They can enter the body the same way pathogens can but are not contagious.

There are numerous naturally occurring toxins. How they affect us will vary. For our purposes, we will discuss the following groups:

Neurotoxins attack the nervous system. They are fairly quick acting and can act just the opposite of nerve agents by preventing nerve to muscle stimulation. Symptoms, such as mental confusion, loss of balance, vision problems, tremors or seizures are not uncommon.

Cytotoxins are cell poisons. They are slower acting and can have a variety of symptoms; vomiting, diarrhea, rashes, blisters, jaundice, bleeding or general tissue deterioration.

There are numerous other modes of action of toxins, which are beyond our need to discuss here.

**Potential Biological Agents**

The following diseases are listed because they have been investigated in the past as potential agents. Because of this, there is information available on them on the Internet and in other easily obtained literature.

**Anthrax**

Anthrax is a bacterium. It occurs naturally in cattle, sheep and other hoofed animals and is normally transmitted to man through cuts or abrasions in the arms and hands. Anthrax can form spores which make the organism more resilient. In spore form, anthrax can be transmitted to man through the respiratory route, where it is a much greater threat (mortality can reach 80-90%). The incubation period is 1-7 days and the early symptoms are, chills, fever, nausea and swelling of lymph nodes. Treatment involves the use of antibiotics and treating the specific symptoms.

The organism that produces the disease anthrax is the pathogenic bacteria, *Bacillus anthracis*. It is a rod shaped, gram positive, aerobic, sporulating microorganism with the spores constituting the usual infective form. It is found worldwide. The spores are very stable and can remain viable for years in soil and water, under certain conditions. Spores will resist sunlight for several days. Anthrax is primarily a disease of herbivorous animals such as cattle, sheep, goats, and horses, but other animals might also become infected. Humans normally catch the disease through scratches or abrasions of the skin on hands or forearms of persons who have contact with infected animals. Due to the widespread immunization of animals, outbreaks that affect humans are rare.

To produce disease the microorganism is optimally employed in its spore form. The most common infection in nature is as a result of a skin infection or lesion. The inhalation form is the most dangerous, with an 80 - 90% mortality rate. The organism gets into the body and is engulfed in macrophages, but survives due to its encapsulation. The macrophages transport the organism to the lymph nodes in the center of the chest (mediastinum). The organisms multiply, produce toxins, and invade the blood system and then other tissues. Death occurs due to the effects of anthrax toxins, invasion of other organ systems, and sepsis (generalized infection).

Early symptoms (in the first one to two days) are nonspecific: fever, chills, malaise, and possibly chest pain. Late signs and symptoms (three to five days) are cyanosis (bluish skin) respiratory distress, rapid heart rate and low blood pressure. Sometimes in cutaneous anthrax, itching of an exposed skin surface occurs first, followed by a lesion and swelling. Symptoms normally occur within 24-72 hours. An infective dosage by aerosol is roughly 8000-10,000 spores per person, but may be as low as 1,300 spores/person, with an incubation period of 1 to 7 days.

Cutaneous anthrax can be treated effectively with some antibiotics. Similar treatment with antibiotics such as ciprofloxacin, doxycycline, or penicillin for pulmonary and intestinal infections may be useful in the very early stages but is of lesser value after the disease is well established. Intensive care may be necessary for advanced infections.

**Plague**

Plague or “black death” is another bacteria normally transmitted to man from rats through the bite of infected fleas. It can also be aerosolized and be transmitted to man through the respiratory tract causing pneumonic plague. Untreated pneumonic plague has a mortality rate of 90-100%. The incubation period is 2-3 days and early symptoms are high fever, chills, headache, spitting up of blood and shortness of breath. Treatment involves using antibiotics treating specific symptoms.

Plague is caused by the organism *Yersinia pestis*, a gram negative bacillus. It is a very communicable biological warfare agent. There are three primary types of plague that affect man; bubonic, septicemia, and pneumonic.

Bubonic plague, the most common type in nature, is transmitted from rats to man by the bite of an infected flea. The disease is perpetuated by the rat-flea-rat transmission cycle. The flea bites are usually on the lower extremities.

The bacilli spread rapidly through the lymphatic system, causing enlarged lymph nodes (buboes) in the groin. The bacilli may escape the nodes, invade the bloodstream, and produce a generalized, often fatal infection (septicemia plague). The spleen, lungs, and meninges may also be affected. Pneumonic plague, which may result from the septicemia form or from inhalation of the organism, spreads rapidly until the entire lung area is involved in a hemorrhagic pneumonic process.

Untreated pneumonic plague is usually fatal. The incubation period is 2 to 6 days for bubonic plague and 3 to 4 days for pneumonic plague. Bubonic plague is not directly communicable from man to man; however, bubonic plague has a mortality rate of 25 to 50 percent, while untreated pneumonic plague kills from 90 to 100 percent of its victims. Vaccines are available, however, the current plague vaccine protects against bubonic, but not pneumonic plague. Prompt treatment is essential and is usually effective. Choice of antibiotic will vary with the type of infection, and severity of the disease.

**Q-Fever**

Q-Fever is a rickettsia, an organism which has some characteristics of bacteria and some of viruses. The organism can be found in nature in cows, sheep and goats and is transmitted to man through his inhalation of dust contaminated with animal tissue or feces or through contaminated milk from infected cows or other animals. The incubation period is 2-10 days with symptoms similar to the flu. The mortality is low (under 1%). A vaccine is currently being evaluated. Recovery occurs in most cases without treatment after 2 days to 2 weeks. Tetracycline has been proven to shorten the duration of the illness.

*Coxiella burnetii* is a rickettsia that causes Q fever, also known as Query fever and North Queensland fever.

This organism can be found in the milk of infected cows, sheep, and goats, and in dust laden air from dairy cattle barns and goat pens that harbor infected animals. In man, the disease appears to be transmitted by inhalation of dust contaminated with material (feces or tissues) from infected animals. Raw milk from cows and goats, dried milk, raw wool, hides, infected meat, goat hair, and tick feces, as well as cultures of infected tissues, have all been involved in establishing infections.

Q-Fever is influenza like disease that is moderately incapacitating and is characterized by the sudden onset of acute fever, headache, chills, weakness, and profuse perspiration. A pneumonitis occurs in many cases with cough, scanty expectoration, and chest pains. Acute pericarditis, acute hepatitis, and generalized infections have been reported. The incubation period is 2 to 3 weeks with a mortality rate of less than 1 percent of the infected individuals.

Vaccines have been effective; however, vaccines should not be used in individuals with a previous history suggestive of Q-fever unless preceded by a hyper-sensitivity skin test with a small dose of vaccine to avoid severe reactions. Tetracycline antibiotics are used to treat and are generally effective. Supportive treatment is indicated. Recovery from an attack confers immunity for at least 1 year. The disease is relatively non-contagious between humans.

**Smallpox**

Smallpox is a virus. There is an effective vaccine, however, without this protection the aerosolized virus presents a respiratory threat. The incubation period is 10-12 days after which a victim will begin to feel ill with fever, rigors, vomiting, headache and backaches. Two to three days later lesions begin to appear. The mortality rate can reach 30%. Treatment involves supportive therapy.

Smallpox is caused by the variola virus. It occurs in at least two strains one of which causes variola major and the other causes a milder disease, variola minor. Although there is a good vaccine available, this virus poses a threat because of the aerosol infectivity of the virus.

Variola may have been used by the British against native Americans during the French and Indian war, by giving them contaminated blankets from beds of smallpox victims. There was an epidemic within the Indian community in this part of the country during that time period.

The incubation period for smallpox averages 12 days. Symptoms include malaise, fever, rigors, vomiting, headache and backache. Some light-skinned victims will exhibit a rash. Following these early symptoms, the rash will become more evident after two to three days, turning to lesions. Mortality can reach 30% in unvaccinated victims.

A very effective vaccination is available. Treatment is limited. There is no effective chemotherapy and treatment of clinical cases remains supportive.

**Viral Hemorrhagic Fevers (including Ebola)**

Viral hemorrhagic fevers include Ebola, Marburg, Lassa, Rift Valley, and Dengue fever. Some are transmitted by person to person contact, some by contact with animals, and others by mosquito or other animal vectors.

Symptoms of hemorrhagic fever are elevated temperature, easy bleeding, small skin spots caused by hemorrhaging, rash, hypotension, malaise, muscle pain, headache, vomiting, and diarrhea.

Mortality from this family of viruses is up to 90% with an incubation period of 3 to 21 days.

Treatment is symptomatic. There are vaccines for some of the hemorrhagic fevers.

The Ebola virus has received a lot of attention in the press and recent movies. It is transmitted to man by direct contact. The incubation period is 3-21 days with a mortality rate as high as 90%. Symptoms include fever, vomiting, and diarrhea, followed by blotches on the skin from subcutaneous bleeding. Treatment includes using Ribavirin and treating individual symptoms.

**Venezuelan Equine Encephalitis**

VEE is another virus. It occurs in nature in mules, donkeys and horses. Transmission is normally through mosquito bites but transmission as an aerosol has been proven, so inhalation through the respiratory tract is possible. The incubation period is 1-5 days. Symptoms are influenza like and last 3-5 days. Mortality is low, under 1%, and recovery occurs without intervention. Treatment is supportive.

Venezuelan Equine Encephalomyelitis (VEE) is caused by the virus Venezuelan equine encephalitis. VEE is usually found in Central and South America, Mexico, and the dry, hot, irrigated farming areas of the western, midwestern, southwestern, and eastern United States.

Horses serve as the major source of the virus with mosquitoes acting as a vector transmitting it to man. Normally, equine outbreaks of the disease precede human outbreaks of the disease. The mosquitoes probably can transmit the virus throughout their life. Transmission of the virus by inhalation of aerosols in laboratories is common.

Person-to-person transmission may occur, but has not been demonstrated.

The incubation period is usually 2-6 days and can be as short as 1 day.

Human symptoms are influenza-like, with an abrupt onset of inflammation of the meninges of the brain, severe headache, chills, fever, dizziness, drowsiness, tremors or convulsions, nausea, vomiting, occasional paralysis, and muscular in coordination. The disease is usually acute and of short duration (3-5 days). VEE has a mortality rate of about 1 percent.

Treatment is supportive only; no specific therapy exists. Antibiotics are not effective. An investigative vaccine has been used effectively to protect factory workers and others at high risk. This vaccine also proved effective in protecting horses. The control of infection in horses will help prevent/reduce additional human cases.

**Staphylococcal Enterotoxin B (SEB)**
SEB is a toxin. It is normally ingested, causing food poisoning. The incubation period is short, 4-6 hours, with symptoms including vomiting, abdominal cramps, and explosive watery diarrhea. Recovery is spontaneous after 6-8 hours. Inhalation of aerosolized toxin is possible, and in this case the symptoms are entirely different: high fever, cough, chills and prostration which usually lasts 1-2 weeks. Treatment is supportive and an antitoxin is available.

*Staphylococcus aureous* (a bacteria), produces Staphylococcal enter toxin type B (SEB). This toxin is a rapid acting toxin whose effects last longer than those of many chemical incapacitants.

SEB causes food poisoning that results from ingestion of the toxin rather than ingestion of the bacteria. Foods contaminated with SEB have a normal appearance, odor, and taste. Situations involving mass feedings and lack of refrigeration with improper food handling are responsible for many natural outbreaks. However, inhalation of aerosolized toxin is possible. Symptoms usually occur within six hours after ingestion.

Symptoms can appear within a few minutes after exposure to large doses by aerosol. Inhaled SEB can cause vomiting and diarrhea if some toxin is also swallowed, however, the most prominent symptoms are fever, cough, chills, and prostration which will usually last 1-2 weeks, (as opposed to SEB food poisoning which lasts 8-12, or at most 24 hours). Incubation period is also about 6 hours for inhaled SEB. Recovery takes 2-3 weeks.

There is no antitoxin currently available.

**Botulinum (neurotoxin)**
Botulinum is another of the toxins. It is normally encountered by ingestion of improperly canned food. The toxin can be aerosolized and present an inhalation threat. Symptoms begin 24-72 hours after ingestion or breathing in the toxin: weakness, dizziness, dry mouth and throat, and blurred vision begin to appear. Mortality can reach 60%. Treatment includes antitoxin and supportive measures.

Botulinum toxin is produced by the bacteria *Clostridium botulinum*. The principal reservoir of these bacteria is soil. Because these bacteria cannot grow in the presence of oxygen, natural exposures to the toxin are via improperly preserved canned foods. The bacteria grow and produce toxin while the food sits on the shelf. There are seven known types of toxin (A through G).

This toxin normally enters the body (in natural cases) through the digestive system. Poisoning comes entirely from the toxin already formed in the ingested material.
Digestive tract secretions do not destroy it. The toxin could also possibly enter the body through inhalation in a BW attack. Botulinum toxin is among the most potent biological toxins known. Mortality rate is 60 percent or higher in untreated cases. Botulinum toxin acts by inhibiting acetylcholine release.

Symptoms are opposite of nerve agent intoxication. Initial symptoms may include weakness, malaise, dizziness, and nausea. Other symptoms include difficulty swallowing and speaking, blurred or double vision, sensitivity to light, and muscular weakness progressing from the head downward. Unlike nerve agents, botulinum toxin does not produce copious body secretions. In severe cases, death results from respiratory paralysis. Symptoms usually begin 24 to 72 hours after ingestion of contaminated food or inhalation of toxin. A delay in symptoms may range up to 6 to 8 days. This delay depends on the amount of toxin and its absorption from the digestive tract or from the lungs.

Medical care consists of supportive measures, including mechanical ventilation. Antitoxin is available; its administration should take place immediately upon suspecting botulism poisoning. Treatment with antitoxin after severe symptoms set in is usually ineffective. The antitoxin will not usually reverse existing paralysis.

**Ricin**
Ricin is a lethal cytotoxin that comes from the seeds of the castor bean plant, *Ricinus communis*, this makes it readily available. Ricin normally enters the body through ingestion but the toxin can be aerosolized. It can also be induced through injection. The incubation period is 24-72 hours after which symptoms appear. The untreated mortality rate is high, with death occurring after 36-72 hours. Ricin is 2-3 times more toxic than the nerve agent VX.

Treatment includes respiratory support, and other supportive measures.

Ricin normally enters the body by ingestion, but can enter by inhalation if in aerosolized form. The toxin attaches to cell surfaces of a variety of tissues, particularly the stomach lining if ingested or the moist, upper respiratory tissues if inhaled. Ricin inhibits protein synthesis. Initial symptoms usually appear anywhere between 24 and 72 hours.

The symptoms may include nausea, vomiting, bloody diarrhea, abdominal cramps, breathing difficulty, renal failure, and circulatory collapse depending on the route of exposure. Victims can linger for 10 to 12 days before death or recovery, depending upon the dose received.

Treatment includes general supportive care including fluid support of circulation and respiratory support. There is no antitoxin currently available.

**Detection of Biological Agents**

Because of the incubation period, recognizing a biological attack or incident will be more difficult and subtle than a chemical attack.

As a first responder, you are not likely to arrive on a scene and see people lying around and exhibiting symptoms. The first real indications of a bio attack will probably come from 9-1-1 operators, EMS personnel and the medical community, especially the emergency departments in local hospitals.

If for example there are a series of calls to 9-1-1 for assistance to individuals with high fever, and vomiting etc., a trained operator should realize he or she is getting a lot of calls with similar symptoms and bring this to their supervisor's attention. If suddenly all over town, individuals start showing up at prompt care facilities, emergency rooms etc. again all showing the same basic symptoms; this should alert the medical community.

Using these processes, the medical and public health community may be able to track what common links exist between all these ill people.

If you're a Tom Clancy fan, his book Executive Orders, has terrorists using a biological agent. A number of individual terrorists each release the agent at boat or RV shows. Following the shows, the attendees all go home and a few days later people with the same symptoms begin to show up all over the country.

In this kind of situation, epidemiologists track back from the victims to the source of the agent.

**Protection against Biological Agents**
If you know you're responding to a potential biological incident;

Blood-borne pathogen universal precautions will be your first line of protection when treating victims.

Use good sanitation measures, including not eating or drinking in the immediate area of the incident, touch nothing if you can avoid it, and wash your hands with soap and water if you do touch something.

An SCBA or protective mask with High Efficiency Particulate Absorbing [HEPA] filters, combined with your clothing and unbroken skin are good protection. **Protective masks must be properly fitted to the individual. The individuals must be examined by a doctor to determine that they are able to safely wear protective equipment. These procedures must be covered by written SOPs. Awareness trained individuals DO NOT have the training necessary to wear this equipment.**
Decontaminate yourself. The procedure includes wet, strip, flush, cover.

(1) Wetting down exposed skin and clothing will prevent re-aerosolizing of the organisms
(2) Remove potentially contaminated clothing

(3) Flush with water, soapy water (if available) is better, or with 0.5% hypochlorite, if available. A 0.5% hypochlorite solution can be made by adding 1 quart of household bleach to 2.5 gallons of water.

(4) Cover to prevent exposure.

Any potentially contaminated equipment which may have been in contact with the agent, will require decontamination.

If, after responding to an incident, you start showing flu-like or other symptoms, seek medical attention immediately. Following exposure these symptoms could be a critical indicator and can't be ignored.

**Decontamination**

a. Wet - wetting down will tend to cause the radioactive material to adhere to clothing and skin, rather than re-aerosolizing, thus preventing it from being ingested.

b. Strip - remove contaminated clothing.

c. Flush - remove any contamination from exposed skin and hair.

d. Cover - for protection.

**Key Points**

In this module, we have briefly examined:

Biological agents and some of their characteristics and behaviors.

How a biological incident is different from a chemical incident because of the incubation periods associated with biological organisms.

Pathogens and toxins and some procedures you can take to protect yourself from them.

How a biological incident or terrorist attack will rapidly become a medical management problem once it is recognized, but like a chemical attack, it is manageable and can be controlled.

# Domestic Preparedness; Awareness Radiological/Nuclear Materials

**Module 5:** Nuclear Materials

**Training Objectives:**

Students will be able to:

1. Demonstrate knowledge of self-protection techniques.
2. Identify the types of radiation and their associated hazards.
3. Demonstrate knowledge of terms associated with nuclear radiation.

Of the CBRNE threats, (chemical, biological, radiological, nuclear and explosives), nuclear is considered the least likely. However, the potential exists and you need to understand the terms, the types of radiation and how to protect yourself.

The potential for a terrorist to obtain an actual nuclear device and then transport it totally undetected is unlikely.

Producing a functional nuclear device is also highly improbable; therefore we are not going to go into the ramifications of a true nuclear detonation occurring here in (your City).

The possible use of radioactive material by a terrorist is more likely, so we will examine the implications of this.

To begin with, we need to understand some basic terms.

**Radiation:** In its simplest definition, radiation can be defined as either electromagnetic or particulate emissions of energy from the disintegration of the nucleus of an atom. This energy, when impacting on or passing through material, including us, can cause some form of reaction. This radiation is also referred to as ionizing radiation.

**Radioactive material:** Again, this is simply any material which is giving off some form of radiation.

**Ionizing Radiation**
When ionizing radiation is absorbed by our bodies, it can cause changes to our cells. Small amounts can be tolerated; larger amounts can be harmful.

For our purposes, this radiation can be classified as:

a. Alpha particles
b. Beta particles
c. Gamma Radiation

Again, for our purposes, we're not so concerned with the mechanism of radiation as we are with the hazard, the detection of it and protection from it.

**Alpha particles** are emitted from the nucleus of an atom and consist of 2 protons and 2 neutrons. They have a positive charge, limited range and penetrating power. When a alpha particle is emitted from an atom, the releasing atom is changed. The atomic number decreases by 2 and the atomic weight decreases by 4. This "new" atom is normally radioactive.

**Beta particles** are also emitted from the nucleus of an atom. They are similar to the electrons which orbit the nucleus and have a negative charge, and depending on their energy, may have greater range and penetrating power than alpha particles. Atoms that emit Beta particles also change, with their atomic numbers increasing by 1 and their atomic weights remaining the same. In the most basic of theories, a neutron breaks down, ejects an electron and leaves one more proton in the nucleus.

**Gamma rays**, as the name implies, are not particulate, but rather pure electromagnetic radiation, similar to X-Ray but at a higher energy level. Gamma rays have long ranges and significant penetrating power. When an atom emits gamma radiation, there is no atomic change to the nucleus.

**Neutron**, neutron radiation is high energy from the release or physical stripping way the neutron from the nucleus of the atom.

**Non-ionzing**
There are also non-ionizing types of radiation. Examples are: Fluorescent light, lasers and microwaves. In these examples the radiation can cause burns but they do not cause molecular change or ionization.

**Units of Radiation**
To quantify amounts of radiation, the term rem or millirem is used. It has a specific definition, but we're concerned with how many rather than a definition.

Rem = roentgen equivalent man
Rem = rad X RBE
Rad = radiation absorbed dose (deposition of 100 ergs of radiation energy per gram of absorbed material)
RBE = relative biological effectiveness

The threshold for any real consequences begins around 200 rem. The $LD_{50}$ is around 450 rem.

In 1975, the 15th General Conference on Weights and Measurements adopted the International System of Units (SI System).

Other terms you may see or encounter are:
a. Gray (Gy): 1 rad = 1cGy or 1 Gy = 100 rads
b. Sievert (Sv): 1 Sv = 100 rems
c. So again for our purposes, 1 Sv = 1 Gy

**Detection**
Radiation cannot be detected by our senses, but each type can be detected and identified with instrumentation.

Most HAZMAT teams are already equipped with radiation detectors. Most radiation detection instruments will measure radiation in dose rates, or how much radiation is being absorbed per unit of time, i.e., 50 mrem/hr.

Because the threat exists, checking for the presence of radiation as part of a HAZMAT response is a good idea.

**Symptoms of Radiation**
In most instances, it takes considerable time before an individual begins to show symptoms of radiation. Of course, there are always exceptions. If one would pick up a very active material, he/she could receive radioactive burns on the skin which would show up in a matter of hours.

**Health Hazards**
Risk depends upon several factors:

a. The total amount of radiation received (dose)
b. The dose rate (how fast the dose is received)
c. The specific type of radiation

The dose rate can further be defined by the duration of exposure. Radiation effects are further defined or categorized as acute, where you begin to show symptoms within 24 hours; chronic, where one receives a lesser dose of radiation resulting in less noticeable symptoms; and delayed, where symptoms such as a tumor or cancer may not show up until years later.

**Health Hazards during an Incident**
The three concerns at an incident involve whole body exposure, ingestion of radioactive material (inhalation, ingestion) or contamination by radioactive material. Incidents involving either an explosion or fire will elevate the potential for the ingestion or contamination by the spreading of the radioactive material in the form of small fragments (dust) or smoke.

**Terrorist Use of Radioactive Material**
It is not inconceivable that a terrorist could obtain radioactive material from a medical facility or other activity and place it in a facility, more to cause an incident and scare a lot of people rather than actually create casualties. This exact scenario occurred in Russia in November 1995. A 30 pound package containing explosives and Cesium, a radioactive material, was placed in a Moscow park by Chechen Separatists. In this instance, the device was located and rendered safe before it detonated. If it had detonated, it would have created a significant cleanup problem; Cesium $^{137}$ has a half-life of about 30 years.

**Protection**
a. Time
b. Distance
c. Shielding

Looking at each of these, the amount of radiation you receive will depend on the type and strength of the radiation and the amount of time you are exposed.

**Time**
You are exposed to a radioactive source and are receiving 100 mrems per hour:
If you are exposed for 15 minutes, you have received 25 mrems. Cutting down your time reduces your exposure.

**Distance**
Distance is also critical. Referring back to our forms of radiation, Alpha particles only travel a little over an inch in air. Beta particles will not travel over a few yards in air. However, gamma will travel extensive distances and this is the radiation we are the most concerned with. The farther you are from a source the better. With gamma, the intensity decreases by a factor of the square of the distance.

There is a formula for computing the distance factor: **$D = S/d^2$**

Suppose you are standing 1 meter (2 steps) from a source, and are being exposed to 100 mrem per hour. By moving back to 2 meters (4 steps), you reduce your exposure to 25 mrem per hour ($D=S/d^2$ or D= 100/4 or 25). Conversely, if you move to within ½ meter (1 step), your exposure jumps to 400 mrem per hour. ($D=S/d^2$ or D=100/.25 or 400 mrem per hour).

**Shielding**
Radiation can also be blocked or partially blocked by various materials: Alpha radiation is stopped by a sheet of paper, Beta radiation is stopped by aluminum foil or clothing, and Gamma rays are only reduced by dense materials such as lead or earth.

Alpha travels approximately 1-1.5 inches in air and cannot penetrate unbroken skin or paper.

Beta travels approximately 10 feet in air and can penetrate a few millimeters of tissue. Can be stopped by light layers of clothing, aluminum foil or an average book (approx. 1-1.5 inches thick).

Gamma travels indefinitely in air, and can penetrate the human body. Intensity is reduced by heavy, dense materials such as steel, concrete, earth or lead.

**Decontamination**

**Wet** - wetting down will tend to cause the radioactive material to adhere to clothing and skin, rather than re-aerosolizing, thus preventing it from being ingested.

**Strip** - remove contaminated clothing.

**Flush** - remove any contamination from exposed skin and hair.

**Cover** - for protection.

**Key Points**
With these definitions you can better understand the significance and potential of radiation.

To acquire a sufficient amount of material and place it in a situation where people are going to be exposed long enough to receive a dose resulting in some type of immediate measurable response is, to say the least, very unlikely.

From a responder's point of view, unless you survey a scene with one of the available detectors, it will be difficult for you to know the source is present, without some type of warning by the terrorist.

Once you are aware of the presence of radioactive material, back away, protect yourself against inhalation by using a respirator and use time, distance and shielding to work to your advantage.

# Domestic Preparedness; Awareness
# Agent Dissemination Devices

**Module 6:** Recognizing Dissemination Devices

**Training Objectives:**

Students will be able to:

1. Identify a potential CBRNE agent dissemination device.
2. Categorize a dissemination device as to type and potential impact.
3. Identify potential targets against which a terrorist might consider employing CBRNE agents.

While knowledge of the capabilities and characteristics of chemical, biological, and radiological agents is useful in the remediation effort after an incident, the ability to recognize both the potential for an event and the tools of an CBRNE terrorist may enable you to anticipate and prevent or mitigate the effects of the attack. This class will address the devices a terrorist might construct to disseminate CBRNE material.

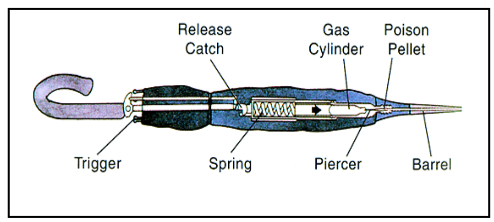
**Dissemination Devices**

Dissemination devices can be categorized based on how they disseminate the agent or material.

**Direct Deposit**

Direct deposit devices are mechanical and employed to execute an attack on a specific target with minimal collateral damage. These devices are normally constructed to inject the agent directly into the target and can be built into items as common as canes, pens, or an umbrella. These weapons pose no downwind collateral hazard. The effects of these devices are the most easily controlled.

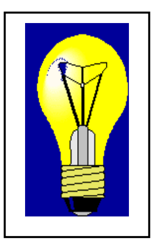
On December 12, 1994, Aum Shinrikyo members attacked Tadahiro Hamaguchi by spraying him with VX dispensed from a syringe while he was walking on the street in Osaka. He died on December 22d.




In 1979, a Bulgarian defector named Georgi Markov, who had been working for Radio Free Europe, was assassinated in London, England. Autopsy results revealed that he had been injected in the calf with a micro-ball containing the cytotoxin ricin. The investigation revealed that as he had been walking home from work, two Bulgarian nationals had approached him and one poked Georgi with an umbrella designed to inject a micro-ball containing the ricin into this leg. Three days after the incident Georgi Markov died.

**Breaking Devices**

Breaking devices are those mechanical weapons which encapsulate the agent and release it when broken. They are optimally constructed from common items such as light bulbs, balloons, or thermos bottles and by inserting the agent and sealing the device. The "loading process" is dangerous, and as risky to the terrorist as to the target. The devices are employed simply by throwing them at the intended victims. Breaking devices cause point dissemination and create some downwind hazard to unprotected individuals. The effects of these devices are moderately controllable.

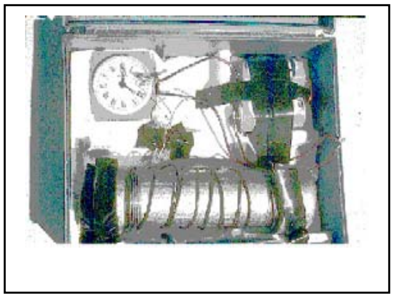


A test was conducted by the government that involved drilling a hole in the base of a light bulb, filling the bulb with BG (a harmless trace biological material), and throwing the light bulbs out the windows of the subway trains. This was determined to be an effective method of attack.

A related type of device is that which is binary in nature and requires the mixing of two relatively non-toxic substances to produce the agent. One of the attacks in Japan was composed of such a design to produce hydrogen cyanide, but the attack was thwarted by an alert restroom attendant.

**Bursting/Exploding Devices**

Bursting or exploding mechanical devices are those which employ an explosive to break the agent container and disseminate the agent. These devices are usually configured with the explosive at one end of a tube, with the explosion forcing the agent out the other end, or with the explosive surrounded by the agent. Bursting devices always have an agent reservoir, a chamber for the explosive, and usually employ either a timer or a command detonation switch. These devices pose a wider area hazard than either the surgical strike or breaking devices, and may produce a larger downwind hazard area due to the increased amount of agent involved and the explosive nature of the dissemination, if the blast and resulting heat do not consume the agent. The effects of these devices are predictable, but may deviate from the expected.



The size and configuration of this type of device is left to the imagination of the terrorist and could be a pipe bomb, or built into the frame of a bicycle.

**Spraying Devices**

Mechanical spraying devices also contain an agent reservoir, but rather than an explosive charge, they employ pressure to disseminate the agent. The pressure may be either supplied independently of, or applied directly to the agent reservoir. They can be employed either as point dissemination weapons, as with an aerosol can, or as line source generating weapons, as might be accomplished with a device incorporated into an automobile exhaust system. Of the mechanical employment devices, the effects of these weapons are the least controllable and pose the largest area hazard. One example of the extent to which a spray attack can reach is the employment of a biological agent simulant off the coast of San Francisco from 20-26 September 1950. During this time, two vessels released clouds of a “harmless bacteria” on six occasions. The result was contamination of 117 square miles of the San Francisco area.

If a line source is used, it will complicate the dissemination pattern, making use of the North American Emergency Response Guide for Downwind Hazard more difficult.

In 1966, the government carried out a mock attack on the 7th and 8th Avenue subway lines in New York City. The purpose of the attack was to determine the ease with which the city might be infected with a toxic biological organism. Posing as industrial researchers, government agents sprayed harmless bacteria into the subway lines from ventilation grates above the stations. Other government agents were deployed with sampling devices to determine the extent of the subway contamination. Within minutes, the turbulence caused by the moving trains carried the bacteria throughout the system.

One of the attacks in Japan employed a spray tank mounted underneath a truck. After the attack, the cult disassembled the truck and disposed of it piece by piece.

**Vectors**
Vectors usually disseminate only living biological agents. A vector is a carrier of the bacteria, and may be an insect or a contaminated item such as clothing, food, or water. As vectors are not weather dependent, this type dissemination is the least predictable and controllable. The vectors, if airborne, can range up to 40 miles within a day's time.

**Potential Terrorist Targets**
In order to increase the potency of an CBRNE agent, the best place for a terrorist to release it is within an enclosed space (indoors). Outside, the winds will rapidly dissipate vapors until they are too thinly concentrated to have a noticeable effect on passers by. Sunlight will also kill most biological agents within 2 hours.

Wherever the agent is released, large crowds ensure more casualties, more panic, and more media attention. High profile events assure instant media coverage, fame and recognition for the group that caused the incident. These payoffs of a successful strike at an event such as the Olympics counterbalance the difficulty of breaching the increased security.

Critical facilities and infrastructure in the government may also be the target of terrorism, such as the Federal Building in Oklahoma City or the Lincoln Tunnel in New York. The same industries that produce or use poisonous chemicals usually store large quantities nearby, making them a potential target for the attack. Security is often low and the sites are usually easily accessible from main thoroughfares. A recent example in Texas involved two men who attempted to bomb a storage tank filled with poison gas. Their motive was not terrorism, but rather a diversionary tactic for their planned holdup of an armored car. Had they been successful, the incident would have been as deadly as any terrorist CBRNE attack. At particular risk are the vehicles used to transport potential CBRNE agents; placarded trains and trucks move regularly through populated areas in most cities.

Particular buildings, such as city halls, federal office buildings (i.e., IRS, FBI offices), military installations are considered likely targets. In brief, almost any facility that is of interest to the terrorist's cause can become the target of an CBRNE attack.

**Responder Actions**
If you are able to recognize a dissemination device before it functions:

Do not touch, cover or move the device. If the device is inside a facility, do not remove it. Taking the device outside could create a greater hazard.
Isolate the area. Closing doors and windows in the immediate area of the device could contain the release.
If feasible, move upwind.

Notify the proper personnel, according to local SOP.

**After an attack:**
Stay upwind of the site, if possible.

Notify the proper personnel, according to local SOP.

**Key Points**
Dissemination devices can take many forms and are sometimes difficult to recognize

Potential targets will generally be enclosed spaces, critical facilities, or specific facilities of interest to terrorists

Responder should not touch, cover or move a suspected device and make proper notification

# Domestic Preparedness; Awareness Responder Actions

**Module 7:** Responder Actions

**Training Objectives:**

Students will be able to:

1. Identify actions appropriate to the awareness level of training and equipment in response to an incident involving CBRNE agents.

2. Describe the considerations that will affect decision making in an CBRNE incident vs. a hazmat incident.

3. Describe the methods of self-decontamination at an CBRNE incident.

In the event a terrorist employs a chemical, biological, or radiological device, local responders are going to be “on their own” for the initial and critical phase of the response. Because of this, responder actions at all levels - awareness, operations, and technician - will determine whether the terrorist is successful in his or her objective of causing panic and casualties. In the case of our attack at the mall, we need to determine the correct response of the first responders at the scene; those at the awareness level.

**SOP’s and Protocols**
Know your regulations, SOP’s and protocols:

Notifying appropriate authorities
Protecting yourself and victims
Maintaining crowd and traffic control
Reporting the presence and location of potential evidence

**C$^3$**

**Without;**
**communication**
**coordination**
**cooperation.**

**You get;**
**chaos**
**crisis**
**confusion.**

**Awareness Level Responders - Roles and Missions**
By definition, responders at the awareness level are those individuals “who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the authorities of the release.” Responders at this level (traffic police officers, transit authority employees, the first emergency vehicle on the scene etc.) should have had sufficient training or experience to:

Understand what a hazardous substance is and the risks associated with them in an incident.

Understand the potential outcomes of an emergency involving the release of hazardous materials.

Be able to recognize the release of a hazardous material.

Be able to identify the hazardous substances, if identification is possible.

Determine the need, if any, for additional resources, and make the appropriate requests to the communications center.

Understand their role in responding to the incident to include site security and control.
The role of the First Responder at the Awareness Level, described above, was drawn from 29 CFR 1910.120. **Awareness trained responders have no personal protective clothing; and must remain in the Cold Zone.**

**Awareness of how CBRNE incidents differ from Hazmat incidents**
You will recall from the introduction the difference between a routine HAZMAT incident and an CBRNE terrorist event:

Mass casualties. Expect to have lots of casualties.

Fast-reacting toxic chemical agents. All of these chemical agents are supertoxic; in some cases 1,000 times more toxic than normal industrial HAZMATs. They are also fast-acting on the body, some able to knock a person down in a matter of seconds or minutes, given a sufficient concentration.

Because of their high toxicity and fast reaction, decon must be done rapidly to reduce exposure.

You can't forget that the site of an CBRNE terrorist incident is a crime scene. At some point in time when the dust settles and the incident site is returned to normal, the perpetrators must be brought to justice.

The CBRNE terrorist incident will be a major drain on resources. Personnel, equipment, transportation, communication, medical and emergency services will quickly be maxed out in an incident involving a chemical agent release.

To minimize exposure to people downwind, vapors of the chemical agent must be controlled as soon as possible. The faster vapors can be controlled the smaller the agent cloud, the faster it will dissipate, and the less exposure potential is presented to personnel downwind.

Finally, an CBRNE terrorist will draw the attention of mass media representatives from around the world. You can expect to be front page news and the lead story on CNN. You can't usually say that about a routine HAZMAT spill.

**Incident Phases**
Response to an incident generally can be broken down into four (4) fairly distinct, yet overlapping phases; Notification, Response, Recovery and Restoration. Of the actions that occur during each phase, Awareness Level Responders will only be involved with those that are **defensive** in nature.

**The Notification Phase**
The Notification Phase begins with the recognition that an incident has occurred and continues until the first emergency vehicle arrives at the incident site and site management begins. The notification may be made by anyone. It may not come from a responder at the awareness level, but rather from some untrained individual who notices the development of a mass casualty situation. (Note: remember the security guard in the video). The challenges presented by the Notification phase include ensuring the safety of emergency responders (making sure the responders don't enter the area without proper protection) and that they approach the site from and upwind and upgrade direction; gathering information about the incident (e.g., wind direction, signs and symptoms of agent, number of victims); and that security is established around the site, where access is controlled into and out of the general

area around the incident, and you begin to restrict movement into the downwind vapor hazard zone.

**Notification Phase Actions**
During each of these phases, there are actions that Awareness Level responders should take.

The Notification Phase. Awareness Level responders observing a dissemination device or what appear to be the signs and symptoms that a device has functioned should immediately:

Ensure responders operate safely from a safe distance. Always move upwind of the attack. A safe upwind distance for a chemical attack is 300 feet; for an explosive is 1,000 feet.

Ensure all Awareness actions have been properly implemented:
(1) Protect yourself and other responders. Are any Awareness responders in jeopardy? Are any Awareness responders potentially contaminated?
(2) Have proper authorities been notified?
(3) Are walking casualties being corralled upwind and upgrade and segregated?
(4) Has the area been cordoned off to prevent people from entering or leaving the area, and are crowds being controlled?
(5) Are specific verbal instructions being given? Are personnel being warned of the danger?
(6) Has the presence of secondary devices and perpetrators in the area been considered?

Gather critical information about the incident and pass it on to those that need to know.
(1) Number of casualties
(2) Signs and symptoms
(3) Weather

Ensure safe site management activities have been instituted.
(1) Site security
(2) Crowd control

**The Response Phase**
The Response Phase begins with the initiation of site management and concludes with the evacuation of the last living casualty away from the hazard. This phase focuses on saving lives. Challenges in the Response Phase include securing the site, rescuing victims, agent identification, emergency decontamination or neutralization of large concentrations of agent, evidence preservation, and searches for secondary devices and perpetrators.
The site and downwind vapor hazard area must be secured and entry into this area restricted, but many law enforcement personnel may have no personal protective equipment of any kind. Consequently, they must be prepared to evacuate quickly if notified of a change in wind direction.

Only responders wearing proper protection should attempt rescue of ambulatory victims; otherwise responders may become victims themselves.

Agent identification. The challenge is to identify the agent category as quickly as possible using available detection and identification equipment and the signs and symptoms of chemical agent poisoning exhibited by the victims.

Emergency decontamination of people. Challenges include the speed at which the decon operation must occur in order to save lives, the number of victims involved, and the limitations imposed by the availability of proper PPE to safely do the job.

Preserve evidence while at the same time neutralizing potentially large areas of contamination. This process may destroy evidence that could be used later in apprehending and prosecuting the perpetrators.

Be alert for secondary devices.

**Response Phase Actions**

Position your equipment upwind, uphill and upstream from the incident site, if possible. Also be aware of ventilation exhaust ports from the incident site (e.g., from subways, buildings)

Isolate the area. Establish Hot, Warm and Cold zones.

Protect yourself. Wear appropriate personal protective equipment if you have to enter the contaminated area. Bunker gear with SCBA is not equivalent to either OSHA Level A or Level B protection, and may only provide minimal protection against chemical agents. This will be discussed in more detail in a later module of this course.

In no case should you, as an Awareness Level responder come in contact with the victims and risk contamination.

Always stay alert to the signs and symptoms of agent exposure on yourself and fellow responders.

Corral casualties and victims. Using an amplified, authoritative voice, direct walking victims to a holding area to await decontamination. Within the limitations of your PPE, carry out non-ambulatory victims and conduct rescue operations. Consider keeping families together. Also the elderly and small children will require special attention because they are more susceptible to the toxic effects of chemical agents.

Set up Decon stations (usually under the supervision of HAZMAT technician level personnel). Emergency Decon stations should be located uphill of the contaminated area, as well as upwind, so that any contaminated runoff will flow into the already contaminated area.

Runoff may be contaminated and spill into sanitary sewage systems, rivers, streams and contaminate ground drinking water.

Expect modesty to be a serious issue. As time and resources permit, use tents and screens to provide separate decontamination sites for men and women.

You can expect some resistance on the part of suspected victims to stripping and being doused with lots of water. Victims not sensing the symptoms of CBRNE poisoning - radiological contamination and delayed acting chemical and biological agents - will initially want to believe that they are in no danger. There will also be resistance to giving up personal articles for decontamination such as wrist watches and wedding rings. It is important that all potential victims be controlled until decontamination can be completed and that a voucher system for personal articles be established.

If the appropriate PPE is available, execute emergency decontamination of victims that have evacuated the immediate area of the incident. You may also assist in the operation of a decontamination corridor to support decontamination of ambulatory victims, if you have the proper PPE. Do NOT decontaminate equipment. Leave the equipment in the Hot zone for later disposition.

Assist in providing first aid to victims after they have been decontaminated. You may also assist in setting up a triage site for the triage, treatment and follow-on transport of victims away from the hazardous area.

Initiate defensive contamination control operations in order to limit the spread of contamination. This includes assisting in diking water runoff.

Be alert to the presence of secondary devices and perpetrators in the area. The perpetrators may be the first victims.

Preserve evidence as much as possible, realizing that when you neutralize the source of the hazard, you may be destroying evidence that could be used later in apprehending and prosecuting the perpetrators. However, if the hazard is not neutralized quickly, the downwind hazard are may continue to grow.

**The Recovery Phase**

The Recovery Phase begins when the incident has been stabilized and the last of the living victims has been delivered to a medical facility to receive definitive medical treatment. It concludes with the end of the survey of the area for agent contamination. During this time the focus is on re-establishing essential services that may have been interrupted by the attack. It is during this phase that state and federal responders may arrive to provide assistance. Other challenges will include the decontamination of essential equipment and establishment of an Equipment Decontamination Station. Evidence is collected for use in apprehending and prosecuting the perpetrators.

**The Restoration Phase**

The last phase, the Restoration Phase, begins upon completion of the survey for contamination and continues until all contamination has been eliminated. Challenges include the restoration of the site to its original state with emphasis on site safety.

**Recovery and Restoration Phase Actions**

The Recovery and Restoration Phases. Properly protected Awareness Level responders:

Within the limitations of available personal protective equipment, continue to support a decontamination corridor in support of HAZMAT personnel. Within the limitations of available personal protective equipment, operate the equipment decontamination site to support decontamination of the equipment necessary for the re-establishment of essential services.

Ensure runoff resulting from decontamination operations is controlled and contained/ confined as best as possible.

Continue to provide first aid to victims as they are evacuated and decontaminated.

Follow-up with medical assessments after the incident to ensure you don't exhibit symptoms of agent exposure. If so, get immediate treatment.

Provide assistance to continue restricting movement within the incident site, enforcing the staging areas, provide other assistance as required.

**Considerations**
There are many considerations that you must take into account as you respond to a CBRNE attack.

**The Four Don'ts**:

**Don't become a victim yourself**. There will be too many victims already if CBRNE is employed by a terrorist. Additional victims resulting from overly aggressive responders only further complicate a difficult situation. Additionally, the original victims may be forgotten.

**Don't rush in.** Always assess the situation before doing anything. Avoid liquid contamination. People and equipment that do not get contaminated, do not have to be decontaminated. This minimizes risk, saves time, and saves resources.
(1) Always minimize exposure. This is accomplished by separation and relocating upwind.
(2) Establish an outer perimeter (Cold Line) early. Control crowds and do not let them pass beyond the cold line.

**Don't T E S T.** Taste, eat, smell, and touch nothing. Any one of these actions may make a responder a casualty.

**Don't assume anything.** Given that this is a terrorist event, booby traps, secondary devices, and perpetrators may also be present.

**Be S A F E**

a. **S**afety comes first.
b. **A**ssess the situation before doing anything.
c. **F**ocus your efforts on the hazard - and avoiding it.
d. **E**valuate the situation and report to proper authorities.

**Emergency Self Decontamination**
To perform emergency self decontamination:

a. **Wet or Blot**

(1) For nuclear and biological contamination, wetting down exposed surfaces will help in preventing the contamination from re-suspending in the air.

(2) For chemical contamination, carefully blot the agent off of exposed skin immediately.

b. **Strip** off all the clothing.
c. **Flush** the affected area with large amounts of water.
d. **Cover** the affected area.

**Secure the Scene**

The scene must be secured to:

**Provide for the security of the response team**. This involves preventing contamination by victims within the Hot Zone, and continually reminding responders of the “four don’ts” while in the hazard area.

**Protect the populace**. This involves containing individuals in the Hot Zone from leaving the area prior to medical evaluation and decontamination, as required, and keeping people outside the Hot Zone from entering.

**Prevent destruction of evidence**. This frequently involves making a determination between the safety of the public and the responders, and maintaining the integrity of the evidence. For example, in our video, the leaking bag on top of the trash container is evidence. Leaving the bag in place, while preserving the integrity of the crime scene also allows the remaining agent to continue to disseminate. The question you must ask is “is there something that can be done to preserve evidence and reduce the hazard at the same time?”

**Considerations**

Considerations. There are two universal considerations for crime scenes, known as the “Golden Rule” and the “Second Rule”.

**Golden Rule:**

**Leave it alone, unless it is absolutely necessary for the performance of your duties and it is done in concurrence with law enforcement.**

(1) Making initial mental notes on what the crime scene looks like (i.e., location of items, their description, etc.) will facilitate documentation of the incident at the earliest possible moment.

(2) These notes can then later be used as evidence, especially in a situation where the crime scene was disrupted (for safety considerations, etc.).

**Second Rule:**

**Do your job using the fewest number of personnel, with due consideration for safety.**

**Evidence Collection**

Your observations of what you see and where and when you see it could prove valuable during the prosecution of a case, as mentioned earlier. Initially, everything is at a site is potential evidence so you should communicate your observations to other responders and to Incident Command.

Record your observations and actions as soon as possible; documented notes are more reliable than “mental notes”.

Victims can provide critical evidence. If victims are able to tell you what they saw, heard, or smelled, this too can prove valuable and provide a form of evidence.

**Principles of Triage**

Until higher authorities arrive, Awareness Level responders will be responsible for the execution of triage. With that thought in mind:

Don't become contaminated; if you become contaminated you will probably become a victim yourself.

Use the resources available to provide treatment for those with the best chance of survival first. This can be a very hard decision, and can go counter to your basic training of saving lives. In these situations, you may be forced to make judgment calls and provide treatment to those casualties with the best prognosis of survival.

**9-1-1 Operators/Dispatchers**

9-1-1 operators and dispatchers must be able to:

a. Recognize telephonic descriptions as CBRNE attacks.
b. Must know what to ask. Asking the right questions can be the key to determining that a CBRNE agent has been employed.
c. Recognize unusual trends. Many attacks may have delayed impacts. Many times the trends that indicate an attack has taken place are not recognized until much later.
d. Alert responders and provide them the requisite safety guidance.
e. Know who to contact.

**Table Top Exercise**

Exercise/Review Questions - Given the situation from the "Attack at Harford Mall:"

(1) Responders at what level are responsible for notifying proper authorities?

(2) What information should be provided to the communications center?

(3) What are the types of emergency response units will be required in the event of an attack employing CBRNE?

(4) What are the key awareness level responder actions?

(5) Should Awareness Level responders attempt to rescue non-ambulatory victims?

(6) What are the challenges to the Awareness Level responder?

**Key Points**

You have learned Awareness Level responder actions, should a chemical, biological, or radiological attack occur. Remember, all Awareness Level responder actions are conducted in the Cold Zone. Awareness Level Responder Actions can be summarized with the acronym

**RAIN:**

a. **R**ecognize - using your experience and the knowledge you have gained during this course, make an assessment of what you see (i.e., the overall scene, number of casualties, symptoms of casualties, liquids, smells, etc.).

b. **A**void - avoid direct contact with victims, touch nothing that you can avoid, and avoid becoming a casualty.

c. **I**solate - isolate the area as best you can utilizing available resources.

d. **N**otify - notify the proper authorities, describing the scene, number of casualties, and symptoms, and requesting assistance as appropriate.

## GLOSSARY

Acetylcholine  a chemical neurotransmitter produced by nerve cells predominantly outside the central nervous system.  It is a chemical “messenger”; stimulating the heart, skeletal muscles, and numerous secretory glands.

Acetylcholinesterase  an enzyme that normally hydrolyzes acetylcholine, thereby stopping its activity.  This enzyme is inhibited by nerve agents.

Aerobe  a microorganism which can live and grow in the presence of oxygen.

Aerosol  a liquid or solid, composed of finely divided particles, suspended in a gaseous medium.  Aerosols are not necessarily visible.

Anaerobe  a microorganism that can live without air or oxygen.  In some cases, oxygen is toxic to these organisms.

Arsenical  a chemical compound containing arsenic.

Atropine  an alkaloid obtained from *Atropa belladonna*.  It is used as an antidote for nerve agent poisoning. It inhibits the action of acetylcholine at the muscle junction by binding to acetylcholine receptors.

Autonomic Nervous System  that part of the nervous system that governs involuntary functions, such as heart rate, reflexes, and breathing.  It consists of the sympathetic and parasympathetic nervous system.

Bacteria  a one-celled microorganism which has no chlorophyll and reproduces by dividing in one, two, or three directions of space.

Binary Chemical Agent  a highly toxic agent produced when two or more chemical substances, which individually have relatively little toxicity, react due to being mixed or combined.

Biological Agent  a microorganism, or toxin from a living creature, that causes either disease in man, plants, or animals or deterioration of materiel.

Blister Agent  is an agent which causes inflammation, blisters and general destruction of bodily tissue. In addition, the vapor also attacks the respiratory tract with the most sever impacts on the upper tract.  Eyes are very susceptible to this class of agents.

Blood Agent  is an agent which affect bodily functions through action on the oxygen-carrying properties of the blood and interfere with normal transfer of oxygen to bodily tissue.

Carrier  is an individual who harbors specific disease organisms, without showing clinical symptoms, and serves as a means of conveying infection.

Central Nervous system  consists of the brain and spinal cord.

Chemical Agent  a solid, liquid, or gas which, through its chemical properties, produces lethal or damaging effects on man, animals, plants or material, or produces screening or signaling smoke.

Chemical Agent Symbol  is the U.S. code designation of any chemical agent.  This is a combination of one to three letters or letter-number combinations.  It not the same as, and should not be confused with, the chemical formula.

Choking Agent  is an agent which causes irritation and inflammation of bronchial tubes and lungs.  Their primary physiological action is limited to the respiratory tract with injury extending to the deepest part of the lungs.

Contagious Disease an infectious disease capable of being directly transmitted from one individual to another. Many infectious diseases are not contagious but require some special method of transmission or inoculation.

Cumulative Effect the building up, within the body, of small ineffective doses of certain chemical agents to a point where eventual effect is similar to a large dose.

Cutaneous pertaining to the skin.

Cyanosis blueness of the skin due to insufficient oxygen in the blood.

Cytotoxin toxin that directly damages and kills the cell with which it makes contact.

Disease is the deviation from the normal state or function of a cell, an organ, or an individual.

Endemic native to, or prevalent in, a particular district or region. An endemic disease has a low incidence but is constantly present in a given community.

Endotoxin a toxin produced in an organism and liberated only when the organism disintegrates.

Enterotoxin a toxin of bacterial origin that affect the intestines, causing diarrhea.

Enzyme organic substance capable of causing chemical changes to take place quickly at body temperature by catabolic action. A biological catalyst.

Epidemic an outbreak of a contagious, infectious disease. The disease can be transmitted from an infected individual to a non-infected individual by direct contact, droplet inhalation, or vector.

Epiphytotic an outbreak of disease among plants. It is analogous to an epidemic in man.

Epizootic an outbreak of disease among animals. It is analogous to an epidemic in man.

Exotoxin a toxin excreted by a microorganism into the surrounding medium.

Fungus any one of a group of thallophytic plants, including molds, mildews, rusts, smuts, and mushrooms. These plants do not contain chlorophyll, and reproduce mainly by sporulation.

Germs are disease-producing microorganisms, microbes, or pathogenic bacterium. The term includes bacteria rickettsiae, viruses, and fungi.

Hydrolysis is the interaction of a chemical agent with water to yield a less toxic product or products.

IDLH Immediately Dangerous to Life or Health; is the maximum concentration from which one could escape - without any respiratory protection - within 30 minutes without experiencing any escape-impairing (e.g. severe eye irritation) or irreversible health effects.

Incapacitating Agent is an agent that produces temporary physiological or mental effects, or both, which will render individuals incapable of concerted effort.

Incendiary Agent is a compound that generates sufficient heat to cause destructive thermal degradation or destructive combustion.

Incubation Period is the time interval between the introduction into the body of an infectious agent and the appearance of the first symptoms of disease.

Latent Period a period of seeming inactivity. An example would be the 10 - 20 year period between exposure to a cancer causing agent and the development of cancer.

Malaise  a feeling of bodily discomfort.

Melting Point  is the temperature at which a solid changes to a liquid.  The melting point is the same as the freezing point.

Miosis  excessive contraction of the pupil.

Mortality Rate  the ratio of the number of deaths from a given disease to the total number of cases of that disease.

Necrosis  death of a cell or group of cells.

Neurotoxin  a poison affecting nerve tissue.

Nerve Agent  is an agent which affects bodily functions by reacting in an irreversible reaction involving tissue fluids, permitting accumulation of acetylcholine and continual stimulation of the parasympathetic nervous system, as well as affecting other parts of the autonomic nervous system.

Parasympathetic Nervous System  the part of the autonomic nervous system that decreases pupil size, heart rate, and blood pressure, and increases functions, such as secretion of saliva, tears, and perspiration.

Pathogen  a disease-producing microorganism.

PEL  Permissible Exposure Limit; is a time weighted average concentration that must not be exceeded during any 8-hour work shift of a 40-hour work week.  PELs are established by the Occupational, Safety and Health Administration (OSHA) and are designed to protect workers exposed to industrial chemicals on a daily basis as part of their professions.

Percutaneous  effected or performed through the skin.

Persistency  is an expression off the duration of effectiveness of a chemical agent.  This is dependent on the physical and chemical properties of the agent, weather, methods of dissemination, and conditions of the terrain.  Non-persistent agents, in general, lose their effectiveness as a military weapon approximately 10 - 15 minutes after deployment.

Phytotoxin  a toxin derived from a plant. An example is ricin from the castor bean.

Pulmonary  pertaining to the lungs.

Residual Contamination  that amount of hazardous material that remains after decontamination.

Rickettsia  gram-negative, nonmotile, intracellular, parasitic microorganism which is intermediate in size between bacteria and viruses.

Riot Control Agent  is an agent that produces only a temporary irritating or incapacitating effect.  This class of agents includes both tear and vomiting agents.

Spores  resistant, dormant cells of some bacteria; primitive reproductive bodies of fungi.

Sympathetic Nervous System  a network of nerves that trigger certain involuntary and automatic bodily functions, such as constricting blood vessels, widening the pupils, and speeding up the heartbeat.

Symptoms  the functional evidence of disease; a change in condition indicative of some mental or bodily state.

Synapse  site at which neurons make functional contacts with other neurons or cells.

Synergistic  working together, having combined cooperative action that increases the effectiveness of one or more of the components' properties.

Systemic relating to the entire organism instead of a part.

Tear Agent is an agent that causes a copious flow of tears and intense (although temporary) eye pain. In high concentrations, they are irritating to the skin and cause a temporary burning and itching sensation. High concentration can cause burns.

Toxin any poisonous substance of microorganic, vegetable, or animal origin.

Toxicity is the classification of toxic agents. There are various systems for identifying relative toxicity of poisons.

$LC_{50}$ / $LD_{50}$ The $LC_{50}$ is the concentration of a vapor or aerosol which would prove lethal to 50% of the individuals exposed. The $LD_{50}$ is the amount of liquid or solid which would prove lethal to 50% of the individuals exposed. The $LD_{50}$ is used to identify the hazard posed by injection, ingestion or contact with liquids or solids, whereas the $LC_{50}$ is used to identify the hazard posed by inhalation or contact with vapor.

Poisoning Potential:

6 (supertoxic) 5 mg/kg body weight
5 (extremely toxic) 5 - 50 mg/kg body weight
4 (very toxic) 50 - 500 mg/kg body weight
3 (moderately toxic) 500 - 5,000 mg/kg body weight
2 (slightly toxic) 5,000 - 15,000 mg/kg body weight
1 (almost non-toxic) 15,000 mg/kg body weight

TWA Time-Weighted Average; is the average concentration of a chemical that a normal worker can be exposed to during a normal 8-hour work day and a 40-hour week without showing any toxic effects. TWAs are calculated by averaging each exposure, taking into account the concentration of exposure as weighted by the duration of the exposure.

Ultraviolet Light is light waves shorter (and therefore with higher energy) than the visible blue-violet waves, but longer (and therefore with less energy) than X-rays. Ultraviolet light is very effective in killing microorganisms.

Vapor Density is the ratio of the density of any vapor to the density of air (assigned a value of 1). If the vapor density of the vapor is greater than 1, it will tend to settle to the lowest point and hug the earth. If the vapor density of the vapor is less than 1, the vapor will tend to disperse.

Vapor Pressure is the pressure exerted by vapor against the atmosphere and is dependent on temperature. The greater the vapor pressure, the faster a material will evaporate.

Vector a carrier; especially the animal or intermediate host that carries a pathogen from one host to another. Examples of carriers are mosquitoes, fleas, ticks, and lice.

Vegetative Cells are nonspore-forming bacteria or spore-forming bacteria in their nonsporing state.

Venom poisonous mixture of toxins and other natural chemical produced by animals. Examples include snakes, spiders, and scorpions.

Virulence is the degree of pathogenicity of a microorganism as indicated by its ability to invade the tissue of a host. It is the capacity of a microorganism to produce disease.

Virus is an infectious agent, smaller than bacteria and rickettsiae, capable of living and replicating only within a living susceptible host cell. Viruses cannot survive or be grown on artificial media.

Volatility is the tendency of a chemical to vaporize or give off fumes. It is expressed as the weight of vapor present in a given volume of air. The volatility depends on vapor pressure and temperature.

Vomiting Agent is an agent that causes vomiting and may produce coughing, sneezing, nasal discharge, tears, and pain in the nose and throat. Headache often follow exposure to this class of agent.

Zoonosis a disease of animals that may be transmitted to man.

Zootoxin a toxin or poison of animal origin such as the venom of snakes, spiders and scorpions.

# APPENDIX

## COMMON CHEMICAL WARFARE AGENTS

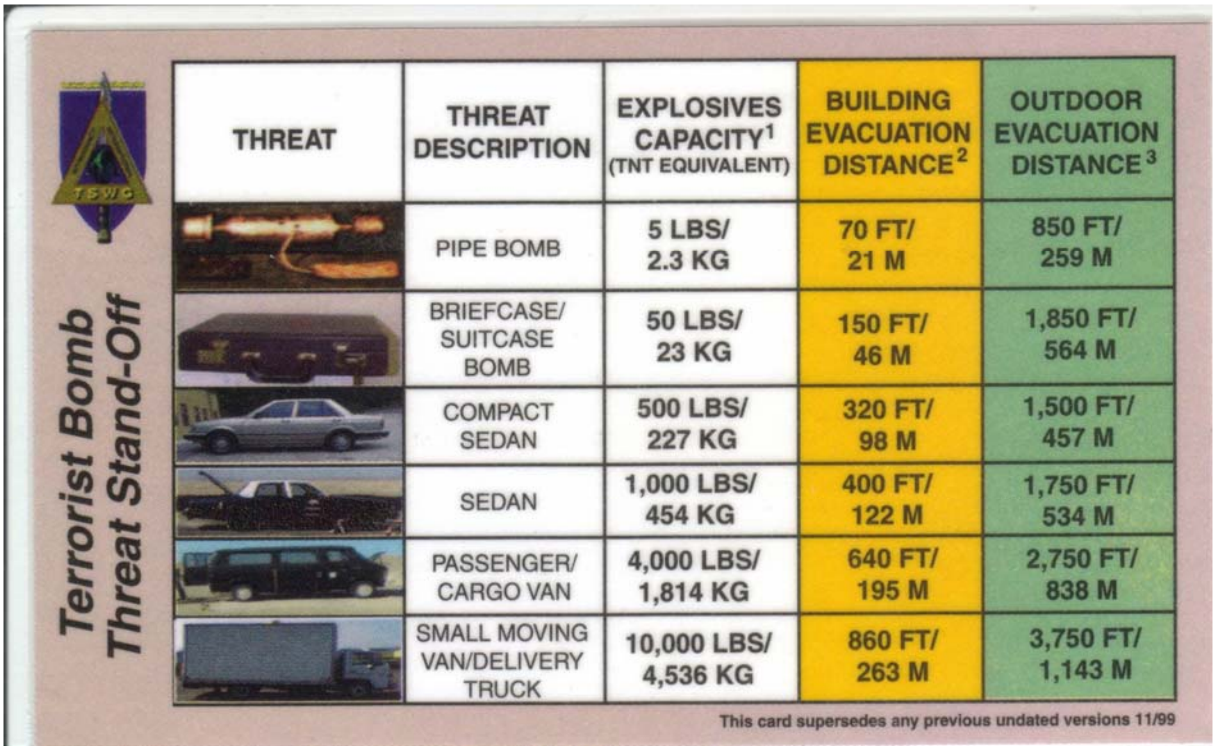
## BOMB EXPLOSIVE STAND-OFF DISTANCE CHART

# NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK ID AND GUIDE NUMBERS, & NFPA HAZARD CLASSIFICATIONS OF COMMON CHEMICAL WARFARE AGENTS

| Substance: | DOT ID # | DOT Guide # | Health: Hazard:: | Flam-mability | Reac-tivity: |
|---|---|---|---|---|---|
| Chlorine | 1017 | 124 | 3 | 0 | 0 |
| Phosgene (CG) | 1076 | 125 | 4 | 0 | 0 |
| Chloropicrin | 1580 | 154 | 4 | 0 | 3 |
| Cyanogen chloride (CK) | 1589 | 125 | 4 | 4 | 2 |
| Hydrocyanic acid (AC) | 1051 | 117 | 4 | 4 | 2 |
| Lewisite (L) | 2810 | 153 | 4 | 1 | 1 |
| Mustard gas (H, HD) | 2810 | 153 | 4 | 1 | 1 |
| Sarin (GB) | 2810 | 153 | 4 | 1 | 1 |
| Soman (GD) | 2810 | 153 | 4 | 1 | 1 |
| Tabun (GA) | 2810 | 153 | 4 | 2 | 1 |
| VX | 2810 | 153 | 4 | 1 | 1 |

**Unclassified**

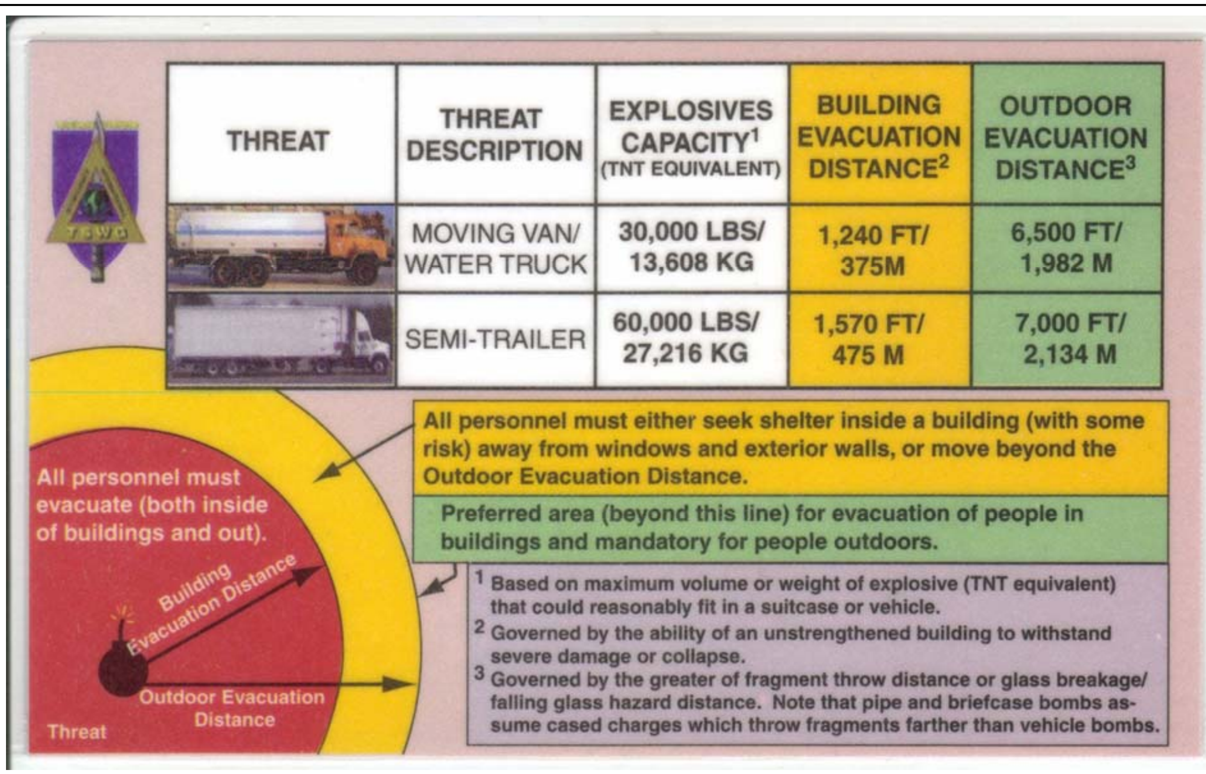
**Improvised Explosive Devices (IED) Safe Stand-off Distance Sheet,**



Terrorist Bomb Threat Stand-Off

| THREAT | THREAT DESCRIPTION | EXPLOSIVES CAPACITY[1] (TNT EQUIVALENT) | BUILDING EVACUATION DISTANCE[2] | OUTDOOR EVACUATION DISTANCE[3] |
|---|---|---|---|---|
| | PIPE BOMB | 5 LBS/ 2.3 KG | 70 FT/ 21 M | 850 FT/ 259 M |
| | BRIEFCASE/ SUITCASE BOMB | 50 LBS/ 23 KG | 150 FT/ 46 M | 1,850 FT/ 564 M |
| | COMPACT SEDAN | 500 LBS/ 227 KG | 320 FT/ 98 M | 1,500 FT/ 457 M |
| | SEDAN | 1,000 LBS/ 454 KG | 400 FT/ 122 M | 1,750 FT/ 534 M |
| | PASSENGER/ CARGO VAN | 4,000 LBS/ 1,814 KG | 640 FT/ 195 M | 2,750 FT/ 838 M |
| | SMALL MOVING VAN/DELIVERY TRUCK | 10,000 LBS/ 4,536 KG | 860 FT/ 263 M | 3,750 FT/ 1,143 M |

This card supersedes any previous undated versions 11/99



| THREAT | THREAT DESCRIPTION | EXPLOSIVES CAPACITY[1] (TNT EQUIVALENT) | BUILDING EVACUATION DISTANCE[2] | OUTDOOR EVACUATION DISTANCE[3] |
|---|---|---|---|---|
| | MOVING VAN/ WATER TRUCK | 30,000 LBS/ 13,608 KG | 1,240 FT/ 375M | 6,500 FT/ 1,982 M |
| | SEMI-TRAILER | 60,000 LBS/ 27,216 KG | 1,570 FT/ 475 M | 7,000 FT/ 2,134 M |



All personnel must either seek shelter inside a building (with some risk) away from windows and exterior walls, or move beyond the Outdoor Evacuation Distance.

Preferred area (beyond this line) for evacuation of people in buildings and mandatory for people outdoors.

1 Based on maximum volume or weight of explosive (TNT equivalent) that could reasonably fit in a suitcase or vehicle.
2 Governed by the ability of an unstrengthened building to withstand severe damage or collapse.
3 Governed by the greater of fragment throw distance or glass breakage/ falling glass hazard distance. Note that pipe and briefcase bombs assume cased charges which throw fragments farther than vehicle bombs.

## COMMON CHEMICAL WARFARE AGENT REFERENCE CHART

| Agent type | Agent Name | Military Symbol | NFPA 704 | CAS# | UN# | DOT Hazard Class | ERG GUIDE # | Hazard |
|---|---|---|---|---|---|---|---|---|
| Blood | Arsine | SA | 442 | 7784-422-1 | 2188 | 2.3 | 119 | Respiratory |
| | Cyanogen Chloride | CK | 302 | 506-77-4 | 1589 | 2.3 | 125 | Respiratory |
| | Hydrogen Cyanide | AC | 442 | 74-99-8 | 1051 | 6.1 | 117 | Respiratory |
| Blister (Vesicant) | Lewisite | L | 411 | 541-25-3 | 2810 | 6.1 | 153 | Respiratory |
| | Mustard Gas | H, HD | 411 | 505-60-2 | 2810 | 6.1 | 153 | Respiratory, Skin, Eyes |
| Choking | Chlorine | C2 | 300 | 782-50-5 | 1017 | 2.3 | 124 | Respiratory |
| | Phosgene | CG | 301 | 75-44-5 | 1076 | 2.3 | 125 | Respiratory |
| Nerve | Sarin | GB | 411 | 107-44-8 | 2810 | 6.1 | 153 | Respiratory, Skin, Eyes |
| | Soman | GD | 411 | 96-64-0 | 2810 | 6.1 | 153 | Respiratory, Skin, Eyes |
| | Tabun | GA | 421 | 77-81-6 | 2810 | 6.1 | 153 | Respiratory, Skin, Eyes |
| | V-Agent | VX | 411 | 50782-69-9 | 2810 | 6.1 | 153 | Respiratory, |

## EXPLOSIVES PROTECTION REFERENCE CHART FOR VEHICLES

| Explosive Amount (pounds) | Fatal Blast Area (ft) | Minimum Evacuation Distance (ft) | Falling Glass Hazard (ft) | Type of Vehicle |
|---|---|---|---|---|
| Up to 500 | 100 | 1,500 | 1,250 | Compact |
| 500 – 1,000 | 125 | 1,750 | 1,750 | Full Size |
| 1,000 – 4,000 | 200 | 2,750 | 2,750 | Van |
| 4,000 – 10,000 | 300 | 3,750 | 3,750 | Small Box Truck |
| 10,000 – 30,000 | 450 | 6,500 | 6,500 | Box, Water or Fuel Truck |
| 30.000 – 60.000 | 600 | 7.000 | 7.000 | Semi-trailer Truck |

## EXPLOSIVES PROTECTION REFERENCE CHART FOR SMALL PACKAGES

| Type | Amount (lb.) | Building Evac. Dist. | Outside Evac. Dist. |
|---|---|---|---|
| Pipe | up to 5 | 70 feet | 850 feet |
| Brief Case/Suit Case | up to 50 | 150 feet | 1,850 feet |

## CONSIDERATIONS FOR SELF-PROTECTION - *TDS*

***Time Exposed*** – LIMIT IT
***Distance*** - MAXIMIZE IT - the distance between you and the hazard
***Shielding*** – USE IT - protective clothing and respiratory protection