First receivers training module: response awareness to terrorism

Brian Michael Spears
Medical University of Ohio

Follow this and additional works at: http://utdr.utoledo.edu/graduate-projects
FINAL APPROVAL OF SCHOLARLY PROJECT
Master of Science in Occupational Health

First Receivers Training Module: Response Awareness to Terrorism

Submitted by
Brian M. Spears

In partial fulfillment of the requirements for the degree of Master of Science in Occupational Health

Date of Presentation:
April 28, 2006

Academic Advisory Committee

Major Advisor
Sheryl Milz, Ph.D., C.I.H.

Dean, College of Health Sciences
Christopher E. Bork, Ph.D., P.T.

Dean, College of Graduate Studies
Keith K. Schlender, Ph.D.
First Receivers Training Module: Response
Awareness to Terrorism

Brian Michael Spears
Medical University of Ohio
2006
# TABLE OF CONTENTS

**MODULE I**  
Introduction – Purpose and Scope  

**MODULE II**  
Definitions and Training Requirements of “First Receivers”  

**MODULE III**  
Regulatory and Guidance Agency Overview  

**MODULE IV**  
Introduction to Terrorism  

**MODULE V**  
General Overview of Terrorism Agents  

**MODULE VI**  
General Overview of Personal Protective Equipment  

**MODULE VII**  
All Hazards Approach to Decontamination  

**MODULE VIII**  
Hospital Emergency Management and Preparedness  

**MODULE IX**  
References and Resources
I. Purpose and Scope

This training module is written for healthcare workers who risk occupational exposures to chemical, biological, or radiological agents when the hospital receives contaminated patients. These healthcare workers are collectively classified as First Receivers. These First Receivers include the following classification of individuals:

- Medical Professionals – Physicians, Physicians’ Assistant, Nurses, Nurse Practitioners, and Medical Support Personnel. Their roles involve the handling and treatment of patients who have been exposed to chemical, biological, or radiological agents (includes contaminated and decontaminated patients).
- All healthcare employees with designated roles and responsibilities in the Hospital Decontamination Zone. This group of individuals includes, but is not limited to: Decontamination Staff who are designated to complete decontamination of patients and individuals who develop the decontamination procedures and selection of personal protective equipment.
- Emergency Department Medical Professionals, Clerks, Triage Staff, and other healthcare employees associated with emergency departments, who might encounter self-referred contaminated patients (and their belongings, equipment, or waste) without receiving prior notification that such patients have been exposed and contaminated to chemical, biological, or radiological agents.
- Healthcare employees who work in the contaminants-free Hospital Post Decontamination Zone; includes Security Staff, Housekeeping Staff, Set-up Personnel.
- Other individuals (skilled support personnel) whose role in the Hospital Decontamination Zone was not previously anticipated (e.g., medical specialist).

The purpose of this training module is to provide these First Receivers with the information they need to take appropriate initial actions when dealing with releases of chemicals, biological, and radiological agents that produce victims who may need decontamination prior to the administration of medical care. Its scope does not include situations where the hospital is the site of the agent release.

Related regulations/standards/guidelines are referenced in this module as applicable, but this module primarily addresses the training requirements of the following Occupational Safety and Health Administration (OSHA), National Fire Protection Association (NFPA), Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and Office for Domestic Preparedness (ODP) documents:

- OSHA Best Practices for Hospital Based First Receivers of Victims from Mass Casualty Incidents Involving the Release of Hazardous Substances (January 2005)
- OSHA regulations in Title 29 Code of Federal Regulations (CFR) 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER), paragraph (q), for first responders at the Awareness and Operational Levels

This training module is designed to meet the requirements for OSHA, NFPA, and ODP first responder Awareness and Operations Level as it pertains to hospital based First Receivers. It addresses the First Receivers’ training responsibilities for all levels: Operations, Awareness, and Incident Training (“Just-in-Time”).
II. Definitions and Training Requirements of “First Receivers”

“First Receivers” is the term used by OSHA to represent those individuals that typically work in hospital emergency departments receiving patients contaminated with chemical, biological, or radiological materials. An assumption is made that the hospital is not the site of release of the agents.

A. Definitions of First Receivers and First Responders

1. “First Receivers” are Healthcare professionals at the hospital receiving contaminated victims from an incident involving weaponized chemical, biological, and/or radiological agents for treatment (e.g., triage, decontamination, medical treatment, security) and those whose roles provide support functions (e.g., set up and patient tracking). First Receivers are a subset of First Responders. Typically, First Receivers include the following personnel: Physicians, Nurses, Nurse Practitioners, Physicians’ Assistants, and others.

2. “First Responder” is defined at two distinct levels; Operation Level and Awareness Level.

   a) “First Responder at Awareness Level

   Individuals who are likely to witness or discover a hazardous substance (including terrorist agents) release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They take no further action beyond notifying the authorities of the release.

   b) “First Responder at Operational Level

   Individuals who respond to releases or potential releases of hazardous substances (including terrorist agents) as part of the initial response to the site for the purpose of protecting nearby individuals, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, prevent it from spreading, and prevent additional exposures. Typically, First Responders include the following personnel: Local police, fire, and emergency medical personnel who arrive first on the scene of an incident.
3. “First Receivers” versus “First Responders”

“First Responders” are individuals that respond to the site or at the point of release. These individuals are usually composed of fire fighters, law enforcement, hazardous material (HAZMAT) teams, and emergency medical technicians.

“First Receivers” are not HAZMAT responders, and are removed from the site of the emergency and the point of release. Exposures when compared to “First Responders” are limited to the amount of material associated with patients and their clothing or accessories. The risks are reasonably less than that of “First Responders”. These individuals are typically healthcare workers (i.e. physicians, nurses) and administration staff.

B. Training Requirements

The training indicated for first receivers is dependent on the individuals’ assigned roles and responsibilities, the zones in which activities are to be performed, and the likelihood that they will encounter contaminated patients. OSHA recognizes three classifications of training that healthcare workers performing First Receiver activities need to be trained to: First Responder Operations Level, First Responder Awareness, and Just in Time briefing. In each case, the training must be provided in a manner the healthcare employee is capable of understanding.

1. “First Responder Operations Level” training is to be provided to the First Receivers who are responsible for the handling of patients who have not been decontaminated or who will participate in the decontamination process. This is minimum eight-hour training with specific competencies, including OSHA-mandated personal protective equipment and respiratory protection training, although an allowance is made to tailor the competencies to meet the specific needs of the First Receivers. If some of the topics are addressed in a separate course, that is acceptable, and awareness level training can apply toward the eight hours of training contact time. In lieu of the eight-hour training program, experienced employees may demonstrate the required competencies. However, it is the responsibility of the hospital to document how the training requirements were met, and certify in writing. Annual refresher training to maintain competencies is also required, with documentation.

The following circumstances are examples of First Receivers who would need this level of training:

- First Receivers who handle patients exposed to chemical, biological, or radiological agents before they are thoroughly decontaminated.
- First Receivers who are designated to complete decontamination of patients.
• Individuals who develop the decontamination procedures and selection of personal protective equipment.
• First Receivers with designated roles in the Hospital Decontamination Zone.

2. "First Responder Awareness Level" training is to be provided to First Receivers who are responsible for work activities in the Hospital Post-Decontamination Zone and have the potential to identify or encounter contaminated patients. This level of training is not of a specified length but does address various competencies. Training requirements can be waived if an experienced employee can demonstrate documented competence. Annual refresher training is required.

First Receivers must be trained to the First Responder Awareness Level in the following circumstance:
• First Receivers who work in the contaminant-free Hospital Post-Decontamination Zone.
• First Receivers who are in a position to identify self-referred patients involved in release of chemical, biological, or radiological agents.
• First Receivers responsible for the set-up of decontamination system prior to receiving patients.
• First Receivers responsible for tracking patients from location outside of the decontamination area.
• Other individuals (skilled support personnel) whose role in the Hospital Decontamination Zone was not previously anticipated (e.g., medical specialist).

3. A third type of training must be available for those who are called into the hospital decontamination zone to provide skilled services, but who have not previously been trained because their exposure was unanticipated. Essentially, this training is a "Just in Time" briefing to address the hazard, duties, personal protective equipment and other safety and health precautions. There are recognized limitations to this type of training, and the hospital is advised to consider in advance which types of staff would be reasonably anticipated to work in the Hospital Decontamination Zone and provide more extensive training in advance. This training module recommends that this training be encompassed into the "First Responder Awareness Level".
## SUMMARY OF TRAINING REQUIREMENTS FOR FIRST RECEIVERS

<table>
<thead>
<tr>
<th>MANDATORY TRAINING</th>
<th>FIRST RECEIVERS COVERED</th>
<th>MINIMUM TRAINING CORE COMPETENCIES</th>
</tr>
</thead>
</table>
| **First Responder Operations Level** | • First Receivers who handle patients exposed to chemical, biological, or radiological agents before they are thoroughly decontaminated.  
• First Receivers who are designated to complete decontamination of patients.  
• Individuals who develop the decontamination procedures and selection of personal protective equipment.  
• First Receivers with designated roles in the *Hospital Decontamination Zone*. | • Knowledge of what terrorist agents are, and the risks associated with them.  
• Knowledge of the indicators and effects of terrorist agents on incoming patients and property.  
• Knowledge of the associated hazards and risks with these agents and the ability to recognize the signs and symptoms of exposure to these agents.  
• Knowledge of hospital emergency operations plan and associated responsibilities.  
• Hospital safety procedures and nature of hazards  
• Know how to use, inspect, and properly maintain the personal protective equipment issued and understand the limitations to this equipment.  
• Knowledge of and the implementation of standard precautions for biological hazards involving blood and other bodily fluids.  
• Know how to use, inspect, and properly maintain respiratory protection equipment and understand the limitations of this equipment.  
• Decontamination procedures. |
| **First Responder Awareness Level** | • First Receivers who work in the contaminant-free *Hospital Post-Decontamination Zone*.  
• First Receivers who are in a position to identify self-referred patients involved in release of chemical, biological, or radiological agents.  
• First Receivers responsible for the set-up of decontamination system prior to receiving patients.  
• First Receivers responsible for tracking patients from location outside of the decontamination area.  
• Other individuals (skilled support) | • Knowledge of what terrorist agents are, and the risks associated with them.  
• Knowledge of the indicators and effects of terrorist agents on incoming patients and property.  
• Knowledge of the associated hazards and risks with these agents and the ability to recognize the signs and symptoms of exposure to these agents.  
• Know how to use, inspect, and properly maintain the personal protective equipment issued and understand the limitations to this equipment.  
• Knowledge of and the implementation of standard precautions for biological hazards involving blood and other bodily fluids.  
• Recognize that patients may be contaminated and... |
There may be a need to establish a *Hospital Decontamination Zone* to stage these patients. Ability to conduct a preliminary triage system.

- Knowledge of the hospital’s emergency response plan and their associated roles and responsibilities as a **First Responder Awareness level**, including security and control.
- The ability to realize the need for additional support and resources, and to make appropriate notifications.

<table>
<thead>
<tr>
<th>“Just in Time” Briefing</th>
<th>“Just in Time” Briefing</th>
<th>“Just in Time” Briefing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Briefing at the time of the incident.</td>
<td>Other individuals (skilled support personnel) whose role in the Hospital Decontamination Zone was not previously anticipated (e.g., medical specialist).</td>
<td>Knowledge of the terrorist agents involved and the risks associated with them, including signs and symptoms.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Instruction on the proper use of personal protective equipment and respiratory protection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Expected roles and responsibilities to be performed in the <em>Hospital Decontamination Zone</em>.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decontamination procedures.</td>
</tr>
</tbody>
</table>
III. Regulatory and Guidance Agency Overview

A. Department of Labor (DOL)
The DOL is responsible for the oversight of the United States labor laws. The U.S. Congress passed the Occupational Safety and Health (OSH) Act in 1970. One year later a new department, the Occupational Safety and Health Administration (OSHA), was created to oversee compliance with the Act under the jurisdiction of the DOL.

1. OSHA
OSHA issues legislation relating to worker safety under Title 29 CFR. OSHA legislation of interest to First Responders/First Receivers includes:

- OSHA regulations in Title 29 Code of Federal Regulations (CFR) 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER);
- OSHA regulations in Title 29 CFR 1910.132, Personal Protective Equipment General Requirements;
- OSHA regulations in Title 29 CFR 1910.133, Eye and Face Protection;
- OSHA regulations in Title 29 CFR 1910.134, Respiratory Protection;

B. Environmental Protection Agency (EPA)
The EPA is responsible for the research and establishment of national standards for a variety of environmental programs. Several pieces of environmental legislation are of particular interest to the First Responder/First Receiver:

- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly referred to as the Superfund Act, which was enacted by Congress on December 11, 1980;
- Superfund Amendments and Reauthorization Act (SARA), which amended CERCLA on October 17, 1986;
- Environmental Protection and Community Right-to-Know Act (EPCRA), also known as Title III of SARA was enacted by Congress as a national legislation on community safety;
- Resource Conservation and Recovery Act (RCRA);
- Toxic Substances Control Act (TSCA);

1. EPCRA
This law was designated to assist local communities with the protection of public health, safety, and the environment from chemical hazards. To implement EPCRA, Congress required each state to appoint a State
Emergency Response Commission (SERC). The SERCs are required to divide their state into Emergency Planning Districts and to name a Local Emergency Planning Committee (LEPC) for each district. Broad representation by emergency responders, health officials, hospitals, government representatives, community groups, industrial facilities, and emergency managers ensure that all necessary elements of the planning process are represented.

C. Nuclear Regulatory Commission (NRC)
The NRC regulates U.S. commercial nuclear power plants and general population use of nuclear materials as well as the possession, storage, and transfer of radioactive materials through Title 10 CFR 20, Standards for Protection Against Radiation. The NRC’s primary mission is to protect the public’s health and safety and the environment form the effects of radiation from nuclear reactors, materials, and waste facilities.

D. Department of Homeland Security (DHS)
Three primary missions of DHS are: (1) Prevent terrorist attacks within the U.S., (2) Reduction of vulnerability to terrorist activities, and (3) Minimize the damage from potential attacks and natural disasters. DHS was created as a result of the terrorist attacks on September 11, 2001. Primary responsibility for ensuring that emergency response professionals are prepared for any situation in the event of an act of terrorism, natural disaster, or other large-scale emergency. The Federal Emergency Management Agency (FEMA) and the U.S. Coast Guard (USCG) are located within this Department.

E. Department of Justice (DOJ)
Operational response to the threats of or acts of terrorism within the U.S is primarily assigned to the Federal Bureau of Investigation (FBI). The FBI then operates as the on-scene manager for the Federal government. It is ultimately the lead agency on terrorist incident scenes.

The Office for Domestic Preparedness (ODP) also falls under the jurisdiction of the DOJ. The ODP issues Federal emergency response guidelines for weapons of mass destruction (i.e. terrorist attacks) events.

- Office for Domestic Preparedness, Emergency Responder Guidelines, 2002, Law Enforcement and Fire Service Awareness and Operational Level for response to terrorist incidents involving weapons of mass destruction

F. Department of Defense Explosives Safety Board (DDESB), Department of Defense (DOD)
Provides oversight of the development, manufacture, testing, maintenance, demilitarization, handling, transportation, and storage of explosives, including chemical agents on DOD facilities.
G. National Fire Protection Association (NFPA)
NFPA has several standards that apply to individuals who respond to hazardous material emergencies. The requirements in these standards are recommendations, not regulatory requirements, unless they are adopted by the authority having jurisdiction. However, because they are a national standard, they can be used as a basis for accepted practice.
- NFPA 1994, Standard on Protective Ensembles for Chemical/Biological Terrorism Incidents (2001 Edition);

H. National Institute for Occupational Safety and Health (NIOSH)
NIOSH was created by the OSH Act of 1970 and is in the U.S. Department of Health and Human Services. NIOSH was established to help assure safe and healthful working conditions for workers by providing research, information, education, and training in the field of occupational safety and health. NIOSH established the National Personal Protective Technology Laboratory (NPPTL) to provide leadership for the prevention of injury and illness among workers who must rely on personal protective equipment, including respirators, gloves, and hard hats.
- NIOSH Recommendations for Protective Clothing and Respirators;
- NIOSH Chemical, Biological, Radiological, and Nuclear (CBRN) Standard for Open-Circuit Self-Contained Breathing Apparatus (SCBA);
- NIOSH Standard for Chemical, Biological, Radiological, and Nuclear (CBRN) Full Face-piece Air-Purifying Respirators (APR);
- NIOSH Standard for Chemical, Biological, Radiological, and Nuclear (CBRN) Air-Purifying Escape Respirator and CBRN Self-Contained Escape Respirator.

I. Joint Commission on Accreditation of Healthcare Organizations (JCAHO)
The JCAHO is an independent, not-for-profit organization, which evaluates and accredits healthcare organizations and programs in the United States. JCAHO maintains state-of-the-art standards that focus on improving the quality and safety of care provided by health care organizations. The comprehensive accreditation process evaluates an organization’s compliance with these standards and other accreditation requirements. The organizational mission is to continuously improve the safety and quality of care provided to the public through the provision of health care accreditation and related services that support performance improvement in health care organizations.
• JCAHO Standards for Emergency Management EC.1.4 require hospitals to: 1) develop a comprehensive emergency management plan (EMP) describing the hospital’s response to emergencies that would affect the need for the hospital’s services or the hospital’s ability to provide these services; 2) evaluate the EMP annually including the objectives, scope, functionality, and effectiveness; 3) conduct an HVA, to identify potential emergencies that could affect the need for the hospital’s services, or its ability to provide these services; and 4) identify the hospital’s role in the community and coordinate plans.
IV. Introduction to Terrorism

This module provides an overview of the definition of terrorism, potential targets of terrorist acts, and the types of terrorist agents used in attacks. In addition, the module gives a brief overview of the Homeland Security Advisory System.

A. Definition of Terrorism

The U.S. Federal Bureau of Investigation (FBI) defines terrorism as follows:

*The unlawful use of force or violence committed by group(s) or individual(s) against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.*

This definition includes the following three elements:

- Acts of terrorism are illegal and involve the use of force or violence. Terrorism is often intended to kill or injure people.
- Acts are intended to force intimidation or coercion.
- Acts are committed to make a political statement, drawing attention to a cause, undermining a sense of security, undermining confidence in the government, and disruption of the economy or infrastructure.

Terrorism can be domestic or international. Acts of domestic terrorism are conducted by group(s) or individual(s) that are not affiliated with foreign influences and are directed at elements of a government or population. Acts of international terrorism are conducted by foreign-based group(s) or individual(s) who either take their direction from countries or groups outside of a country or whose activities transcend national boundaries.

Terrorist organizations intend their activities to have an emotional effect on the target population, causing it to act in a manner that furthers the group’s objectives. Acts of terrorism can be categorized in terms of their associated goals. Some of these goals include:

- **Intimidation** – Acts that are primarily designed to intimidate as a mean of preventing an organization or government from acting in a defined manner. These acts are aimed at diminishing the general public’s confidence in the government’s ability to provide security.
- **Coercion** – Acts are intended to force individuals, organizations, or governments to act in a desired manner. Terrorists selectively target facilities with the intent of bringing increased pressure on the targeted activity.
• **Recognition** – The objective of these acts is to gain national and/or international attention for the group(s) or individual(s) and its stated objectives. Terrorist organizations often conduct attacks to gain recognition early in their life span.

For the purpose of this module, a terrorist event is considered as an event that is intended to do harm to life, the environment, or property. This includes both physical harm and disruption of normal activities.

**B. Common or Potential Targets of Terrorism**

When the goal is to kill, injure, or disrupt as many people as possible, any place that has large public gatherings is a potential target. Potential targets of terrorist activities share three similarities: highly visible, easily accessible, and access to large populations. Examples of targets include:

- Public buildings and public assembly areas, particularly those with large populations (e.g., greater than 250) or high life-hazard potential (assembly, educational, healthcare, and correctional facilities), as well as special events
- Infrastructure components such as mass transit systems, telecommunications facilities, and critical supply points, such as power plants and fuel-distribution facilities (or other occupancies with large quantities of flammable and combustible materials), and industrial facilities
- Places with historic or symbolic significance such as government buildings, military installations, colleges, and churches
- Places with high economic impact, such as shopping malls, media locations, and banks

**C. Types of Terrorist Attacks**

This training module focuses on three categories of terrorist agents that the First Receiver may encounter: Chemical Agent Attacks, Biological Agent Attacks, and Radiological/Nuclear Attacks. These agents will be discussed in further details in later chapter modules.

1. **Chemical Attacks**

A chemical attack is the deliberate release of a toxic gas, liquid, or solid that can poison the exposed population and the environment. These agents are intended for use in terrorist activities to kill, seriously injure, or seriously incapacitate the exposed population.
2. Biological Attacks

A biological attack is the intentional release of viruses, bacteria, or their toxins for the purpose of harming or killing the exposed population.

3. Radiological/Nuclear Attacks

Three scenarios are likely in the use of these materials in a terrorist attack: (1) the detonation of a conventional explosive device that incorporates nuclear materials (commonly referred to as dirty bomb); (2) attack on a source of nuclear materials such as detonation of explosive device in the vicinity of a nuclear power plant or radiological cargo in transport; and (3) actual detonation of nuclear bomb, improvised nuclear device (IND), or suitcase bomb. The latter scenario is probably the least likely because most terrorist organizations do not have the means to build or acquire a nuclear bomb.

Frequent “buzzwords” associated with incidents involving these agents include:

- **NBC** – Nuclear, Biological, or Chemical
- **CBRNE** – Chemical, Biological, Radiological, Nuclear, and Explosive
- **WMD** – Weapons of Mass Destruction
- **B-NICE** – Biological, Nuclear, Incendiary, Chemical, Explosive
- **COBRA** – Chemical, Ordinance, Biological, Radiological Agents

Since the Joint Commission on Accreditation for Healthcare Organizations (JCAHO) uses ‘NBC’, this training module will refer to this acronym when referencing chemical, biological, or radiological/nuclear agents throughout for continuity and familiarity by healthcare workers.

D. Examples of Terrorist Attacks

- In September 2001, an unknown terrorist mailed threatening letters containing a biological agent (anthrax spores) to television new anchor Tom Brokaw, and U.S. Senators Tom Daschle and Patrick Leahy, through the U.S. Postal Service. As a result of this incident, 23 individuals had contracted anthrax – 10 with inhalational anthrax and the remainder with cutaneous anthrax. Of these 23 cases, 5 (all inhalational cases) resulted in fatalities as a result of anthrax infection.
- On March 20, 1995, a terrorist organization (Aum Shinrikyo) launched a chemical attack on the Tokyo subway. This group placed dilute chemical agents (sarin nerve agent) into lunch boxes and other containers disguised as lunch bags. The terrorists used umbrellas with sharpened points to puncture the containers during the morning rush hour on three subway lines. This tragic event caused 11 deaths and approximately 5,500 injuries.
• In June of 1994, a terrorist organization (Aum Shinrikyo) attempted to assassinate three judges in Matsumoto, Japan. The organization released a chemical agent (sarin nerve agent) in the residential community where the judges resided. The attack involved the use of a truck with a special device to release the agent. Although the judges were not killed, the event caused 7 deaths and injured 280 people.

• In 1984, a group (Bhagwan cult) located in a small town in Oregon, sprayed a biological agent (salmonella) onto restaurant salad bars in an attempt to influence local elections. This event lead to the admission of 45 victims to area hospitals and ultimately 751 people became ill. No fatalities were reported.

E. The Homeland Security Advisory System

The U.S. Department of Homeland Security (DHS), in conjunction with the Homeland Security council, has developed and implemented the Homeland Security Advisory System. This system is designed to provide quick, comprehensive information concerning the potential threat of terrorist attacks or threat levels.

• **Low Condition (Green).** This condition is declared when there is a low risk of terrorist attacks. Agencies should consider the following general measures in addition to any agency-specific protective measures they develop and implement:
  1. Refine and exercise pre-planned protective measures.
  2. Ensure that personnel receive proper training on the Homeland Security Advisory System and on specific pre-planned departmental or agency protective measures.
  3. Institute a process to ensure that all facilities and regulated sectors are regularly assessed for vulnerability to terrorist attacks, and that all reasonable measures are taken to mitigate these vulnerabilities.

• **Guarded Condition (Blue).** This condition is declared when there is a general risk of terrorist attacks. In addition to the protective measures listed under the previous threat conditions, agencies should consider the following general measures as well as protective measure that they will develop and implement:
  1. Check communications with designated emergency response or command locations.
  2. Review and update emergency response procedures.
  3. Provide the public with any information that would strengthen its ability to act appropriately.

• **Elevated Condition (Yellow).** An Elevated Condition Threat Alert is declared when there is a significant risk of terrorist attacks. In addition to the protective measures listed under the previous threat conditions,
agencies should consider the following general measures as well as the protective measures that they will develop:

1. Increase surveillance of critical locations.
2. Coordinate emergency plans as appropriate with nearby jurisdictions.
3. Address whether the precise characteristics of the threat require the further refinement of pre-planned protective measures.
4. Implement, as appropriate, contingency and emergency response plans.

- **High Condition (Orange).** A High Condition Threat Alert is declared when there is a high risk of terrorist attacks. In addition to the protective measures listed under the previous threat conditions, agencies should consider the following general measures as well as agency-specific protective measures:
  1. Coordinate necessary security efforts with Federal, State, and local law enforcement agencies or any National Guard or other appropriate armed forces organizations.
  2. Take additional precautions at public events and consider alternative venues or even cancellation.
  3. Prepare to execute contingency procedures, such as moving to an alternate site or dispersing a workforce.
  4. Restrict threatened facility access to essential personnel only.

- **Severe Condition (Red).** Declaring a Severe Condition Threat Alert reflects a severe risk of terrorist attacks. Under most circumstances, the protective measures for a Severe Condition are not intended to be sustained for extended periods of time. In addition to the protective measures listed under the previous threat conditions, agencies should consider the following general measures as well as the agency-specific protective measures:
  1. Increase or redirect personnel to address critical emergency needs.
  2. Assign emergency response personnel and pre-position and mobilize specially trained teams or resources.
  3. Monitor, redirect, or constrain transportation systems.
V. General Overview of Terrorism NBC Agents

A. Chemical Agents

An attack involving the use of chemical agents is defined as the deliberate release of a toxic gas, liquid, or solid that results in the poisoning of people and the environment. Chemical warfare agents or toxic chemicals are typically involved in terrorist attacks. Chemical agents are intended to kill, seriously injure, or seriously incapacitate people through their physiological effects.

Unlike biological attacks, chemical agents used in terrorist attacks have effects that are typically acute in nature, acting within minutes to elicit a response from the exposed population. Chemical agents attack the organs of the human body, preventing the organs from functioning normally. The results are usually disabling or fatal in nature. Chemical attacks are characterized by the rapid onset of medical symptoms. The following are some indicators of possible terrorist activity involving chemical agents:

   i. Unexplained patterns of sudden onset of similar, non-traumatic illnesses or deaths (the pattern could be geographic, by employer, or associated with agent dissemination methods).

   ii. Multiple individuals exhibiting unexplained signs of skin, eye, or airway irritation.

   iii. Multiple individuals exhibiting unexplained health problems such as nausea, vomiting, twitching, tightness in the chest, sweating, pinpoint pupils (miosis), runny nose (rhinorrhea), disorientation, difficulty in breathing, or convulsions. Two common mnemonics, SLUDGEM and DUMBELS, are tools in the remembering of characteristics of chemical agent exposure:

   

<table>
<thead>
<tr>
<th>Salivation (drooling)</th>
<th>Diarrhea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lacrimation (tearing)</td>
<td>Urination</td>
</tr>
<tr>
<td>Urination</td>
<td>Miosis</td>
</tr>
<tr>
<td>Defecation</td>
<td>Bronchoconstriction and bronchorrhea</td>
</tr>
<tr>
<td>Gastrointestinal upset/aggravation (cramping)</td>
<td>Emesis (vomiting)</td>
</tr>
<tr>
<td>Emesis (vomiting)</td>
<td>Lacrimation (tearing)</td>
</tr>
<tr>
<td>Miosis or Muscular twitching/spasms</td>
<td>Salivation (drooling)</td>
</tr>
</tbody>
</table>

   iv. Skin or clothing exhibiting oily droplets or films.
There are numerous agents that could be used as chemical weapons, but only a handful that are considered chemical warfare agents. This module provides general information that applies to the use of chemical agents in terrorist attacks. Chemical agents are classified as the following:

1. Types of Chemical Agents

   a) Nerve Agents

Most toxic of the known chemical agents used in acts of terrorism. They work by attacking the nervous system and disrupting nerve impulse transmissions and are similar in nature to organophosphate pesticides. This category of agents is characterized by their stability, ability to be easily dispersed, extremely high toxicity, and their rapid onset of effects when absorbed through the respiratory system and skin. As First Receivers, you should be familiar with the following nerve agents (military designations are provided in parentheses):

- **Tabun (GA)** – low volatility persistent agent that is typically absorbed through skin contact or inhaled as a gas or aerosol.
- **Sarin (GB)** – volatile, non-persistent agent that’s main route of entry is through the respiratory system.
- **Soman (GD)** – moderately volatile agent with its route of entry focusing on inhalation and absorption through skin contact.
- **Cyclohexyl Sarin (GF)** – low volatile persistent agent with its route of entry being absorption through skin contact and inhalation when in a gaseous form or aerosol.
- **V-agent (VX)** – low volatility persistent agent that can remain on material, equipment, and the surrounding environment for long durations; main route of entry is skin absorption and also through inhalation of the substance as a gas or aerosol.

Nerve agents in their pure form are colorless liquids. Their volatility varies widely among the agents. The G-agents tend to be non-persistent (it is possible to add a thickening agent to increase persistency), where as the V-agents tend to exhibit more persistency.

The route of entry for Nerve agents, regardless of the form (liquid, aerosol, gas), is through absorption through the skin and through the respiratory system. Another, less likely route of entry is through ingestion – contamination of water or food supplies. The route of entry influences the development and sequence of symptoms. Nerve agents are most effective when the route of entry is through inhalation. The respiratory system (i.e. lungs) contains numerous
blood vessels and the agent can quickly diffuse into the blood and circulate to target or vital organs. Exposure to high concentrations of nerve agents typically results in death in a matter of minutes.

Skin absorption typically results in signs and symptoms at lesser rate of action. Nerve agents are fat-soluble, and can easily penetrate the outer layers of skin but the rate of poisoning takes longer to reach the deeper blood vessels. As a result, the first symptoms do not manifest for approximately 30 minutes after initial exposure (dependent on concentration of dose received).

Exposures to low doses or concentrations of nerve agent produce characteristic symptoms such as; increased production of saliva, runny nose, and feeling of pressure on the chest. The pupil of the eye becomes contracted (miosis), which impairs night vision and increased sensitivity to bright lights. In addition, the capacity of the eye to change focal length may be reduced, causing the exposed individual to experience pain when attempting to focus on nearby objects. Less specific symptoms are tiredness, slurred speech, hallucinations, and nausea.

Exposures to moderate doses or concentrations tend to lead to the development of more dramatic and pronounced symptoms. Changes to the respiratory system lead to the development of difficulty in breathing and coughing. Gastrointestinal tract discomfort manifests into severe cramping and vomiting, and may lead to involuntary urination and defecation. Excessive tearing, salivation, and sweating may be experienced. Effects on the skeletal muscles will be exhibited in the form of muscular weakness, local tremors, or convulsions.

High dose or concentration exposures lead to a more pronounced muscular symptoms, leading to convulsions and potential lose of consciousness. The rate of action of the agent may be so rapid that previously mentioned symptoms may not have the time to manifest. Nerve agents affect the respiratory muscles leading to muscular paralysis and the central nervous system. The effect of this combination is the direct result of death.

**b) Blister Agents (Mustard agents or Vesicants)**

Exposure leads to the burning and blistering of the skin or any other part of the body that comes in contact with the agents. Agents act on the eyes, skin, mucous membranes, lungs, and blood forming organs. Typically these agents are persistent and are employed in the form of colorless gases and liquids. Exposures to blister agents typically involve casualties rather than fatalities - although moderate to high
exposures can be fatal. Blister agents can be categorized into the following groups:

- **Mustard Agents** – At room temperature, mustard agents are liquid with low volatility. Agents can be dissolved in most organic solvents but have negligible solubility in water.
  
  i. **Sulfur mustards (H, HD [distilled mustards], and HT)** – sometimes smell like garlic, onions, or mustard; sometimes they have no odor. They can be a vapor, an oily-textured liquid, or a solid. Can be clear to yellow or brown colored when they are in liquid or solid form.

  ii. **Nitrogen mustards (HN, HN-1, HN-2, HN-3)** – Available in different forms that can smell fishy, musty, soapy, or fruity. They can be in the form of an oily-textured liquid, a vapor, or a solid. Liquids at room temperature and can be clear, pale amber, or yellow colored when in liquid or solid form.

- **Arsenical Vesicants** – Not common or as stable as the mustard agents. Typically are colorless to brown-colored liquids. They are more volatile than mustards and have fruity to geranium-like odors. These types of agents are much more dangerous as liquids than as vapors. Absorption of either vapor or liquid through the skin in adequate dosage may lead to systemic intoxication or death.
  
  i. Lewisite (L, L-1, L-2, L-3)
  
  ii. Mustard/Lewisite mixture (HL)
  
  iii. Phenyldichloroarsine (PD)

- **Halogenated Oximes – Phosgene Oxime (Cx)** – It has a disagreeable penetrating odor. Pure phosgene oxime is a colorless, crystalline solid; the munitions grade compound is yellowish-brown colored liquid. Both the liquid and the solid can emit vapors at ambient temperatures.

Relatively persistent in nature, these agents are readily absorbed by all parts of the body. Secondary routes of entry may occur through the ingestion of contaminated food or water sources. Exposure results in the inflammation, development of blisters, and general destruction of tissues. Mustard agents in the gaseous or liquid state attack the skin, eyes, lungs, and gastrointestinal tract. Internal organs, mainly blood-generating organs, are damaged as a result of the agent being absorbed through the skin or lungs and distributed through the body. Blisters have a latency period of up to several hours.
c) Blood Agents

Blood agents, often referred to as cyanide agents, are chemical asphyxiants based on their interference with oxygen utilization at the cellular level. First Receivers should be familiar with the following blood agents:

- **Arsine (SA)** – formed from the contact of arsenic with an acid. It is a colorless, non-irritating toxic gas that has a mild odor that resembles garlic.
- **Hydrogen Cyanide (AC)** – colorless, highly volatile liquid that is extremely flammable, highly soluble, and stable in water; may form explosive mixture. Less dense than air and has a faint odor similar to bitter almonds; 25% of the population is unable to smell it. Non-persistent agent; does not remain long in its liquid form.
- **Cyanogen Chloride (CK)** – colorless, highly volatile liquid that dissolves in organic solvents but is only slightly soluble in water. Odor that has been variously described as "pungent," "biting," "pepper-like," and "similar to tear gas," the first indication of exposure will typically involve tearing and irritation rather than detection of any odor.

d) Choking Agents

These agents attack the respiratory system causing tissue damage to the lungs. Based on their method of attack they are often referred to as pulmonary or lung-damaging agents. Predominately, phosgene (CG) and chlorine (CL) are the choking agents of choice; however other agents – diphosgene, chloropicin, ammonia, hydrogen chloride, phosphine, and elemental phosphorus can be categorized as choking agents. For this training the emphasis will be placed on phosgene and chlorine.

- **Phosgene** – colorless, non-flammable gas that has the odor of freshly cut hay or mown grass. Odor threshold is well above the permissible exposure level, so it is already at a harmful concentration when detected. Is a gas at room temperature but is sometimes stored as liquid under pressure or refrigeration. The agent is extremely volatile and non-persistent; heavier than air; and will not remain in its liquid form very long.
- **Chlorine** – recognizable by its pungent, irritating odor, which is similar to bleach. Gas is usually yellow-green in color.

e) **Riot Control Agents**

Sometimes referred to as tear gas or irritating agents these chemicals temporarily make the exposed individuals unable to function by a resulting in an immediate irritation to the eyes, mouth, throat, lungs and skin. Several different compounds are categorized as riot agents. These agents are solids and require dissemination in the form of aerosolization. Extent of the effect is dependent on the concentration to which the individual is exposed; location of exposure (indoors versus outdoors); method of exposure; and duration of exposure. Effects of exposure are typically short lived (15 to 30 minutes) after removal from source. Under ideal conditions (i.e. release in an enclosed or confined space or area), these agents can result in asphyxiation and may trigger secondary health effects (asthma attacks and other respiratory problems).

Types of riot control agents include:

- **Chlorobenzylidene malononitrile (CS or Tear Gas)** – most common form of irritant used for riot control. Cloud is white at the point of release and for several seconds following release. Non-persistent hazard, although it may stick to rough surfaces (i.e., clothing) from which it is slow to release from, with typical aeration requiring a minimum of one hour. Exposure is associated with pepper-like odor. Individuals exposed should be removed to fresh air, face into the wind with eyes open and breath deeply. Following exposure, clothing and individual equipment will need to be inspected for residual material.

- **Chloroacetophenone (CN or Mace)** – riot control purposes; higher toxicity than tear gas. Yellowish-brown colored solid that is poorly soluble in water but dissolves in organic solvents. The white smoke resembles the odor of apple blossoms. Similar in nature to tear gas and causes stimulation of sensory nerve endings.

- **Chloropicrin (PS)** – oily, colorless, insoluble liquid with an intense odor that results in the tearing of the eyes and vomiting.

- **Dibenzoxazepine (CR)** – newer agent; pale yellow-colored crystalline solid; pepper-like odor. Similar in nature to tear gas, but the minimum effective concentration is lower; less toxic when inhaled; and
skin effects are more pronounced. Extremely persistent in the environment and on clothing.

- **Oleoresin capsicum (OC or Pepper Spray)** – often categorized as an irritant and riot control agent. Oily substance derived from chili peppers; inflames the mucous membranes of the eyes, nose, and mouth resulting in intense pain and discomfort. Effects may last between 20 and 30 minutes.

2. **Routes of Exposure and Dissemination**

- Inhalation is primary route of entry for most chemical agents.
- Absorption through the skin or eyes is also a major route of entry for many of the chemical agents.
- Accidental ingestion is unlikely unless First Receivers fail to thoroughly wash their hands after contact with contaminated patients, their accessories, or equipment.
- The worst case terrorist scenario involves disseminating the agents in a manner that creates a large gas or vapor cloud (e.g., opening a gas cylinder, use of spray devices, or dispersal of agent utilizing a detonation device) because it is harder to protect against a gas or vapor than against a liquid or solid.
- Other possible scenarios include contaminating surfaces that people are likely to contact or the contamination of food or water supplies. However, these scenarios are less effective and thus considered less of a risk.

3. **General Health Effects of Chemical Agents**

Initial signs and symptoms associated with chemical agents usually manifest themselves within minutes of exposure. Sometimes, depending on the agent and route of exposure, initial effects may be delayed for several hours, but most chemical agents act very quickly. The general health effects listed below may help point the First Receiver toward a particular class of agent, particularly when combined with other indicators (e.g., odors). More detailed descriptions are provided in the agent specific profiles addressed in later sections of this module.

**a) Nerve agents**

The most significant indicators of nerve agent poisoning are rapid onset of pinpoint pupils (miosis) and muscular twitching. Other key indicators are runny nose (rhinorrhea), salivation, sweating, nausea and vomiting, difficulty in breathing (dyspnea), and convulsions.
b) **Blister Agents**
Most blister agents produce immediate irritation to eyes, skin, and mucous membranes. With mustard agents, however, pain and irritation may be delayed by as much as 24 hours. (Mustard agents are the only chemical agents that do not illicit responses within minutes of exposure.) Irritation to the respiratory system causes shortness of breath. Blisters are the most distinguishing characteristic of blister agents.

c) **Blood Agents**
Cyanide exposure causes rapid onset of respiratory stimulation, dizziness, nausea, vomiting, and headache. High concentrations cause convulsions and respiratory arrest. (Both nerve agents and cyanide exposures result in convulsions, but cyanide does not produce miosis, excessive secretions, and fine tremors in the muscles under the skin.)

d) **Choking Agents**
These gases quickly result in irritation to the eyes, nose, and throat; respiratory distress; nausea and vomiting; burning of exposed skin; and tightness in the chest. Pulmonary edema may develop within 24 hours of initial exposure.

e) **Riot Control Agents**
These agents result in the rapid onset of respiratory distress, eye irritation, and tearing. Effects seldom persist more than a few minutes once exposed individuals are removed from the source of exposure and to fresh air.
4. Characteristics of Chemical Agents

<table>
<thead>
<tr>
<th>NERVE AGENT CHARACTERISTICS</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>AGENT</th>
<th>DESCRIPTIONS</th>
<th>SYMPTOMS (All Listed Agents)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tabun (GA)</td>
<td>• Clear, colorless, and tasteless liquid</td>
<td><strong>Low or moderate dose</strong>&lt;br&gt;Experience to some or all of the following within seconds or minutes of exposure:</td>
</tr>
<tr>
<td></td>
<td>• Slight fruity odor may be present – not reliable to provide sufficient warning</td>
<td>• Runny nose</td>
</tr>
<tr>
<td></td>
<td>• Dissemination by aerosolized liquid</td>
<td>• Watery eyes</td>
</tr>
<tr>
<td>Sarin (GB)</td>
<td>• Clear, colorless, tasteless, and odorless liquid in pure form</td>
<td>• Small, pinpoint pupils</td>
</tr>
<tr>
<td></td>
<td>• Dissemination by aerosolized liquid</td>
<td>• Eye pain</td>
</tr>
<tr>
<td>Cyclohexyl Sarin (GF)</td>
<td>• Clear, colorless, tasteless, and odorless liquid in pure form</td>
<td>• Blurred vision</td>
</tr>
<tr>
<td></td>
<td>• Only slightly soluble in water</td>
<td>• Drooling &amp; excessive sweating</td>
</tr>
<tr>
<td></td>
<td>• Dissemination by aerosolized liquid</td>
<td>• Cough</td>
</tr>
<tr>
<td>Soman (GD)</td>
<td>• Pure liquid is clear, colorless, and tasteless; discolors with aging to dark brown</td>
<td>• Chest tightness</td>
</tr>
<tr>
<td></td>
<td>• Slight fruity odor or camphor odor - not reliable to provide sufficient warning</td>
<td>• Rapid breathing</td>
</tr>
<tr>
<td></td>
<td>• Dissemination by aerosolized liquid</td>
<td>• Diarrhea</td>
</tr>
<tr>
<td>V-Agent (VX)</td>
<td>• Clear, amber-colored odorless, oily liquid</td>
<td>• Increased urination</td>
</tr>
<tr>
<td></td>
<td>• Miscible with water and dissolves in all solvents</td>
<td>• Confusion</td>
</tr>
<tr>
<td></td>
<td>• Least volatile agent</td>
<td>• Drowsiness</td>
</tr>
<tr>
<td></td>
<td>• Very slow to evaporate</td>
<td>• Weakness</td>
</tr>
<tr>
<td></td>
<td>• Primarily a liquid hazard, but if heated to very high temperatures can turn into small amounts of vapor</td>
<td>• Headache</td>
</tr>
<tr>
<td></td>
<td>• Dissemination by aerosolized liquid</td>
<td>• Nausea, vomiting, abdominal pain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Slow or fast heart rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Abnormally low or high blood pressure</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Skin Contact:</strong> even a small drop on the skin can cause sweating and muscle twitching at the point of contact</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Large dose by any route:</strong> These additional health effects may result:</td>
</tr>
<tr>
<td>Loss of consciousness</td>
<td>Convulsions</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>Paralysis</td>
<td>Respiratory failure</td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Recovery Expectations:**
- Mild or moderately exposure usually recovers completely
- Severe exposure – survival unlikely
- Not associated with neurological problems

### Blister Agent Characteristics

<table>
<thead>
<tr>
<th>Sulfur Mustard (H/HN)</th>
<th>Clear to yellow or brown when in liquid or solid form</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odor similar to garlic, onions, or mustard; sometimes no odor</td>
</tr>
<tr>
<td></td>
<td>Can be in vapor form, an oily-textured liquid, or a solid</td>
</tr>
<tr>
<td></td>
<td>Vapors are heavier than air</td>
</tr>
<tr>
<td></td>
<td>Dissemination by aerosolized liquid</td>
</tr>
</tbody>
</table>

**Symptoms include:**

- **Skin:** redness and itching occurs within 2 to 48 hours after exposure and develops into yellow blistering of the skin

- **Eyes:** irritation, pain, swelling and tearing occurs within 3 to 12 hours after mild to moderate exposure. Severe exposure may cause symptoms within 1 to 2 hours and include sensitivity to light, severe pain, or temporary blindness (lasting up to 10 days)

- **Respiratory System:** runny nose, sneezing, hoarseness, bloody nose, sinus pain, shortness of breath, and cough within 12 to 24 hours of mild exposure and within 2 to 4 hours after severe exposure.

- **Gastrointestinal Tract:** abdominal pain, diarrhea, fever, nausea, and vomiting

**Other factors:**

- Signs and symptoms do not occur immediately
- Dependent on the severity of the exposure, symptoms may not occur for 2 to 24 hours
| Nitrogen Mustard (HN) | Individual susceptibility  
Exposure is not typically fatal |
|----------------------|----------------------------------|
| - Clear, pale amber, or yellow colored liquid or solid  
- Available in different forms that have odors similar to fishy, musty, soapy, or fruity  
- May take the form of an oily textured liquid, vapor, or a solid  
- Liquid at normal room temperature  
- Vapors are heavier than air  
- Dissemination by aerosolized liquid | - Skin: redness develops within a few hours of initial exposure followed by blistering within 6 to 12 hours  
- Eyes: irritation, pain, swelling, and tearing may occur. Concentration of a high nature may lead to severe burns and blindness.  
- Respiratory System: nose and sinus pain, cough, sore throat, and shortness of breath may occur within hours of exposure.  
- Gastrointestinal Tract: abdominal pain, diarrhea, nausea, and vomiting.  
- Brain: tremors, incoordination, and seizures may result following exposure to high concentrations. |
| Lewisite (L) | - Colorless liquid in its natural state; can appear amber to black if not pure  
- Odor that resembles geraniums  
- Vapors are heavier than air  
- Dissemination by aerosolized liquid | - Typically signs and symptoms do not occur immediately  
- Dependent on the severity of the exposure, symptoms may not occur for several hours. |
| | Signs and symptoms occurring immediately after exposure:  
- Skin: pain and irritation within seconds to minutes; redness within 15 to 30 minutes followed by blister formation within several hours  
  - Blister begins small in the middle of redness and expands to cover the entire reddened area of the skin  
  - Lesions heal much faster than lesions caused by... |
| Phosgene Oxime (CX) | Colorless in its solid form and yellowish-brown in liquid form  
| Disagreeable, irritating odor  
| Vapors are heavier than air  
| Dissemination by aerosolized liquid | other blister agents,  
- Discoloration of the skin occurs later and is much less noticeable  
- **Eyes:** irritation, pain, swelling, and tearing may occur at initial point of exposure.  
- **Respiratory System:** runny nose, sneezing, hoarseness, bloody nose, sinus pain, shortness of breath, and cough  
- **Gastrointestinal Tract:** diarrhea, nausea, and vomiting  
- **Cardiovascular:** lewisite shock or low blood pressure  

Signs and symptoms occur immediately following exposure:  
- **Skin:** pain occurs within a few seconds of exposure, blanching of the skin surrounded by red rings occurs within 30 seconds  
  - Hives develop within 15 minutes  
  - After 24 hours, the blanched areas of the skin transcend to brown and die resulting in the formation of scab  
  - Noticeable itching and pain throughout healing process  
- **Eyes:** sever pain and irritation, tearing, and temporary blindness  
- **Respiratory System:** immediate irritation to the upper respiratory tract, causing runny nose, hoarseness, and sinus pain  
- Absorption through the skin or inhalation may lead to the development of fluid in the lungs (pulmonary edema) with shortness of breath and cough
## Blood Agent Characteristics

| Arsine (SA) | Colorless, non-irritating toxic gas with mild garlic odor that is detected only at levels higher than those necessary to cause poisoning  
|            | Formation occurs when arsenic comes into contact with an acid  
|            | Dissemination by vapor release | **Inhalation exposure to low or moderate concentration:** Exposed individuals may experience some or all of the following symptoms within 2 to 24 hours:  
|            | Weakness  
|            | Fatigue  
|            | Headache  
|            | Drowsiness  
|            | Confusion  
|            | Shortness of breath  
|            | Rapid breathing  
|            | Nausea, vomiting, and/or abdominal pain  
|            | Red or dark urine  
|            | Jaundice  
|            | Cramping of muscles | Large uptake by any route of entry: These additional health effects may occur:  
|            | Loss of consciousness  
|            | Convulsions  
|            | Paralysis  
|            | Respiratory failure, leading to death | Other factors:  
|            | Showing these signs and symptoms does not necessarily mean that the individual was exposed  
|            | Survival of initial exposure, the development of chronic effects may occur:  
|            | ➢ Kidney damage  
|            | ➢ Numbness and pain in the extremities  
|            | ➢ Neuropsychological symptoms – memory loss, confusion, and irritability |  
| Hydrogen Cyanide | Colorless gas or liquid | **Inhalation:** headache, dizziness, confusion, nausea, |
| (AC) | • Bitter almond odor  
• Slightly lighter than air  
• Miscible  
• Extremely flammable  
• Explosive gas/air mixture  
• Reacts violently with oxidants and hydrogen chloride – resulting in fire and explosion hazards  
• Dissemination by aerosolized liquid | shortness of breath, convulsions, vomiting, weakness, anxiety, irregular heart beat, tightness in the chest, and unconsciousness. Onset of effects may be delayed.  
• **Skin**: may be absorbed through the skin. See inhalation for other symptoms.  
• **Eyes**: redness; vapor is absorbed. See inhalation for other symptoms.  
• **Ingestion**: burning sensation. See inhalation for other symptoms. |
| Cyanogen Chloride (CK) | • Colorless gas  
• Pungent odor  
• Heavier than air  
• Dissemination by vapor release | • **Inhalation**: runny nose, sore throat, drowsiness, confusion, nausea, vomiting, cough, unconsciousness, edema, with symptoms which may be delayed  
• **Skin**: readily absorbed through intact skin, resulting in systemic effects without the irritation of the skin; frostbite may occur on contact with liquid; liquid may be absorbed resulting in redness and pain.  
• **Eyes**: frostbite on contact with liquid; redness, pain, and excessive tearing |
| **Choking Agent Characteristics** |  |
| Phosgene (CG) | • Poisonous gas at room temperature  
• Colorless or white to pale yellow cloud  
• Pleasant odor at low concentrations – resemblance of newly cut hay or freshly mown grass  
• Strong unpleasant odor at high concentrations  
• Heavier than air  
• Dissemination by vapor release | **Exposure to dangerous level concentrations**: During or immediately following the exposure the following signs and symptoms may manifest:  
• Coughing  
• Burning sensation in the throat and eyes  
• Watery eyes  
• Blurred vision  
• Difficulty in breathing or shortness of breath  
• Nausea and vomiting  
• Skin contact can result in lesions similar to frostbite or burns |
**Exposure to high concentrations:** Development of fluid in the lungs within 2 to 6 hours.

**Delayed effects:** typically not apparent for up to 48 hours; exposed individual may appear to be feeling recovered prior to the onset of the following:
- Difficulty in breathing
- Coughing up white to pink-tinged fluid
- Low blood pressure
- Heart failure
- Chronic bronchitis and emphysema may develop

| Chlorine (CL)                  | • Pungent, irritating odor that resembles bleach  
|                               | • Yellow-green in color  
|                               | • Not flammable, but can react explosively or form explosive compounds with other chemicals  
|                               | • Dissemination by vapor release  

**Dangerous level concentrations**
- Coughing
- Chest tightness
- Burning sensation in the nose, throat, and eyes
- Watery eyes
- Blurred vision
- Nausea and vomiting
- Burning pain, redness, and blisters on the skin; similar effects to frostbite if exposed to liquid
- Difficulty in breathing or shortness of breath
- Fluid in the lungs may develop within 2 to 4 hours

### Riot Control Agent Characteristics

| Chlorobenzylidene malononitrile (CS) | • White crystalline solid  
|                                    | • Pepper-like odor  
| Chloroacetophenone (CN; Mace)      | • Clear yellowish brown solid  
|                                    | • Poorly soluble in water, but dissolves in organic solvents  
|                                    | • White smoke with an odor similar to apple blossoms  
| Oleoresin Capsicum (OC, Pepper Spray) | • Oily liquid, typically used as a spray mist  
| Dibenzoazepine (CR) | • Pale yellow crystalline solid  

**Immediately after exposure:** Exposed individuals may experience some or all of the following symptoms:
- **Eyes:** excessive tearing, burning, blurred vision and redness
- **Nose:** runny nose, burning, and swelling
- **Mouth:** burning, irritation, difficulty swallowing, and drooling
| Chloropicrin (PS) | • Pepper-like odor  
• Dissemination by propellant |
|------------------|--------------------------------------------------|
|                   | • Oily, colorless liquid  
• Intense odor  
• Violent decomposition when exposed to heat |
|                   | • **Lungs:** chest tightness, coughing, choking sensation, noisy breathing (wheezing), and shortness of breath.  
• **Skin:** burns and rash  
• **Other:** nausea and vomiting |

Long lasting exposure or exposure to large concentration, especially in a closed environment may cause severe effects:  
• Blindness  
• Glaucoma  
• Immediate death due to severe chemical burns to the throat and lungs  
• Respiratory failure potentially leading to death.
B. Biological Agents

An attack using a biological agent is defined as an intentional release of viruses, bacteria, or other toxins for the purpose of harming killing the exposed population. In addition to aerosolization, food, water, or insects must be considered as potential vehicles of transmission for biological weapons. First Receivers must be prepared to address various biological agents, including pathogens that are rarely seen in the United States. In addition, they should also be aware of the possible indicators of biological attacks, the different types of biological agents, and the signs and symptoms of those commonly used in weaponized attacks.

Generally, biological weapons agents do not cause immediate health effects. Most biological agents take hours, days, or weeks to manifest to illness, depending on the incubation period of the agent. Because of this delay, the cause of illness may not be immediately evident, and the source of the attack may be difficult to trace.

Depending on the agent used and the scope of an incident, First Receivers may be first to realize that there has been an attack. In some cases there may be reliable evidence to implicate terrorist activity such as a witness to an attack or the discovery of an appropriate delivery system. Terrorist activity may not be obviously evident, and First Receivers should be aware of the following examples of indicators of possible terrorist activity involving biological agents:

i. Unusual number of sick or dying people or animals.
ii. Multiple casualties with similar signs or symptoms.
iii. Dissemination of unscheduled or unusual spray.
iv. Abandoned spray devices.
v. Illness type highly unusual for the geographic area.
vi. Casualty distribution aligned with wind direction.
vii. Lower attack rates among those working indoors than in those exposed outdoors.

1. Types of Biological Agents

a) Viral Agents

Viruses are the simplest types of microorganisms that can only replicate themselves in living cells of their hosts. Viruses do not respond to antibiotics, making them an attractive weapon. Examples of viruses include smallpox, Venezuelan equine encephalitis (VEE), and viral hemorrhagic fever (VHF).

b) Bacterial Agents

Bacteria are microscopic, single-celled organisms. Most bacteria do not cause disease in exposed individuals, but when they do, two different mechanisms are possible: invading the tissues or
production of poisons (toxins). Examples of bacteria include anthrax, brucellosis, cholera, plague, and tularemia.

c) Rickettsias
Specialized bacteria that live and multiply in the gastrointestinal tract of arthropod carriers (such as ticks and fleas). They are smaller than most bacteria, but larger than viruses. They have properties that are similar to both viruses and bacteria. Like bacteria, they are single celled organisms with their own metabolisms, and they are susceptible to broad-spectrum antibiotics. However, like viruses, they only grow in living cells. Most rickettsias are spread only through the bite of infected arthropods and not through human contact. Q fever is an example of a rickettsia.

d) Biological Toxins
Poisons produced by living organisms; however, the biological organism itself is usually not harmful to the exposed individual. Some biological toxins have been manufactured synthetically and/or genetically altered in laboratories. They are similar to chemical agents in the way they are disseminated (and in their effectiveness) as biological weapons. Examples of toxins are botulinum toxin (botulism), ricin, saxitoxin, staphylococcal enterotoxin B, and trichothecene mycotoxins.

2. Routes of Exposure and Dissemination

a) Inhalation
The most likely terrorist scenarios for biological agents involve inhalation as the route of exposure. Many biological agents can be disseminated by aerosolization (mixing of the agent with a liquid and dispersing it with a spray device) or the dispersal of dry powders (possible with spores, toxins, and freeze-dried bacteria and viruses).

Airborne transmission of an infectious disease occurs by dissemination of either dust particulates containing an infectious agent or airborne droplet nuclei (small-particle residue of evaporated droplets containing microorganisms that remain suspended in air for long periods of time). Microorganisms that spread by airborne transmission can be dispersed widely by air currents and can easily be inhaled by the First Receivers during the handling of contaminated patients, their accessories, or equipment. Fortunately, not many diseases are spread by airborne transmission.
b) Dermal or Eye Contact

Most biological agents do not penetrate healthy, unbroken skin. (The exception to the rule - the trichothecene mycotoxins.) Thus, it is unlikely terrorists would have much success attempting to infect people through this route of entry. However, some of the diseases caused by these agents can be transmitted from one person to another through contact with blood and other body fluids (contact transmission). Skin and eye protection is required when handling patients with these diseases.

Droplet transmission can occur when droplets containing a microorganism are generated from an exposed patient during coughing, sneezing, and talking, or during certain procedures, such as suctioning. Droplets are propelled a short distance in air (usually 3 feet or less) and can be deposited on the First Receiver’s conjunctiva, nasal mucosa, or mouth. A mask and eye protection are required.

c) Ingestion

Terrorists might inject an agent directly into an intended victim. First Receivers are at risk to biological agents through needle sticks or puncture wounds from other sharp objects during the handling and treatment of infected patients.

d) Vector

Many diseases are naturally transmitted by bites from mosquitoes, fleas, ticks, etc. It is conceivable that terrorists might attempt to use vectors as a means to transmit some biological agents, although this scenario is far less likely than others.

3. General Health Effects of Biological Agents

The health effects identified in this module are designed to give First Receivers an overview of common signs and symptoms associated with terrorist use of biological agents.

The time lapse between exposure or contamination and the onset of symptoms varies with the type of agent, the dose received, the duration of exposure, the route of entry, and the individual susceptibility. With bacteria and viruses, onset is typically hours to days after exposure. On the other hand, when dealing with toxins the onset is usually minutes to hours after exposure. This rapid onset may cause First Receivers to mistakenly assume they are dealing with a chemical agent. Careful evaluation of both symptoms and circumstances of the illness is essential.

By weight, biological agents are generally more toxic in nature than chemical agents. The initial effects of many bacteria and viruses resemble
those of a common cold or flu. Therefore, many exposed individuals may
delay in seeking treatment until they are overcome by the illness, and First
Receivers may not realize they are dealing with a biological agent until
they receive more specific information or indicators. The effects of some
toxins resemble those of some of the chemical agents. Thus it is possible
to miss diagnosis the exposure and assume the exposure is a result of
chemical exposure. Some bacteria and viruses are contagious, but a
majority of them are not. The biological agents used in acts of terrorism
that can be transmitted from one person to another to the degree that they
require more than universal precautions are pneumonic plague, smallpox,
and viral hemorrhagic fevers. Toxins are not contagious.

C. Radiological/Nuclear Attacks

Incidents involving radioactive materials are uncommon because of the strict
requirements governing their use and transportation. However, with nuclear
devices falling into the category of potential agents used in acts of terrorism, it’s
important for the First Receiver to understand how radioactive materials can be
used for a terrorist event. Radiological/nuclear attacks involve the use, threatened
use, or threatened detonation of nuclear device, or the dispersal of irradiating or
radiological-contaminated materials. Four potential scenarios have been
identified:

- **Detonation of a Thermonuclear Bomb** – Detonation of a thermonuclear
  bomb is considered unlikely because it would be extremely difficult for a
terrorist to acquire a fully functional nuclear weapon. The use of this type
  of weapon by a terrorist organization would produce devastating effects,
  including thermal, blast overpressure, and radiation contamination. The
  activation of thermonuclear bomb would destroy a huge area in
  comparison to that of a conventional bomb, and it would overwhelm the
  emergency response effort in any community.

- **Sabotage/Attack of Nuclear Power Plant or Transportation Vehicle** –
  A terrorist might use an ordinary explosive device to damage a nuclear
  power plant, a nuclear storage facility, or a vehicle transporting nuclear
  materials. Because of existing safety procedures, checks, and balances
  used at U.S. commercial nuclear power plants, it is unlikely that any sort
  of terrorist attack or assault would be successful at creating a nuclear
  explosion or major release. Transportation vehicles, however, are more
  vulnerable to attack. If an attack did some how succeed, the First
  Receiver at the receiving hospital would follow established protocols in
  the local emergency response plans that are established in the communities
  these facilities are located in.

- **Use of Dirty Bomb** – A terrorist might use an ordinary explosive device
to disseminate radioactive materials such as those used in medical
profession and industry, which are so commonplace that they would be
relatively easy to obtain, despite the regulations that govern the use,
storage, and disposal of such materials. In general, radioactive materials
for medical use pose less of a health risk than those used in industry because they must be safe enough to use on patients. However, they can still cause harm when used improperly. A dirty bomb does not produce a nuclear explosion. It destroys property and kills people in the immediate vicinity like a conventional bomb according to the strength of the initial blast. While dirty bomb is likely to cause damage and a great deal of panic, it is unlikely to release lethal amounts of radiation. A dirty bomb is the most likely radiological weapon to be employed by terrorist organizations.

- **Dissemination by a Spray Device** – A terrorist group may disseminate radioactive materials with a spray device. This scenario lacks the immediate, dramatic results a bomb would produce, but contains frustrating complications of delayed discovery similar to those in a biological attack.

### 1. Types of Ionizing Radiation

Ionizing radiation is a general term applied to both electromagnetic waves and/or particulate radiation capable of producing ions by interaction with matter. The process of removing electrons from atoms is called ionization and also is the method by which radiation causes damage to the human body. The most common types of ionizing radiation are alpha particles, beta particles, protons, neutrons, gamma radiation, and x-rays. All radioactive materials give off at least one type of radiation. Many give off two or three. The main threats to the First Receiver involve the following three forms of ionizing radiation:

a) **Alpha Particles**

Energetic, positively charged particles (helium nuclei) emitted from the nucleus during radioactive decay that rapidly lose energy when passing through matter. They are commonly emitted in the radioactive decay of the heaviest radioactive elements such as uranium and radium as well as some manmade elements. Alpha-emitters are primarily uranium isotopes and are generally found in nuclear chemistry laboratories and isotope production facilities. They can also be found in hospitals that offer nuclear medical services. They are not likely to be used as a weapon unless combined with a conventional explosive device (dirty bomb).

Alpha particles lose energy rapidly in matter and do not penetrate very far: they travel only a few centimeters in ambient air and up to 60 micrometers into tissue. The high energy and short path result in a dense track of ionization along the tissues with which the particles interact. Alpha particles are unable to penetrate intact skin, and thus they are not an external hazard. However, alpha-emitting elements may enter the body through inhalation,
ingestion, or contamination of an open wound. Uptake of alpha particles into the body may develop into cancer.

b) Beta Particles
Beta particles interact much less readily with matter than do alpha particles. These particles are much smaller than alpha particles, but have far more penetrating power. They have the ability to travel a few centimeters in tissue and several meters in the air. Unlike alpha particles, beta particles have the ability to penetrate intact skin, potentially damaging the skin and internal organs. Beta particles can be inhaled or ingested just like alpha particles. Exposure to external sources of beta particles is potentially hazardous, but internal exposure is more hazardous. Shielding of beta particles takes heavier and thicker materials (i.e. thick piece of metal or inch of wood) to stop beta radiation. Examples of beta-particle emitters are the isotopes of carbon-14, gold-198, iodine-131, radium-226, cobalt-60, selenium-75, and chromium-51.

c) Gamma Radiation
Electromagnetic waves are emitted from the nucleus and consist of high energy and short wavelength with strong penetrating power. Ability to travel at the speed of light for considerable distances in ambient air and through heavy, thick materials. Ability to penetrate intact skin, resulting in skin burns and severe internal damage. Gamma radiation can easily pass completely through the human body or be absorbed by tissue, thus constituting a radiation hazard for the entire body. Dense shielding, such as lead, is required to stop gamma radiation. One source of gamma radiation in the environment is naturally occurring potassium-40. Manufactured sources include plutonium-239 and cesium-137.

2. Routes of Exposure

Each of the different routes by which an individual can be exposed to radioactive materials results in exposure to different parts of the body. According to the Environmental Protection Agency (EPA), the three basic radiation routes of exposure:

a) Inhalation
Exposure occurs when individuals breathe radioactive materials into the lungs. The primary concerns are radioactively contaminated particulates, aerosols, or gaseous radionuclide. Inhalation is the primary route of exposure for alpha or beta particle emitters.
  - Radioactive particles can lodge in the lungs and remain for a long period of time. As long as they remain and continue
to decay, the exposure continues. For radionuclides that decay slowly, the exposure continues over a long period of time.

- Alpha and beta particles can transfer large amounts of energy to surrounding tissue, damaging deoxyribonucleic acid (DNA) or other cellular material. This damage can eventually lead to cancer or other chronic effects.

b) Ingestion
Exposure occurs during the swallowing of radioactive materials. Alpha- and beta-emitting materials are of most concern for ingested radioactive materials. They release large amounts of energy directly to tissue, causing DNA and other cellular damage.

- Ingested materials can expose the entire digestive system.
- Some materials can also be absorbed and expose the kidneys and other organs as well as the bones.

c) Direct Contact (Dermal Contact/Penetration)
External exposure from radioactive materials is a concern that varies depending on the type.

- The threat of harm from alpha particles is reasonably limited since they cannot penetrate the outer layer of skin. However, they may still pose a risk if the skin is broken such as with an open wound.
- Beta particles can burn the skin in very high doses and/or damage the eyes.
- The greatest threat is from gamma radiation. While different radionuclides emit gamma radiation of different strengths, they can travel long distances and penetrate the entire body.

3. Types of Radiation Exposure

Three types of radiation exposure can occur: external irradiation, contamination, or incorporation. These three types of exposure events can happen in combination and can be complicated by physical injury or illness.

a) External Irradiation
This type of exposure occurs when all or part of the body is exposed to penetrating radiation from an external source. During the exposure, radiation is absorbed by the body or can pass completely through it. Following external exposure, an individual is not radioactive and can be treated like any other patient. Thus these individuals will pose little risk to the First Receiver.
b) Contamination
Refers to radioactive materials in the form or gases, liquids, and/or solids are present on/in a patient’s body. An external surface of the body, such as skin or clothing, can become contaminated, and if radioactive materials get inside the body (through the lungs, gastrointestinal tract, or wounds), the contaminant can become deposited internally. Contaminated individuals are at a significant risk due to close proximity to the radiation and the potential for a long duration of exposure unless decontaminated. These individuals act as a radioactive source and can both expose and contaminant the First Receiver and/or the hospital.

c) Incorporation
Uptake of radioactive materials occurs by body cells, tissues, and target organs such as bone, liver, thyroid, or kidney. In general, radioactive materials are distributed throughout the body based upon their chemical properties. Incorporation cannot occur unless internal contamination has occurred.

4. Overview of Health Effects

a) Stochastic Effects
Stochastic effects are those in which the probability within a population of the effect occurring increases with dose, without threshold. Any dose, therefore, has a certain probability, however low, of causing the effect. Stochastic effects may result from injury to a single cell or a small number of cells. Carcinogenic and genetic effects are examples of stochastic effects. In these, once the effect is induced, the severity is already determined by the nature of the effect. Stochastic effects are assumed to have some chance of occurring no matter how low the dose, applicable dose limits intend to limit the probability of stochastic effects occurring to an acceptable level. That is, any exposure to radiation involves a risk, and no risk should be undertaken without the expectation of a net benefit.

b) Non-Stochastic Effects
Non-stochastic, or deterministic, effects are those in which the severity of the effect varies with the dose. For these types of effects, a threshold dose may exist. That is, if the dose is kept below the threshold dose, the effect will not be observed. Non-stochastic effects are considered to result from the collective injury of a substantial number of cells in the tissue. Examples of such effects are cataracts, skin ulcerations or burns, depletion of blood-forming cells in bone marrow, and impairment of fertility.
c) Lethal Dose
Not only do various organisms vary in their sensitivity to radiation, but individuals of the same species also react differently. Because of this biological variability, the dose which is lethal to 50% of the exposed individuals is used. The concept used is lethal dose (LD) 50/30. LD 50/30 is defined as the dose of radiation expected to cause death within 30 days to 50% of the exposed population, without medical treatment. The best estimate for the LD 50/30 is between 300 and 500 rems, and is usually stated as 450 rem.

d) Effects of Chronic Exposure
Chronic radiation exposure effects involve a low dose over a relatively long period of time (weeks to years). The effects, if any occur, do not manifest themselves until many years after the exposure. Other than radiation sickness associated with acute exposures, there is no unique disease from radiation, but only a statistical increase in existing conditions. The body is better equipped to handle chronic exposures than it is at acute exposures. The body can repair the damage from chronic doses because a smaller percentage of cells will need repair at any given period of time. The body has enough time to replace dead or non-functioning cells with healthy one. The following are possible chronic effects from exposure to ionizing radiation: cancer, cataracts, sterility or other damage to the reproductive system, damage to blood vessels, genetic changes, and shorten life span. First Receivers are not typically subjected to chronic effects based on their limited duration of exposure and limited exposure levels during the handling of contaminated patients.

e) Effects of Acute Exposure
Acute effects are classified as effects that occur within 1-2 months of the exposure. Acute effects are often referred to as Acute Radiation Syndrome. This definition is somewhat arbitrary in view of the various factors that can affect the length of time between the exposure and the effect. Normally, acute effects are only observed if the dose is high and delivered over a short time. Some possible health effects for acute exposure include reduced blood count, hair loss, nausea, and fatigue. First Receivers are subjected to acute effects during the handling of contaminated patients.

(1) Whole Body Exposure Effects
The effects of radiation sickness will vary depending on the type of radiation, how much of the body was exposed, the depth of penetration, the dosage received, and whether the exposure is from a single event or multiple events (radiation exposures are cumulative). The following effects
apply to whole-body exposures. Initial symptoms may be delayed for 2 to 6 hours, even with high doses.

- Below 100 Roentgen Equivalent Man (rem), exposed individuals are not likely to have any observable effects. Some minor blood changes may result above 50 rem, but they will have little impact on the body.
- Whole-body exposures above 100 rem may cause nausea and vomiting for 1 to 2 days and a temporary drop in the production of new blood cells.
- As the exposure increases, so do the signs and symptoms of acute radiation syndrome. Initial effects may include nausea, vomiting diarrhea, dizziness, fatigue, headache, and loss of appetite. Higher doses may also result in fever, sweating, and difficulty in breathing.
- Above 350 rem, the initial effects will be followed by a period of apparent wellness. But usually within 2 to 3 weeks, exposed individuals will become sick again and experience infection, electrolyte imbalance, diarrhea, bleeding, cardiovascular collapse, and sometimes lapses in consciousness.
- A whole-body of 450 rem is considered the Lethal Dose (LD) 50/30. However, all individuals exposed at this level can survive if treated with proper medical attention.
- Above 1000 rem, the chances of survival drop significantly, even with aggressive medical treatment.
- Individuals exposed above 5000 rem will die within 48 hours. There is no effective treatment for such acute exposures. Treatment is limited to making patients as comfortable as possible.

(2) Partial-Body Exposure Effects
Partial-body exposure results in radiation burns that are typically slow in development, although exposed individuals may experience the early symptoms associated with whole-body exposures – nausea and vomiting.

- Roughly 2 to 3 weeks after partial-body exposures of 300 to 1000 rem, effects may resemble those of first-degree sunburn.
- Higher exposures (up to 2500 rem) will produce blisters within 1 to 2 weeks.
- Partial body-exposures exceeding 3000 rem may develop into slow healing ulcers or gangrene.
- Extremely high exposures (greater than 3000 rem) manifest with tingling, pain, redness, and swelling very soon after the initial exposure
VI. General Overview of Personal Protective Equipment

Protective clothing must be worn whenever a First Receiver faces potential hazards arising from exposure to NBC agents. Typical protective clothing is designed to protect the First Receiver from exposure to these agents during activities involved in the handling and treatment of contaminated patients.

A. Chemical Protective Clothing

The purpose of chemical protective clothing (CPC) is to shield or isolate First Receivers from the NBC agents that may be encountered during assigned activities. Two types of CPC are often recognized: liquid-splash protective clothing and vapor-protective clothing. CPC is made from a variety of different materials, none of which protects against all types of NBC agents. Each material provides protection against certain agents, but only limited or no protection against others. The manufacturer of a particular suit must provide a list of agents for which the suit is effective. Selection of CPC depends on the specific agent and on the specific tasks to be performed by the wearer.

CPC is designed to afford the wearer a known degree of protection from a known type, concentration, and length of exposure to NBC agent, but only if it is fitted properly and worn correctly. Improperly worn equipment can expose and endanger the First Receiver. One factor First Receivers should remember during the selection process is that most protective clothing is designed to be impermeable to moisture, thus limiting the transfer of heat from the body through natural evaporation (i.e., heat stress). Other factors include the garment’s degradation, permeation, and penetration abilities and its service life.

1. Whole Body Protection Suits

Whole body protection suits can either be fully encapsulating suits or splash suits. Fully encapsulating suits protect the individual from chemical splashes, gases, and vapors. The word encapsulate means to totally enclose, as if in a capsule. These are used with supplied air respirators so that a sealed environment is created which keeps out contaminants in any form. A fully encapsulating suit with a self-contained breathing apparatus (SCBA) can weigh up to nearly 50 pounds.

A one piece whole body suit, similar to a coverall, provides better protection than a two piece suit because the two piece suit has an opening between the jacket and pants. In addition, most one piece suits have attached hoods.

Splash suits are non-encapsulating suits. They usually consist of a jacket and hood in combination with a pair of pants or bib overalls. This type of
suit provides protection from chemical splashes only. A splash suit is usually worn with protective boots, gloves, and a respirator. Duct tape or other chemical resistant tape is used to seal the overlap between sleeves and gloves, and suit legs and boots.

2. Non-Chemical Protective Clothing
Additional types of non-chemical protective clothing includes: radiological anti-contamination clothing, and barrier gowns and smocks. Barrier gowns are waterproof and protect against exposures to biological materials, including body fluids, but do not provide adequate skin or mucous membrane protection against chemicals.

3. Gloves
Hands are the most likely body part to come into contact with NBC agents, so gloves are critical for First Receiver protection. Gloves come in different materials and thicknesses. The ability of a glove to withstand chemical permeation is very important. In many situations encountered by the First Receiver, it may be common to wear more than one pair of gloves.

Outer gloves are usually used to protect chemical resistant gloves from damage due to abrasion, puncture, rips, and gross contamination. Often these outer gloves are disposable because once gloves are contaminated on the outside surface it is very difficult to decontaminate them. Depending on the type of glove material, contamination will eventually permeate through. Once glove breakthrough has occurred, the gloves become a source of exposure to the First Receiver. Because of this possibility, strict rules must be set as to when gloves are discarded.

One problem area with gloves is that chemicals can get into the glove cuff if care is not taken. To solve this problem, gloves with extra long sleeves are sometimes used. Also, care must be taken to put the suit or jacket sleeves over the glove cuffs. Then, the sleeves are sealed with tape. An additional pair of vinyl, latex, or cotton inner (for radiological agents) disposable glove may also be used.

4. Boots
Boots are made from chemical resistant materials to protect the feet from NBC contact. They are available in a wide range of materials. Boot plastic is much thicker than glove material, so permeation is less of a problem. However, eventually boots must also be discarded. Disposable boot covers are commonly used by First Receivers to minimize contamination. The boot covers are discarded after each use.

5. Face Shields and Goggles
When a full-face respirator is used, the face and eyes are protected. However when wearing half-face respirators, particulate filtering facepieces, or no respiratory protection, face shields or goggles are used to protect the face from NBC agents.

The following table summarizes the different materials used in the manufacturing of CPC.

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butyl Rubber</td>
<td>Man-made rubber. Resistant to many chemicals. Low resistance to petroleum based solvents and halogenated hydrocarbons. Relatively expensive. Used in boots, gloves, aprons, splash suits, and fully encapsulating suits.</td>
</tr>
<tr>
<td>Chloropel</td>
<td>A plastic material. Also called CPE, chlorinated polyethylene, or polychloroprene. Resistant to some chemicals. Used in splash suits and fully encapsulating suits.</td>
</tr>
<tr>
<td>Natural Rubber</td>
<td>Natural rubber from rubber trees. Resistant to acids, caustics, alcohols, and oils. Inexpensive. Used for boots, gloves, and respirator facepieces and hoses.</td>
</tr>
<tr>
<td>Nitrile</td>
<td>Synthetic rubber. Also referred to as BUNA-N, NBR, milled nitrile, and nitrile latex. Resistant to acids, caustics, alcohols, gasoline, and some petroleum and halogenated solvent. Inexpensive. Used in boots and gloves.</td>
</tr>
<tr>
<td>Polyethylene</td>
<td>A plastic material. Used as a covering for some disposable suits, because it increases the resistance against acids, caustics, and salts. Also used for disposable suits, gloves, and boots.</td>
</tr>
<tr>
<td>Polyvinyl Alcohol</td>
<td>A plastic material. Also called PVA. Excellent resistance to aromatic and halogenated solvents. Not resistant to water or water-based chemicals. Used for gloves.</td>
</tr>
<tr>
<td>Polyvinyl Chloride</td>
<td>A plastic material. Also called PVC. Resistant to acids and caustics. Used in boots, gloves, aprons, splash suits, and fully encapsulating suits.</td>
</tr>
<tr>
<td>Saranex®</td>
<td>A plastic material. Used with disposable materials such as Tyvek®. Used as a general purpose material for disposable suits, boots, and gloves.</td>
</tr>
<tr>
<td>Tyvek®</td>
<td>A plastic fiber. Reasonable puncture and abrasion resistance. Good resistance to particulates. Low protection from chemicals by itself. Chemical resistance is increased when coated with materials, such as polyethylene and Saranex®. Inexpensive. Used for disposable garments.</td>
</tr>
<tr>
<td>Viton</td>
<td>A plastic material similar to Teflon®. Provides excellent resistance to petroleum and halogenated solvents (chemicals that permeate many other types of materials. Expensive. Used for gloves and fully encapsulating suits.</td>
</tr>
</tbody>
</table>
6. Permeation, Degradation, and Penetration

The effectiveness of CPC can be reduced by three actions: permeation, degradation, and penetration. These are also characteristics that must be considered when choosing and using protective ensembles.

a) Permeation
Process that occurs when a chemical passes through a material on a molecular level. Typically, there is no visible evidence of agents permeating a material. The rate at which an agent permeates CPC depends on factors such as the chemical properties of the agent, nature of the protective barrier in the CPC, and concentration of the chemical on the surface of the CPC.

b) Degradation
Process that occurs when characteristics of a material are altered, breaks down the CPC material, through contact with NBC substances. Examples include cracking, brittleness, and other changes in the structural characteristics of the garment. The most common observations of material degradation are discoloration, swelling, loss of physical strength, or deterioration.

c) Penetration
Process that occurs when material enters an opening or a puncture in a protective material. Rips, tears, and cuts in protective materials – as well as unsealed seams, buttonholes, and zippers – are considered penetration failures.

B. Respiratory Protection

Respiratory protection is a primary concern to First Receivers because one of the major routes of exposure to NBC agents is inhalation. Respiratory protection devices protect the First Receiver from the inhalation of these agents. However, each type of respiratory protection equipment is limited in its capabilities. The two basic classifications of respirators are as follows:

- Atmosphere-Supplying Respirators
  - Self-Contained Breathing Apparatus (SCBA)
  - Supplied Airline Respirators (SAR)
  - Combination airline and SCBA

- Air-Purifying Respirators (APRs)
  - Particulate Removing
  - Vapor and Gas Removing
  - Combination Particulate and Vapor-and-Gas Removing

1. Types of Respirators
Respiratory protection is a primary concern to First Receivers based on one of the major routes of exposure to chemical, biological, and/or radiological agents is inhalation. Respiratory protection devices protect the First Receiver from the inhalation of these harmful agents. A respirator is a device that covers the nose and mouth or the entire face or head of the individual. Respirators can have two general types of fit: (1) Tight Fitting Facepieces, and (2) Loose Fitting Facepieces.

a) Tight Fitting Facepieces

- **Half-Mask** – This respirator covers the area from above the nose to underneath the chin.
- **Full-Facepiece** – This respirator covers from above the eyes to below the chin. Both the half-mask and full-facepiece respirators fit tight to the face. A full-facepiece provides protection from eye irritants.

b) Loose Fitting Facepieces

- Hood that covers the head, neck, and a portion of the shoulders.
- Helmet type hood that offers head protection against overhead impact and penetration hazards.
- Loose fitting facepiece covers the entire facial area but only forms a partial seal with the face. It does not cover the neck and shoulders and may not offer over head hazard protection.
- Encapsulating suit that is directly supplied with breathing air.

2. Air-Purifying Respirators

APRs contain an air-purifying filter, canister, or cartridge that removes specific contaminants found in the ambient air as it passes through the air-purifying element. Based on what cartridge, canister, or filter is being used, these purifying elements are generally divided into the three following types:

- Particulate-removing APRs
- Vapor and Gas removing APRs
- Combination particulate/vapor/gas APR

APRs may be powered (PAPRs) or non-powered. APRs do not supply oxygen or air from a separate source, and they protect only against specific contaminants at or below certain concentrations. Combination filters combine particulate-removing elements with vapor-and-gas removing elements in the same cartridge or canister.

Respirators with air-purifying filters may have either full facepieces that provide a complete seal to the face and protect the eyes, nose, and mouth or half facepieces that provide a complete seal to the face and protect the
nose and mouth. Disposable filters, canisters, or cartridges are mounted on one or both sides of the facepiece. Canister or cartridge respirators pass the air through a filter, sorbent, catalyst, or combination of these elements to remove specific contaminants from the ambient air.

As with CPC, no single canister, cartridge, or filter protects against all chemical hazards. Therefore, First Receivers must know the hazards present on the incoming patients in order to select the appropriate canisters, filter, or cartridges.

a) Negative Pressure Respirators
APRs are commonly called negative pressure respirators. They depend on the individual’s respiratory system to pull the air through the filters. The suction created when an individual inhales draws air into the respirator. This suction creates a momentary negative pressure. During inhalation, the negative pressure brings contaminants into the facepiece through leaks and improper seals. During exhalation, air is blown out and a positive pressure is created in the facepiece. It’s important to stress that negative pressure respirators must only be used in atmospheres containing oxygen levels above 19.5%.

b) Powered Air Purifying Respirators (PAPR)
The PAPR uses a blower to force air through the air-purifying element. To be certified as a PAPR by NIOSH, the blower must provide at least 4 CFM of air to a tight-fitting facepiece and at least 6 CFM to a loose fitting facepiece, helmet, or hood. The great advantage of the PAPR is that it usually supplies air at positive pressure, reducing inward leakage of contaminants when compared with negative pressure respirators. As a result of this advantage, PAPRs are assigned a higher protection factor.

c) Particulate-Removing Filters
Particulate filters protect the First Receiver from particulates (including airborne diseases, biological agents) in the air. These filters may be used with half facepiece respirators or full facepiece respirators. Eye protection must be provided when the full facepiece respirator is not worn.

Particulate-removing filters are classified by their level of effectiveness and regulated by Title 42 (Public Health) CFR 84, Approval of Respiratory Protection Devices. They are divided into nine classes, three levels of filtration (95, 99, and 99.97 percents), and three categories of filter degradation. The following three categories of filter degradation indicate the use limitations of the filter:

- **N** – not resistant to oil
In the healthcare service, particulate-removing filters are used primarily during the handling of emergency medical incidents, but they may be used to protect against toxic particulates, radionuclides, mists, metal fumes, asbestos, and similar hazards. Particle masks (also known as dust masks) are also classified as particulate-removing air-purifying filters. These disposable masks protect the respiratory system from large-sized particulates. These types of masks should never be used by First Receivers during the handling and decontamination of contaminated patients. They provide no protection against chemical or radiological agents. They may have some practicality in the handling of patients contaminated with biological agents.

d) Vapor- and Gas-Removing Filters
As the name implies, vapor and gas removing cartridges and canisters are designed to protect against specific vapors and gases. They typically use some kind of sorbent material to remove the targeted vapor or gas from the air. Individual cartridges and canisters are usually designed to protect against related groups of chemicals such as organic vapors or acid gases. Many manufacturers color-code their canisters and cartridges so it is easy to see what contaminant(s) the canister and cartridge is designed to protect against. Manufacturers also provide information about contaminant concentration limitations.

e) Combination Particulate/Gas/Vapor Removing
These respirators use particulate removing filters with a chemical cartridge or canister for exposure to multiple contaminants.

3. Atmosphere-Supplying Respirators

There are two types of atmosphere-supplying respirators – Supplied Airline Respirators (SAR) and Self-Contained Breathing Apparatus (SCBA). These types of respirators provide a respirable atmosphere to the wearer, independent of the ambient air. The breathing atmosphere is supplied from an uncontaminated source, which must conform to certain purity levels. The air source for an atmosphere supplying respirator must conform to Grade D requirements as specified in the Compressed Gas Association Standard, G-7.1-1989, Commodity Specification for Air. Atmosphere-supplying respirators fall into three groups:


a) Airline Respirators

Airline Respirator is an atmosphere supplying respirator where the wearer does not carry the breathing source. The apparatus typically consists of a facepiece, a belt-or facepiece mounted regulator, up to 300 feet of air supply hose, an emergency escape pack or emergency breathing support system, and a breathing air source (either cylinders mounted on a cart or a portable breathing-air compressor). Because of the potential for damage to the air-supply hose, the emergency escape pack provides enough air (5 to 15 minutes) for the user to escape to a safe area. NIOSH classifies airline respirators as Type C Respirators. Type C respirators are further divided into two approved types: (1) regulator and facepiece only, and (2) airline respirator with escape bottle. The second classification is used in immediately dangerous to life and health atmosphere (IDLH), potential IDLH, and at the point of release of unknown agents. Airline respirators may be equipped with tight fitting facepieces (full facepiece respirator) or loose fitting facepieces (i.e. hoods, helmets).

b) SCBA

SCBA consists of a facepiece and regulator mechanism connected to a cylinder of compressed air that is worn by an individual. SCBA provides respiratory protection against gases, particles, and oxygen deficient environments. The use of SCBA provides more mobility than the airline respirators and independent of the surrounding as the breathing cylinder is carried by the wearer. SCBA may be used in immediately dangerous to life and health (IDLH) environments and in oxygen-deficient atmospheres either as escape-only devices or for entry into and escape. A full facepiece is most commonly used with SCBAs. There are two major types of SCBAs: closed-circuit and open-circuit.

c) Combination Airline Respirators

- Combination SCBA and Airline Respirators – These units are airline respirators with an auxiliary self-contained air supply that can be used if the primary air supply fails. Since they have escape capabilities, these respirators are usable in IDLH and oxygen deficient environments.
- Combination Air-Purifying and Airline Respirators – Combination of an airline respirator with an auxiliary air-purifying element attached, which if properly selected provides protection in the event the air supply fails.

4. Respiratory Protection Limitations
To operate effectively, First Receivers must be aware of the limitations of respiratory protection devices. These include limitations of the respirator wearer, the respiratory protection devices, and the air supply.

**a) Respirator User Limitations**

The following physical, medical, and mental limitations affect the First Receivers’ ability to use respiratory protection equipment effectively:

- **Physical Condition** – The First Receiver must be in good physical condition in order to maximize the activities that can be performed and to stretch the air supply as far as possible.
- **Agility** – Wearing respiratory protection, in particular the SCBA, restricts the First Receivers’ movements and affects their balance.
- **Facial Features** – The shape and contour of the face affect the wearer’s ability to get a good facepiece to face seal. Fit testing must be performed to ensure that tight fitting facepieces fit properly.
- **Neurological Functioning** – Good motor coordination is necessary for operating effectively in respiratory protection equipment.
- **Mental Soundness** – First Receivers must be sound of mind to handle emergency situations that may arise during the course of activities.
- **Muscular/Skeletal Condition** – First Receivers must have the physical strength and size required to perform assigned tasks while wearing respiratory protection devices (SCBA).
- **Cardiovascular Conditioning** – Poor cardiovascular conditioning can result in heart attacks, strokes, or other related problems during strenuous activities.
- **Respiratory Functioning** – Proper respiratory functioning maximizes the wearer’s operation time while wearing respiratory protection.
- **Respiratory Protection Training** – First Receivers’ must be knowledgeable in every aspect of respiratory protection use.
- **Self-Confidence** – First Receivers’ belief in their abilities has an extremely positive overall effect on the actions performed.
- **Emotional Stability** – The ability to maintain control in an excited or high-stress environment reduces the chances of making a serious mistake.

Assignment of respiratory protection should only be to individuals who have been medically cleared as fit to wear respiratory protection devices.
b) Respiratory Protective Equipment

First Receivers must also consider the following limitations of respiratory protective equipment:

- **Limited visibility** – Respirator facepieces reduce peripheral vision, and facepiece fogging can reduce overall vision
- **Decreased ability to communicate** – facepieces hinder and distort voice communication
- **Increased weight** – depending on the type of respirator (PAPR, SCBA) and the model, respiratory protection equipment can add additional weight to the wearer – 6 to 8 pounds for PAPR, and 25 to 35 pounds for SCBAs
- **Decreased mobility** – increase in the weight and splinting effect on the SCBA harness straps reduce the wearer’s mobility
- **Inadequate oxygen levels** – APRs cannot be worn in IDLH or oxygen-deficient atmospheres
- **Chemical specific** – APRs can only be used to protect against certain chemicals.

c) Air Supply

SCBA have maximum air-supply durations that limit the amount of time an individual has to perform the assigned tasks. Some of the limitations affecting air supply include:

- **Physical condition of user** – poor physical condition of the user will result in faster depletion of oxygen supply
- **Degree of physical exertion** – The harder that the wearers exert themselves, the faster the oxygen supply is depleted
- **Emotional stability** – Individuals who become excited increase their respirations and use air faster
- **Condition of equipment** – Minor leaks and poor adjustment of regulators can result in excess oxygen loss
- **Cylinder pressure before use** – If the cylinder is not filled to capacity, the amount of working time is reduced proportionately
- **Training and experience** – Poorly trained and inexperienced individuals use oxygen at a faster rate

<table>
<thead>
<tr>
<th>FACEPIECE STYLE</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half Facepiece</td>
<td>First Receiver may wear any appropriate eyewear that does not interfere with the respirator seal</td>
<td>If there is a break in the seal between the mask and the face, contaminated air can enter. Fit testing must be conducted prior to initial use and annually, and user seal checks must be performed before each use. Does not provide eye protection</td>
</tr>
<tr>
<td>Full Facepiece</td>
<td>When used with a PAPR, a</td>
<td>If there is a break in the seal between the</td>
</tr>
</tbody>
</table>
tight fitting facepiece might allow a worker to pull filtered air into the facepiece if battery fails.

- Provides eye and face protection.

mask and face, contaminated air can enter. Fit testing must be performed prior to initial use and annually, and user seal checks must be performed before each use.

<table>
<thead>
<tr>
<th>Loose Fitting Helmet/Hood</th>
<th></th>
<th>Fit Testing Not Required</th>
<th>When used with a PAPR, the hood will provide little or no protection during battery/blower failure.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>▪ Can be worn by employees with facial hair, facial scars or other deformities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Provides eye and face protection</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ More comfortable than tight fitting respirators</td>
<td></td>
</tr>
</tbody>
</table>

5. Respiratory Protection Program

Like all operating procedures and policies, a respiratory protection program must be defined in a written document that is reviewed periodically and revised as necessary. According to program details in OSHA’s Respiratory Protection Standard (29 CFR 1910.134), the seven key elements that every respiratory protection program should contain are:

1) A written plan detailing how the program will be administered.
2) A complete assessment and knowledge of respiratory hazards that will be encountered in the workplace.
3) Procedures and equipment to control respiratory hazards, including the use of engineering controls and work practices designed to limit or reduce employee exposures to such hazards.
4) Guidelines for the proper selection of appropriate respiratory protective equipment.
5) An employee training program covering hazard recognition, the dangers associated with respiratory hazards, and proper care and use of respiratory protective equipment.
6) Inspection, maintenance, and repair of respiratory protective equipment.
7) Medical surveillance of employees.

a) Facepiece Fit Testing

Fit testing helps to ensure a full and complete seal of the mask to the face. Testing must be performed prior to use by employees. The requirements for a proper fit prohibits the wearer of any facial hair such as beards or sideburns that would interfere with a complete seal of the facepiece on the wearer. Medical clearance is required before fit testing. No fit testing is required for loose-fitting facepiece PAPR.
b) Medical Clearance Evaluations

Medical evaluation requirements are required for individuals using respiratory protection. The initial medical evaluation is performed initial, when the individual is placed in the respiratory protection program and annually there after. Annual evaluation may be extended based on the professional judgement of the physician.

C. Protective Ensembles

The EPA has established the following levels of protective equipment: Level A, Level B, Level C, and Level D. NIOSH, OSHA, and the U.S. States Coast Guard (USCG) also recognize these levels. They can be used as the starting point for ensemble creation; however, each ensemble must be tailored to the specific situation in order to provide the most appropriate level of protection.

1. Level A

Provides the maximum protection available for respiratory, eye, and skin protection. It includes a National Institute of Occupational Safety and Health (NIOSH) approved positive-pressure full face-piece self-contained breathing apparatus (SCBA) or positive-pressure supplied-air respirator (SAR) with escape SCBA. A completely encapsulating chemical-protective suit, chemical-resistant inner and outer gloves, chemical-resistant boots, and an additional disposable suit, gloves, and boots (dependent on suit construction may be worn over totally-encapsulating suit) are part of the ensemble. Under OSHA, Level A protection is required when certain environmental conditions are or may be present. These include the following conditions:

a. Agent of concern has been identified or is unknown, and requires the highest level of protection for the respiratory system, skin, and eyes based on ambient concentrations (or potential for) of implicated vapors, gases, or particulates; or when site conditions or normal activities carry a significant exposure risk for splash, immersion, or spray to an agent that can be absorbed transdermally;

b. Agents or substances that are a known or suspected significant hazard to the skin;

c. Activities are performed in confined, poorly ventilated areas, and the absence of conditions requiring Level A protection have not yet been determined; or

d. Incident is uncontrolled or information is unknown about: the type of agent, the dissemination method, if dissemination is still occurring or it has stopped.

Incorporation of Level A use in incident response by First Receivers is not conducive to sustain medical operations; requires the highest level of
training requirements, suit acclimation, medical monitoring; and provides the shortest length of time in a protective garment. Additionally, Level A protection for First Receivers will typically exceed the protection level necessary to accomplish the health-care facility mission. The complete encapsulation condition of Level A diminishes the First Receiver’s movement, ability to access patients, and ability to render medical care.

2. Level B.

Protection includes the maximum respiratory protection while including lesser degrees of protection for skin. Ensemble requirements include a NIOSH-approved positive-pressure, full face-piece SCBA, or positive-pressure SAR with escape SCBA, hooded chemical resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls), chemical resistant inner and outer gloves along with chemical resistant boots. Level B protection is required during the following conditions:

a. Agent and atmospheric concentration are known and requires a high level of respiratory protection and less skin protection;

b. Atmosphere contains less than 19.5 percent oxygen; or

c. Vapors or gases are present (incomplete identification only) but are not suspected to be harmful to the skin or have significant transdermal absorption potential.

Level B protection requires a high level of training, medical monitoring, and sustainability issues. Ensembles typically restrict motor skills less than Level A, but are still cumbersome to perform assigned duties.

3. Level C.

Defined as a liquid splash-resistant suit with the same level of skin protection as Level B, along with a full-faced positive or negative pressure respirator (a filter-type mask) rather than an SCBA or air line, used when the concentration(s) and type(s) of airborne substances(s) are known and the criteria for using air-purifying respirators are met. Level C protection is adequate for the following conditions:

a. Atmospheric contaminants, liquid splashes, or other direct contact may adversely affect or be absorbed through any exposed skin;

b. Types of air contaminants have been identified, concentration levels established, and an air-purifying respirator (APR) is available that can remove the contaminants; and

c. All criteria for the use of APRs are met.
Level C is increasingly supported as the ensemble of choice for First Receivers engaged in warm zone care of potentially contaminated patients.

4. **Level D**

Equivalent to everyday uniforms. It may include a variety of components but is not designed to offer any significant protection against chemical, biological or radiological agents.

**D. Personal Protective Equipment for First Receivers**

First Receivers are limited in their exposures to chemical, biological, and radiological agents that are transported to the hospital as contaminants on the exposed individual(s) skin, hair, bodily fluids, clothing, or personal effects. The classification of First Receivers typically includes personnel in the following roles: clinicians and other hospital staff who have a role in receiving and treating contaminated individuals (e.g. triage, decontamination, medical treatment, and security) and those whose roles support these functions (e.g., set up and patient tracking).

The source of exposure for the First Receiver is admission of exposed individuals from the scene of the incident. Two categories of this source can be identified: (1) exposed individuals are decontaminated at the scene and transported to the receiving hospital; and (2) self-referred individuals not participating in decontamination at the scene. Decontamination of exposed individual(s) at the scene of the incident dramatically lessens the amount of agent contaminant that the First Receiver is potentially exposed to during patient handling procedures. Individuals at the point of release of gases and vapors are exposed at high concentrations. Exposed individuals that self-admit to the hospital prior to decontamination will tend to be healthier (i.e. less exposure/contamination) than the individuals at the point of release unable to leave or release from the scene. Self-admitted individuals will, typically, have less contamination, thus a reduction in secondary exposure to First Receivers. Based on these conditions, Level C protection is anticipated to provide adequate protection to First Receivers during work conducted in areas classified as Hospital Decontamination Zone. Level D protection would be appropriate for operations conducted in the Hospital Post-Decontamination Zone. The following table illustrates the Zone classification, activities conducted and the minimum PPE requirements.
<table>
<thead>
<tr>
<th>Zone Classification</th>
<th>Zone Description</th>
<th>Minimum PPE</th>
</tr>
</thead>
</table>
| Decontamination Zone        | - Area where the type and quantity of agent is unknown and contaminated individuals, equipment, or waste is present.  
- Source of exposure includes: contaminated individual(s), their belongings, equipment, or waste  
- Potential Areas – initial triage and/or medical stabilization area, pre-decontamination staging area, decontamination area, and post-decontamination inspection area.  
- Includes the following team members; decontamination representatives; physicians, nurses, nurse practitioners, physicians’ assistants, and others (Clinicians); set-up/tear-down and support crews; security staff; and tracking clerks. | Level C Protection  
- NIOSH approved Hooded Powered Air Purifying Respirator (PAPR) that provides a protection factor of 1000 (Substitute tight fitting PAPR face-piece if hooded type is not available).  
- Combination 99.97% efficiency particulate filter/organic vapor/acid gas respirator cartridge (NIOSH approved); or NIOSH approved CBRN cartridge.  
- Chemical resistant laminate suit (Tyvek®F or CPF 4 Fabric).  
- Chemical resistant boots.  
- Double layer of protective gloves (inner set of nitrile gloves and outer set of butyl rubber gloves; or double set of nitrile gloves).  
- Head covering and eye/face protection (if not part of respirator).  
- Suit openings sealed with tape. |
| Post-Decontamination Zone   | - Area that is considered uncontaminated – includes the emergency department.  
- Handling and treatment of decontaminated individual(s) when secondary exposure may result from bodily fluids including respiratory off-gassing, skin, and hair.  
- Personnel and equipment are not expected to become contaminated in this area. | Level D Protection  
- Medical gown/smock.  
- Double set (if feasible) of non-sterile (i.e. nitrile medical exam gloves) gloves.  
- Respiratory Protection (dependent on situation and activity, may require surgical mask or N-95 respirator), if needed/required. |
VII. All Hazards Approach to Decontamination

An act of terrorism involving the use of chemical, biological, or radiological agents will typically result in a large number of contaminated victims. Potentially, a majority of these individuals may arrive at the hospital within a short period of time.

The dose of toxic substances influences the magnitude of health effects, and since dose is a function of both concentration and time, First Receivers should initiate decontamination of victims as soon as possible. The main focus of the decontamination process is the prevention of contaminated individuals from entering the hospital facilities – leading to direct and secondary exposures to First Receivers, Support Personnel, and unaffected patients; and the direct contamination of the facility.

Due to the ever increasing threat in the use of chemical, biological, or radiological agents as a weapon of terrorism it is imperative that hospitals design for an all hazards approach to decontamination versus the development of specific agent plans. Important features to this method of design, include; adaptability of the approach, effective use of time, efforts, financial components, and resources.

Three objectives of an all-hazards approach should be focused on during the development: (1) prevention of contaminated individuals into the hospital facility; (2) timely and efficient decontamination of individuals; and (3) protection of First Receivers from secondary exposure and injury.

Because decontamination procedures, terminology, and other details may differ greatly from organization to organization, First Receivers should know their hospital’s predetermined decontamination procedures. This module discusses contamination types, decontamination methods and types, and how to implement decontamination procedures.

A. Regulatory and Guidance Requirements

Under Federal law, 42 CFR 489.24, hospital facilities are not allowed to refuse medical or emergency treatment to individual in need who report to the hospital. Based on this requirement, all hospitals must have the capability to care for any contaminated individual who arrives with an emergency medical condition.

The authority for accredited health care facilities is the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). JCAHO has identified specific requirements under the emergency management standards EC 1.4 and 1.6. This standard requires the healthcare facility to be prepared to decontaminate patients. In addition, JCAHO requires that healthcare facilities:
- Implementation and utilization of an internal incident management system.
• Mitigate effects from possible contaminated patients presenting to the facility by conducting a hazard vulnerability analysis. This should identify potential credible hazards and threats to life, safety, property, and environment.

• Preparations to address contaminated casualty issues by developing decontamination plans. These plans must address the health care facility’s normal approach to individual patient decontamination methods. In addition, these plans require evaluation and validation by regular drills and exercises formatted to test the plans’ efficiency and effectiveness.

Recent revisions to the JCAHO standards also address the need for all-hazards approach to decontamination. JCAHO element of performance 21 from standard EC.4.10 requires that each healthcare facility emergency management plan “identifies a means for radioactive, biological, and chemical isolation and decontamination”.

In addition to JCAHO requirements, the following organizations have provided additional guidance/requirements:

- Regulations affecting decontamination team training are primarily those of Occupational Safety and Health Administration’s (OSHA) Hazardous Waste Operations and Emergency Response regulations (29 CFR 1910.120). Though the emergency response provisions were written for operations at the scene of a release, OSHA requires healthcare facility personnel (First Receivers) providing decontamination services to be trained to the First Responder “Operations” level. Annual refresher training or demonstration of competency is also required.

- National Fire Protection Administration (NFPA) standards require medical facilities to have the ability to perform decontamination. These standards clarify the minimum level of competency required. Healthcare facilities must have a decontamination area with proper ventilation, and plans for the restriction of access and containment of runoff. These standards also require the facility to provide trained, in-house personnel to decontaminate and care for contaminated patients.

- The Agency for Toxic Substances and Disease Registry (ATSDR) provides a series of guidelines to help local emergency departments, communities, and other policymakers in the development of their own response plan for hazardous materials incidents (i.e. NBC agents).
B. Basic Terminology of Contamination

1. Contamination
Anytime NBC agents are used in an act of terrorism and patients or self-referrals are admitted to the hospital, it is possible that First Receivers, their equipment, and non-healthcare personnel may become contaminated. Furthermore, there is a risk that contamination will spread beyond the point of initial contact. In other words, those patients who were initially contaminated can then spread contamination wherever they go. Contamination can be categorized as primary or secondary depending on how and where it occurs. Other categories include surface and permeation contaminations. Secondary contamination is the main source facing First Receivers.

a) Primary (or Direct)
Primary or direct contamination occurs at the point of release of the terrorist NBC agent. Primary contamination is the direct transfer or exposure of the general population with the NBC agent. First Receivers will not have contact with this form of contamination unless the hospital itself is the primary target and the release point of the agent.

b) Secondary
Secondary contamination (sometimes referred to as cross contamination) is the contamination of First Receivers, other hospital personnel, hospital facility, or equipment outside of the initial release point of the NBC. A victim of a terrorist attack who is rushed to an ambulance without being decontaminated can contaminate the ambulance, emergency medical services personnel, emergency room, and physicians and nurses (i.e. First Receivers) treating the victim. Additionally, many victims of the attack may self-refer to the hospital resulting in contamination of the facility and personnel.

c) Surface and Permeation
As the name implies, surface contamination is limited to the surface of a material (i.e., clothing, skin). This type of contamination doesn’t penetrate, permeate, or soak into materials. Surface contaminants are normally easy to detect and remove to a reasonably achievable and safe level using decontamination methods. Dry solids, powders, and fibers such as radiological particles, chemical powders, or anthrax spores are examples of surface contaminants. One potential draw back of surface contaminants is that they are capable of being re-entrained into the ambient air during disturbance of the patient (i.e. handling, disrobing, etc.).
Permeation contaminants are absorbed into a material at the molecular level. If the contaminants are not removed, they may continue to permeate through the material. The following factors influence permeation:

- **Contact Time** – Longer the contaminant is in contact with the material, the greater the probability and extent of permeation.
- **Concentration** – Molecules of the contaminant will flow from areas of high concentration to areas of low concentration. The greater the concentration of the contaminant, the greater the potential for permeation to occur.
- **Temperature** – Increased temperatures generally increase the rate of permeation. Conversely, lower temperatures will generally slow down the rate of permeation.
- **Physical State** – Gases, vapors, and low-viscosity liquids tend to permeate more readily than high viscosity liquids or solids.

A single contaminant, especially in liquid form, can present both surface and permeation threats.

### 2. Contamination versus Exposure

Simply stated contamination is the process of transferring a hazardous material from its source to the surrounding environment, including people and equipment. Once these components are contaminated they then can act as a carrier and potential secondary source.

Exposure is simply the process by which people, equipment, or environment are subjected to or actually come in contact with a hazardous material. In the case of First Receivers, exposure implies that individuals have been in a situation where the NBC agents have the potential to contact or enter their body by one or more routes of entry.

CPC is designed to protect a First Receiver from exposure to the NBC agents, but in the handling and treatment process, the First Receiver, CPC, and equipment may become contaminated. Just because the CPC or equipment has become contaminated does not mean the First Receiver has been exposed to the NBC agent. When a First Receiver is exposed to a NBC agent, it is the hazard of the agent (or the harm it can do) based on the nature of the exposure (concentration, duration of exposure, route of entry) that determines how it may ultimately affect the First Receiver’s health.
C. Functional Zones of Hospital-Based Decontamination

OSHA has found it appropriate to define two functional zones during hospital-based decontamination activities that apply to First Receivers. These zones, which guide the application of OSHA’s recommendations, are:

- **The Hospital Decontamination Zone** includes any areas where the type and quantity of hazardous substance is unknown and where contaminated victims, contaminated equipment, or contaminated waste may be present. It is reasonably anticipated that employees in this zone might have exposure to contaminated victims, their belongings, equipment, or waste. This zone includes, but is not limited to, places where initial triage and/or medical stabilization of possibly contaminated victims occur, pre-decontamination waiting (staging) areas for victims, the actual decontamination area, and the post-decontamination victim inspection area. This area will typically end at the ED door. In other documents this zone is sometimes called the “Warm Zone.”

- **The Hospital Post-decontamination Zone** is an area considered uncontaminated. Equipment and personnel are not expected to become contaminated in this area. At a hospital receiving contaminated victims, the Hospital Post-decontamination Zone includes the ED (unless contaminated). In other documents this zone is sometimes called the “Cold Zone.”

D. Decontamination Methods

Decontamination methods can be divided into two basic categories: Physical and Chemical methods. Decontamination methods vary in their effectiveness for removing different substances. What works to remove one type of contaminant may be ineffective for another type of contaminant.

1. Physical Decontamination Methods

Generally involves physically removing the contaminant from the contaminated patient or equipment. While these methods are often easier to perform and may dilute the contaminant’s concentration, it generally remains chemically unchanged. Examples or physical methods include:

a) **Isolation and Disposal**

It is a two-step process that does not involve the use of any water or liquid decontamination solutions. First, the contaminated articles (e.g. clothing) are removed and isolated in a designated area. As the contaminated items are collected they are disposed of.

(1) **Clothing Removal**

The first priority in decontamination is the removal of clothing and accessories. Removing the clothing will
usually remove a majority of the contamination. When clothing is removed it should be placed and sealed inside of plastic bags.

b) Dilution/Washing
Use of water or mild detergent and water to flush the hazardous materials from contaminated people, equipment, or environment. The use of detergent or soap takes advantages of the surfactant properties and works well on oils, greases, polar solvents, dirt, grime, and powders. Dilution and washing using detergents are the most commonly used methods for the decontamination process.

(1) Soap and Water Method
The core of the wet decontamination process is washing with high volumes of water with a mild soap or detergent. Soap will aid in emulsifying oil substances like blister/vesicant agents. Liquid soaps are quicker than solid bars and reduce the need for mechanical scrubbing or brushing. Best practices would be to use sponges and disposable towels in place of brushes to ensure that additional dermal damage does not occur. The biggest disadvantage of the use of soap is the large amount that will be necessary, dependent on the size of the affected population. It is recommended that high volume, low pressure warm or temperate water be delivered at a minimum of 60 pounds per square inch (psi) to ensure the showering process removes the agent.

c) Brushing or Scraping
Manual removal of contaminants using either dry methods or water solution methods, involves the brushing or scrubbing of materials off of patients, equipment, or environmental surfaces. Typically involved in the removal of radiological surface contamination of patients.

d) Absorption
Process of “soaking up” a liquid material to prevent spreading of the agents to areas outside the exclusion zone (contaminated area). It is primarily used in the decontamination for wiping down equipment, structures, and property. Beyond the gross removal (i.e. wiping down) of contaminants from protective clothing and equipment with towels, it has limited application for the decontamination of patients.

Contaminants in absorbents remain chemically unchanged. The most readily available absorbents are soil, diatomaceous earth (Fuller’s Earth), and vermiculite. Other acceptable materials
include anhydrous fillers, sand and commercially available products (e.g., pads, towelettes, pillows). Absorbent materials should be inert or have no active properties.

e) Adsorption
Process of a contaminant adhering to the surface of another material. The adhesion takes place in an extremely thin molecular layer of between the contaminant and the adsorbent. It is primarily used in the decontamination of equipment or an area; examples include activated charcoal, silica, and fuller’s clay.

f) High Efficiency Particulate Air (HEPA) Vacuuming
Use of vacuums to collect a contaminant (dust, powder, fiber) from the surface of the material. This method is primarily used to decontaminate structures and equipment.

g) Thermal Application
Involves the use of high temperature steam in conjunction with high-pressure water jets to heat up and blast away the contaminant. It is primarily used for the decontamination of vehicles, equipment, and structures. Heating can also be used in the evaporation of contaminants. Heating techniques should not be used to decontaminate chemical protective clothing or patients.

h) Evaporation
Simply allows a contaminant to evaporate or “off-gas”, particularly if its vapors do not present a hazard. It can be used to decontaminate equipment, vehicles, or structures. Its effectiveness can be limited when dealing with porous surfaces and large quantities of materials.

2. Chemical Decontamination Methods
Removal of contaminant through some type of chemical process – the contaminant undergoes some type of chemical transformation that facilitates its removal. Examples of chemical decontamination include:

a) Chemical Degradation
Process of altering the chemical structure of the contaminant through the use of a second chemical or material. Commonly used degradation agents include calcium hypochlorite and sodium hypochlorite. Chemical degradation is primarily used to decontaminant structures, vehicles, and equipment and should not be used to decontaminate chemical protective clothing. Degradation chemicals should never be applied directly to the skin.
b) Neutralization
Process used in the inactivation of a chemical or biological agent. Neutralization renders the chemical agent to a non-hazardous state.

(1) Dry Decontamination Compounds
The use of dry, gelled, or powdered decontamination materials that absorb the chemical agent are appropriate if their use is expedient and no water is available. Commonly available absorbents include dirt, flour, Fuller’s earth, baking powder, sawdust, and charcoal. The military provides skin decontamination kits, however these are not typically used in civilian settings.

(2) Sodium Hypochlorite and Water
Sodium hypochlorite (bleach) and water solutions remove hydrolyze and neutralize most chemical and biological agents. This approach is less favorable in mass casualty decontamination situations than soap and water, where speed is the paramount consideration.

c) Disinfection
Disinfection if properly performed results in the selective elimination of certain undesirable microorganisms to prevent their transmission – the reduction in the number of viable organisms to some acceptable level to prevent infection. It does not result in the complete destruction of the microorganism you are trying to remove. There are two major categories of disinfectants:
- Chemical Disinfectants
- Antiseptic Disinfectants

d) Sterilization
Process of destroying all microorganisms in or on an object. The most common method of sterilization is by using steam, concentrated chemical agents, or ultraviolet light radiation. Because of the size of the sterilization process, it has limited field application and cannot be used to decontaminate patients, but it does play an important role in the decontaminating medical equipment.

E. Types of Decontamination and General Procedures

Many different types of decontamination exist in the handling of hazardous material incidents and response actions to acts of terrorism. First Receivers may perform a variety of decontamination processes and should be aware of the different types of decontamination. This section of the training module provides details on the different types of decontamination and provides sample procedures.
for patient and mass decontamination. First Receivers also need to be well versed in their healthcare facility’s decontamination procedures.

1. **Gross Decontamination**

Gross decontamination is the initial phase of the process aimed at the immediate reduction of surface contamination. Gross decontamination can be accomplished in easy and expedited manner. The removal of contaminated clothing and accessories or the uses of high volume of water are effective means to accomplish gross decontamination. Depending on the nature of the incident and condition of the patient this may be the only decontamination effort prior to the mobilization to the emergency department at the recipient healthcare facility. Or this may be the initial phase of the decontamination process leading into secondary decontamination methods.

2. **Emergency Decontamination**

The goal of emergency decontamination is to remove the threatening contaminant from the patient in expeditious manner – typically there is no regard for the surrounding environment or equipment. Emergency decontamination may be necessary for both patients and First Receivers. If either is contaminated, the individual removes their clothing and a wash down is performed. Patients may be in the need of immediate medical care and cannot wait or complete the decontamination process. The following situations are examples are instances where emergency decontamination may be needed:

- Failure of protective clothing
- Accidental contamination of First Receiver
- Life threatening medical conditions develop (i.e. heat stress) or injury is suffered by the First Receiver in the Hospital Decontamination Zone
- Immediate medical treatment required for other patients

Emergency decontamination is considered a quick win response, however contamination may still be present that could still constitute a hazard. Patients once stabilized will need additional decontamination efforts to remove the remaining contaminants.

Decontamination procedures may differ depending on the circumstances and the agents present. However, a basic set of emergency decontamination procedures is as follows:

- **Step 1** - Removal of the victim from the contaminated area (point of release)
- **Step 2** – Wash immediately any exposed body parts with copious amounts of water or decontamination solutions
- **Step 3** – Removal of victims clothing or accessories and/or PPE – if possible, cutting from the top down in a manner that
minimizes the spread of contaminants. Removal of clothing will typically remove most of the contamination.

- **Step 4** – Perform a quick cycle of head-to-toe rinse, wash, and rinse.
- **Step 5** – Transfer the victim for treatment or observation.
- **Step 6** – Ensure proper communication among the First Receivers on the contaminant conditions.

### 3. Technical (Formal) Decontamination

Technical decontamination is the planned and systematic process of reducing NBC agent contamination to a level that is as low as reasonably achievable (ALARA). This type of decontamination is typically conducted at healthcare facilities handling contaminated patients. Technical decontamination is a multi-step process in which contaminated patients are cleansed with the assistance of First Receivers. Basic operational concepts include:

- There are two functional zones, an entry point (*Hospital Decontamination Zone*) and an exit point (*Post-Decontamination Zone*).
- In between these points, several progressive decontamination steps take place to remove the contaminants.
- In the initial stages of the decontamination process a majority of the contaminant is removed (i.e. gross decontamination) and the latter stages refine the decontamination of the patient to acceptable levels.

#### a) First Receiver Decontamination

First Receivers should remove protective clothing in the following sequence:

- **Step 1** – Some form of wash, vacuuming, brushing or combination of outer surfaces of the protective clothing being utilized.
- **Step 2** - Removal of tape (if applicable) that is securing gloves and boots to the protective clothing.
- **Step 3** – Removal of outer gloves, by turning them inside out as they are removed.
- **Step 4** – If PAPR is worn, loosen and secure the PAPR belt and battery pack. Proceed with the removal of suit, turning it inside out and folding it downward avoiding excessive shaking.
- **Step 5** – If applicable, removal of respirator. Secondary wash of hood or facepiece of respirator with soapy water or decontamination solution and thoroughly wipe the PAPR blower housing, battery pack, and cords or hoses prior to the removal of inner gloves. Place respirator and accessories in plastic bag and seal.
• **Step 6** – Removal of inner gloves and inner/under garments (if applicable).
• **Step 7** – First Receivers should then move to a shower area and shower. If shower facility is not available, then a minimum of thorough washing of hands and facial areas.

4. **Mass Decontamination**

Mass decontamination is the process of conducting gross decontamination of multiple individuals’ at one time in emergency situations. This type of decontamination is initiated where the number of victims and time constraints do not allow the establishment of an in-depth decontamination process. It is essentially a form of gross decontamination that utilizes large volumes of rinse water to reduce the levels of contamination. Ideally, a soap and water solution or universal decontamination solution would be more effective.

Mass decontamination needs to be established quickly to reduce the associated risk posed by the contaminant to the victims. While a technical decontamination process is being established, initial operations of clothing and accessory removal followed by the wash down.

5. **Patient Decontamination**

Patient decontamination is necessary whenever victims have been contaminated and are in need of medical attention. Patient decontamination steps presented in this module are based upon a model originally prepared by the U.S. National Disaster Medical System (NDMS) Office of Emergency Preparedness with separate sections provided for ambulatory and non-ambulatory patients. First Receivers must be familiar with the procedures set forth by the administering healthcare facility because they may differ from those provided in this module.

a) **Ambulatory Patients**

Victims who are able to understand directions, talk, and walk unassisted are considered ambulatory, and they should be directed to an established gathering point where they can be prioritized for decontamination. These patients include self-referrals. Most ambulatory victims are triaged as minimal unless severe signs or symptoms are present. Several of the following factors determine the highest priority for ambulatory patients:

• Casualties closest to the point of release
• Casualties reporting exposure to the terrorist agent
• Casualties with evidence of contamination on their clothing, accessories, or skin
• Casualties with serious medical symptoms
• Casualties with conventional injuries
Ambulatory patients may be decontaminated using the following procedures:

- **Step 1** – Direct patients to the staging area in the *Hospital Decontamination Zone*
- **Step 2** – Direct patients to remove all clothing and accessories
- **Step 3** – Place the patients clothing and accessories into sealable plastic storage bags
- **Step 4** – As necessary, vacuum, brush or wipe all visible contaminants off of the patient
- **Step 5** – Patients should quickly rinse themselves from head to toe with water
- **Step 6** – Patients should next wash with soap and wash cloth and brush in a systematic fashion cleaning open wounds first and then in a head to toe fashion for 5 minutes when the agent is non-persistent and 10 minutes when a persistent or unknown agent is involved. Discourage the patient from rubbing too vigorously while washing. Eye irrigation may require the use of a topical anesthetic first before irrigating.
- **Step 7** – The First Receiver should closely observe each patient to ensure they are thorough in washing themselves. Particular attention should be made to ensure they wash the axilla, creases, folds, and hair. Help should be offered as necessary.
- **Step 8** – Once the washing is completed then each patient should thoroughly rinse themselves for approximately one minute to complete the process.
- **Step 9** – Direct patients to the *Post-Hospital Decontamination Zone*

**b) Non-ambulatory Patients**

Non-ambulatory patients are victims who are unconscious, unresponsive, or unable to move unassisted. These patients may be more seriously injured than ambulatory patients. They will remain in place while further prioritization for decontamination occurs. It is recommended that prioritization of patients for decontamination is done using medical triage systems such as START (Simple Triage and Rapid Treatment/Transport). Non-ambulatory patients may be decontaminated using the following procedures:

- **Step 1** – Stage the individuals in the *Hospital Decontamination Zone* or designated area
- **Step 2** – Remove the patient’s clothing, cutting it off as necessary
• **Step 3** – Place the patient’s clothing and accessories into sealable plastic bags.
• **Step 4** - As necessary, vacuum, brush or wipe all visible contaminants off of the patient
• **Step 5** – Close the patient’s mouth and pinch the nose shut if the patient cannot do so.
• **Step 6** - Rinse the patients off with water or decontamination solutions. Begin with the facial area and airway and proceed to open wounds (if present). Follow by head-to-toe rinsing in systematic fashion.
• **Step 7** – Ensure the armpits, genitalia, and the back are rinsed
• **Step 8** – Rinse the backboard before transferring the patient to the *Post-Hospital Decontamination Zone* unless transferring to a clean backboard
• **Step 9** – Apply a C-collar as soon as possible if a C-spine injury is suspected
• **Step 10** – Determine if secondary decontamination will be performed. If not, transport the patient to the *Post-Hospital Decontamination Zone* for medical treatment or observation
VIII. Hospital Emergency Management and Preparedness

The Joint Commission on Accreditation of Healthcare Organizations has adopted the Federal Emergency Management Agency’s (FEMA) four-phase organizational model for emergency management and disaster readiness. The model defines four phases of emergency management as mitigation, preparedness, response, and recovery.

1) Mitigation – refers to actions or activities taken prior to an event to prevent or reduce the consequences (i.e. impact to life, health, and property);
2) Preparedness – activities, actions, procurements, planning, training, and inter-jurisdictional cooperation aimed to increase response readiness to identified hazards within the community;
3) Response – mobilization of resources to meet the needs of the community in response to an emergency event (terrorist activity);
4) Recovery – returning the community the hospital facility to its pre-event condition.

A. Phase 1: Mitigation

Mitigation is the first phase of hospital emergency management and preparedness. This phase is encompasses activities that are aimed to lessen the severity and impact of a terrorist event involving NBC agents on the receiving hospital. Mitigation begins with the identification of potential hazards that may impact the hospital or the demand of its services. This is followed by a vulnerability analysis of risk for such an event and finally the implementation of a strategy to address these areas of vulnerability. Mitigation efforts serve as the basis for all activities relative to hospital emergency management and preparedness.

1. Hazard Vulnerability Analysis

The first task associated with the mitigation phase is the Hazard Vulnerability Analysis and can be simply defined as “the identification of hazards and the direct and indirect effect these hazards may have on the hospital”. The following two steps compose the Hazard Vulnerability Analysis:

a) Hazard Identification

Identification of potential emergency or terrorist events that can reasonably be expected to occur within the community of the serving hospital. This step begins with the development of a comprehensive list of all possible terrorist scenarios.
b) Vulnerability Analysis
The hazards that are identified (have occurred or could occur) are balanced against the community or population that is at risk to determine the vulnerability to the identified hazard. The vulnerability of the analysis looks at the probability of the hazard occurring, the associated risk (impact that the given hazard may have on the hospital) or magnitude of the event, and the assessment of resources (internal and external) for the handling of the event or incident.

2. Emergency Management Plan
The final step in mitigation involves the Emergency Management Plan (EMP). This document describes how the hospital intends to function during a terrorist event, bringing hospital services and departments into one incident-focused organization. The EMP requires an annual revision based on changes in the local community, newly identified vulnerabilities, and on the lessons learned from exercises and drills. This plan should address four key issues: (1) life safety – protection of personnel, patients, visitors, and the public; (2) property protection; (3) continuity of operations; and (4) environmental protection.

The basic EMP should define the command and control, lines of communication, life safety, property protection, community outreach, recovery and restoration, and administration and logistics. Based on the HVA, all high-risk events will have a hazard specific appendix or standard operating procedures.

B. Phases 2 and 3: Preparedness and Response

The second phase of hospital emergency management, preparedness, refers to activities that are driven to increase the readiness of response actions to vulnerabilities. Response is the third phase of the emergency management and refers to the mobilization of resources to meet the hospital’s and the community’s specific needs in the event of terrorist event. Comprehensive preparedness and response for hospitals encompasses 22 critical elements. An in-depth discussion of each element is beyond the scope of this training module, a general overview of the important aspects is presented in this module.

1. Incident Command
The incident command system (ICS) is the section of the EMP that details the authority structure and control of personnel, facilities, equipment, and communications to be employed during the handling of a terrorist event. The ICS remains operational until the requirements for its operation no longer exist. It is modular in fashion and is scalable, based on the type and size of the incident or event.
ICS is composed of five management sectors: Command, Operations, Planning, Logistics, and Finance.

- **Command** responsibilities are an executive function designed to develop, direct, and maintain a viable organization and to coordinate with other entities or agencies. Policy, objectives, and priorities are set by this management sector. The highest level of authority rest with the incident commander (IC), who is supported by the public information official, safety representative, and the liaison official. These individuals assist and advise the IC in regards to issues pertaining to the media, safety, and external agencies.

- **Operations** carry out the directions of the Command management section and are essentially the doers of the organization, where the real work of incident control is accomplished.

- **Planning** provides information about the incident which is utilized to support the Command and Operations sectors.

- **Logistics** identifies and obtains all personnel, equipment, supplies, and services required for the incident.

- **Finance** is a staff function that is responsible for financial management and accountability of the incident.

The Hospital Emergency Incident Command System (HEICS) is a pre-existing plan that can be adapted to individual hospitals. HEICS is free of charge and has been adapted by many U.S. hospitals. It provides an authority structure and job descriptions designed for hospitals. HEICS provides for an incident commander who is supported by at least four chiefs, operating over sections: Logistics, Planning, Finance, and Operations. The program has preformatted organizational chart and job descriptions that can be applied to an individual hospital.

2. **Interagency Coordination**

Hospitals are a major player in the response to terrorist events and must work seamlessly with local government officials, emergency managers, law enforcement, fire/rescue services, emergency medical services, public health officials, other healthcare providers.

3. **Response**

Event recognition is the initiating factor in response efforts. The rapid identification of events depends on the type of terrorist agent used, the event location, and the method of dispersal. Explosive and incendiary events become manifest immediately, chemical agent attacks typically will manifest over minutes or hours, and biological will usually become evident only after an incubation period of days, weeks, or even months. Biological attacks require region wide surveillance, unusual event reporting, laboratory analysis, and sentinel case investigation.

The first priority in a terrorist attack is to secure the hospital physical plant and to protect personnel, current patients, and visitors. Another priority is
to establish sites for patient reception and identification. Simple, rapid identification processes that facilitate ongoing and continuous patient tracking are most desirable. If patients are contaminated, decontaminating and securing of valuables or evidence collection will be necessary.

4. Treatment Logistics
Treatment logistics simply involves placing patients with similar levels of exposure and symptomatology in the appropriate treatment setting. Predesignated locations within or near the hospital may be utilized if bed capacity is limited or absent. Community assets, such as sports arenas, school gymnasiums, hotels, or places of religious worship, may serve as holding or observation areas. The public should be informed of the purpose of these treatment sites and where to find them.

5. Decontamination
Hospitals must possess a decontamination area, supplies, and adequately trained First Receivers. The location of the decontamination unit may be internal or external to the hospital. It should be readily available and not disrupt routine operations. Internal decontamination facilities have the advantage of providing protection from inclement weather. Disadvantages include the risk of allowing contaminated patients to enter the hospital, the need for specialized ventilation systems, and limitation of the number of patients it may accommodate. External decontamination facilities prevent contaminated patients from entering the hospital and allow for large patient volumes. Disadvantages include difficulty in controlling the weather extremes and lighting conditions and inherent delays in setup.

6. Personnel (First Receiver) Management
The most important asset for an effective response lies with the hospital personnel. A plan is required to notify on-duty hospital First Receivers of a terrorist event. In addition, a mechanism for the staged recall of off-duty First Receivers, or those with unique job functions, must be clearly delineated.

7. Mental Health Resources
Mental health counseling is an important aspect of preparedness, response, and recovery from disaster events. These services should be available to patients, healthcare personnel, First Receivers and the community at large.

8. Media/Public Information Management
Planned and structured arrangements for communication throughout the incident are critical components of hospital and community preparedness.

Surge capacity encompasses the need for additional patient beds and also available space for triage, management, vaccination, decontamination, or for patients waiting to be seen.
10. Security
Security is a vital aspect of preparedness and response. A guide for security-enhancing activities that are aligned with the five color-coded Homeland Security Advisory System. Hospital security planning and response must address perimeter management, personnel security, patient security, and resource security. Perimeter management involves controlling access to the facility and the surrounding hospital properties.

11. Supplies and Equipment
It is recognized that the adequacy of existing hospital supplies and equipment may be problematic due to economic restrictions and storage limitations promote just-in-time inventories. Also supplies and equipment may differ widely depending on the nature of the terrorist event. Therefore it is impractical to cache a vast inventory of every potential supply item or equipment that may be needed. It is necessary for every facility to maintain a 24-hour supply of all reasonably expected supplies and equipment, to allow for the rapid treatment of the first wave of patients. Vendor agreements may be one way to circumvent this issue.

12. Services
During protracted or high-volume incidents, a modification in staffing patterns may be necessary. This may involve an increase in the numbers of staff, a prolongation in the work shift, and need for overnight staff housing. Managers and employees need to be involved in the planning and response to terrorist events so as to be able to meet the increase in service needs.

13. Facility Management
Effective planning and response require that basic utilities to the hospital continue uninterrupted. The utilities are critical assets that must remain operational. Based on the potential for terrorists to target hospitals, these systems should be secured and monitored. Redundancy in utilities is good practice and mandatory in some cases, and in the event of primary failure, secondary systems should be immediately available. Security and the operation of redundant contingencies should be routinely tested.

Contingencies for the potential use of chemical and biological agents should address the safe storage, handling, and disposal of hazardous materials. In particular, the containment and disposal of runoff from decontamination activities should be determined in concert with local regulators.

14. Contingencies
Contingencies are activities that (1) predict potential disruptions of critical supplies, (2) prevent delays or disruptions in supply lines and bed capacity, and (3) procure needed assets via alternative routes. Effective contingency planning must anticipate the potential for partial or total
disruption in the supply chain for medical supplies, pharmaceuticals, cleaning supplies, maintenance supplies, linens, and food services.

15. **Education, Training, and Exercises**

Effective response to terrorist events is built on a foundation of knowledgeable, trained, and practiced First Receivers. The education of First Receivers must learn of potential terrorist agents, be able to diagnose unusual disease patterns or clinical findings, and know how to practice appropriate surveillance, reporting, and treatment. It is critical that First Receivers be trained to protect themselves from contamination, so they do not also become victims.

Exercises are conducted to evaluate a hospital's capability to execute its response or contingency plans. The First Receivers, plans, procedures, facilities, and equipment should be exercised and tested on a routine basis. The exercise process is a continuous process that includes planning, training, exercising, and evaluation.

16. **Demobilization**

Demobilization describes a variety of actions that transition command, planning, operations, logistics, and finance functions back to normal operations. During this phase, departmental functions are assessed, consumed resources and assets are accounted for, assets are returned to their original location, documentation is completed, and incident review and debriefing are conducted.

C. **Phase 4: Recovery**

The fourth and final phase of emergency management, recovery, refers to the mobilization of support operations that work toward returning the hospital and the community back to its pre-event condition. These activities are directed at restoring essential services and resuming normal operations.

1. **Finance**

Hospitals need to seek financial reimbursement from government agencies for unrecoverable costs associated with providing care under terrorist event conditions. Effective pre-event documentation and accurate and detailed records of patient care activities during the event are essential.

2. **Facility Recovery**

Hospital recovery involves the inspection of the facility, hazard removal and abatement, and decontamination.

3. **Personnel and Psychological Considerations**

Critical incident stress debriefing should be offered to anyone involved in the response. In addition, hospitals should offer group and individual counseling services, family support programs, and employee assistance.
programs. All First Receivers involved in the response need to be enrolled in a health surveillance program due to the fact that chemical and biological agent exposures may result in delayed health effects.

All First Receivers should participate in after-response assessments. These reviews consist of the objective analysis of pertinent response information to produce “lessons learned”. Based on these lessons, modifications in procedures, assignments, equipment, training, and personnel may contribute to improved response capability for future events.
IX. References and Resources

1) Keyes DC. 2005. Medical Response to Terrorism, First ed: Lippencott Williams & Wilkins, Philadelphia PA.


17) OSHA. 1991a. Letter of Interpretation Addressed to Mr. Edward McNamara, Executive Director, Central Massachusetts Emergency Medical Systems Corporation, Re: Training Requirements for emergency medical service personnel.

18) OSHA. 1992a. Letter of Interpretation Addressed to Randy Ross, Re: Medical personnel exposed to patients contaminated with hazardous waste.


24) California Emergency Medical Services Authority www.emsa.ca.gov

25) Centers for Disease Control and Prevention (CDC) www.cdc.gov
26) The InterAgency Board
   www.iab.gov

27) Joint Commission on Accreditation of Healthcare Organizations
   www.jcaho.org

28) National Institute of Justice
   www.ojp.usdoj.gov/nij

29) Federal Emergency Management Agency
   www.fema.gov

30) National Institute for Occupational Safety and Health (NIOSH)
   http://www.cdc.gov/niosh/homepage.html

31) Occupational Safety and Health Administration (OSHA)
   www.osha.gov

32) Office for Domestic Preparedness
   http://www.ojp.usdoj.gov/odp/welcome.html

33) Mine Safety and Appliances (MSA)
   www.msanet.com

34) Scott Health and Safety Services
   www.scotthealthsafety.com

35) Lab Safety Supply Company
   www.lss.com