Chapter 36
First Responder Procedures with Weapons of Mass Destruction

Overview
- Terrorism
- Agents of Terrorism
  - Chemical Weapons
  - Biological Weapons
  - Radiological Devices
- Common Management Strategies

Terrorism
- Terrorism is a crime that is directed at a political goal not achievable by normal means
- Terrorist groups operating within the United States have a variety of goals and different technical capabilities
To understand terrorism, one must understand the terrorist. There are three classes of terrorists:

- International groups
- Domestic issue terrorists
- Loners

International terrorist groups:
- Composed of members drawn from a foreign nation or nations
- International terrorists are often motivated by religious or nationalistic goals
- Often supported by a nation or nations and therefore can have access to more technologically advanced agents and organizational structures

Domestic issue groups:
- Americans who disagree with a certain policy or practice within the United States
- Often called “hate groups” as they raise their political objections to acts of hate directed against specific individuals or groups with the goal of some social change
  - Domestic “militia” groups, radical environmental groups, anti- or pro-abortion violence, and racial or religious intolerance groups are examples of these groups.
Terrorism

- Loners
  - Loners are the remainder of terrorists who are often individuals motivated by a certain set of views that are often difficult to understand
    - Ted Kaczynski, the Unabomber, is an example of this sort of terrorist threat
    - Loners represent a subset of domestic terrorism

Agents of Terrorism

- Chemical weapons
  - Nerve agents
  - Vesicants (blister agents)
  - Chemical asphyxiants
  - Lung irritants
  - Riot control agents

- Biological weapons
  - Microbes and toxins
  - Neurologic conditions
  - Hemorrhagic viral diseases
  - Gastroenteritis-causing diseases
  - Infectious skin diseases

- Radiological devices

Chemical Weapons

- Nerve agents
  - Organophosphate nerve agents
    - This class of compounds is similar to organophosphate pesticides malathion or parathion
Chemical Weapons

- **Nerve agents**
  - Members of this class of agents include:
    - Tabun
    - Sarin
    - Soman
    - VX
    - Novichok

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Chemical Weapons

- **Nerve agents**
  - Exposure to these agents produces a toxic condition known as **cholinergic crisis**
  - Occurs when the neurotransmitter acetylcholine is in overload
    - Nerve agents produce an overload of acetylcholine by blocking the enzyme that breaks down acetylcholine within the body

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Chemical Weapons

- **Nerve agents**
  - Symptoms of a cholinergic crisis: **SLUDGE**
    - Salivation
    - Lacrimation or tearing
    - Urinary incontinence
    - Defecation or fecal incontinence
    - Generalized weakness
    - Emesis
Chemical Weapons

- Nerve agents
  - Nerve agents are treated with atropine, oximes, and benzodiazepines
  - These agents are combined into a Mark I kit in the military
  - Mark I kits are now deployed at many urban services

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Chemical Weapons

- Nerve agents
  - The Mark I kit consists of two autoinjectors:
    - Atropine (2 mg)
    - Pralidoxime (600 mg)

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Chemical Weapons

- General supportive care is needed with or without antidotal medications that would include suctioning and ventilatory support
Chemical Weapons

- Scene safety
  - Nerve agents are odorless and tasteless and therefore undetectable by the victim
  - Some residual agent is found on the clothing and person exposed
  - Similar to cigarette smoke, nerve agent vapor will be contained on the surface of the person and their clothing and then will release slowly over time
  - This slow secondary release of nerve agent is called off-gassing

Chemical Weapons

- Nerve agents
  - Scene safety
    - Off-gassing is a problem for first responders without protective gear
    - Breathing in small amounts of nerve agent over time will cause the same toxic effects in the caregiver
    - Nerve agents also readily penetrate latex gloves; therefore barrier protection is required if potential liquid exposure may be encountered

Chemical Weapons

- Nerve agents
  - Scene safety
    - Barrier protection refers to personal protective equipment (PPE), not standard infection control gear
    - Standard hazardous materials gear consisting of heavy rubber gloves and chemical-resistant garments with either air filtration or supplied air is required
Chemical Weapons

● Vesicants (blister agents)
  ➢ Vesicants are a class of chemical weapons that are strong inhibitors of deoxyribonucleic acid (DNA) replication
    ▪ DNA replication is necessary for cells to divide and grow; therefore vesicants exert their effects by killing growing cells
    ▪ The name vesicant refers to the chemical’s ability to cause blisters (vesicles) within the skin and airways

Chemical Weapons

● Vesicants (blister agents)
  ➢ Common warfare vesicants include:
    • Mustard
      ➢ Mustard is given its name from the odor of mustard, onions, or horseradish associated with its release
    • Lewisite
      ➢ Lewisite smells of geraniums and is quite irritating to the skin and to the nose
      ➢ In addition to being a vesicant, Lewisite contains arsenic, which causes loss of red blood cells

Chemical Weapons

● Vesicants (blister agents)
  ➢ Vesicants are associated with blister production due to their toxic effects at the growth layer of the skin
  ➢ Systemic effects that involve damage to the growing cells of the bone marrow and the gastrointestinal tract
Chemical Weapons

- Vesicants (blister agents)
  - Primary issue is to intervene in potential airway compromise caused by blisters within the airways
  - Prophylactic intubation at the first sign of blister formation is indicated
  - If intubation is not possible, rapid transport to advanced airway management

Chemical Weapons

- Vesicants (blister agents)
  - Vesicants can cause failure of the immune system and death by overwhelming infection
  - Late complications of exposure

Chemical Weapons

- Vesicants (blister agents)
  - British anti-lewisite (BAL) is a potential antidote for lewisite exposure
  - BAL will bind with arsenic both topically and within the body
  - BAL should only be administered under the direction of a physician
Chemical Weapons

- Vesicants (blister agents)
  - Scene safety
    - Vesicants, and particularly mustard, are a potential risk to the caregiver
    - Mustard will readily penetrate latex gloves, so barrier protection is required

Chemical asphyxiants

- A group of chemicals able to poison the victim by interfering with the use and metabolism of oxygen within the body
- Chemicals of this class are often found in industry or as environmental hazards
- Chemical asphyxiants include:
  - Cyanide
  - Hydrogen sulfide
  - Carbon monoxide

- Cyanide
  - Commonly available industrial chemical common to plating and other industries
  - Causes the disruption of the body’s ability to manufacture energy by blocking the use of oxygen within cells
Chemical Weapons

- Chemical asphyxiants
  - Cyanide
    - Symptoms of cyanide exposure are similar to carbon monoxide, but are more difficult to treat
    - Restless behavior
    - Poor concentration
    - Headaches
    - Nausea

Chemical Weapons

- Chemical asphyxiants
  - Cyanide
    - Best treated by removing the person from the scene of exposure
    - Following removal, if a person has continuing symptoms, a cyanide kit may be administered

Chemical Weapons

- Chemical asphyxiants
  - Cyanide
    - Kit contains amyl nitrite, sodium nitrite, and sodium thiosulfate
      - The amyl nitrite is in the form of a “pearl” or “popper” and is intended to be inhaled prior to the administration of intravenous sodium nitrite
      - Treatment of cyanide poisoning with a cyanide kit can lead to potential problems
Chemical Weapons

- Chemical asphyxiants
  - Cyanide
    - Cyanide kit

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Chemical Weapons

- Chemical asphyxiants
  - Cyanide
    - No field test exists for cyanide to reinforce clinical suspicions
    - The symptoms of cyanide poisoning are vague and difficult to recognize from other conditions, including fright
    - Administering the antidote can harm the victim if cyanide is not present

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Chemical Weapons

- Chemical asphyxiants
  - Hydrogen sulfide
    - Smells strongly of rotten eggs and is typically avoided

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Chemical Weapons

- Chemical asphyxiants
  - Carbon monoxide
    - Familiar to many first responders who encounter victims living in homes where the furnace is not properly maintained
    - Carbon monoxide is odorless and tasteless and produces rather vague symptoms until the victim is overcome
    - The key to carbon monoxide detection is that most individuals from that home will have similar symptoms

Chemical Weapons

- Chemical asphyxiants
  - Entering any area with chemical asphyxiants is hazardous to the rescuer
  - Respiratory protection is most important for the first responder to use
  - Carbon monoxide testing is available by many fire departments
  - Hydrogen sulfide is so unpleasant, its presence is clear and is usually avoided
  - Cyanide, however, is associated with only a “bitter almond” smell that only about 50%-60% of the public can detect
  - Cyanide must be suspected at venues or in victims with sudden onset of collapse preceded by vague symptoms

Chemical Weapons

- Lung irritants
  - Chemicals that are especially toxic to lung tissue
  - Examples of this class of chemicals are:
    - Chlorine
    - Ammonia
    - Phosgene
Chemical Weapons

- Lung irritants
  - All three chemicals are useful industrial reagents and are commonly shipped around the U.S. by rail and tanker truck
  - These chemicals, if released, cause large, low-hanging clouds that move with the wind and collect in lower areas
  - Chlorine and ammonia have very strong odors and are quite irritating to the nose and lungs
  - Exposure is prevented because potential victims avoid the area

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Chemical Weapons

- Lung irritants
  - Phosgene
    - Phosgene smells of newly mown grass or hay and may be less irritating

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Chemical Weapons

- Lung irritants
  - Cause their effects by direct irritation of the lining of the nose and lungs
  - Cause cellular damage to the lung itself with the subsequent formation of noncardiogenic pulmonary edema or adult respiratory distress syndrome (ARDS)
  - The development of ARDS may take hours to days; therefore observation is an important part of the management
  - Exercise or increased rates of breathing worsen the effects of these exposures, so enforced rest with minimal exertion is the key to treatment
  - There is no antidote to lung irritant exposure
Chemical Weapons

- Riot control agents
  - Riot control agents refer to tear gas and related compounds
  - Tear gas is readily available, quite irritating, and has caused panic due to the potential confusion with chemical weapons agents

Chemical Weapons

- Riot control agents
  - For those first responders familiar with managing riot control-contaminated patients, the off-gassing effect is readily apparent
  - Tear gas is irritating to the membranes of the mouth and nose; it causes no further physiologic damage unless the exposed person has other health difficulties, or unless a large volume of tear gas is used in a confined space

Biological Weapons

- Microbes and toxins
  - Biological weapons refer to microbes and toxins that are intentionally spread to cause illness
Biological Weapons

- The term *microbe* refers to a living microscopic organism, such as a bacterium or a virus.
- The term *toxin* refers to chemicals created by microbes that cause illness.
- A number of microbes are contagious, meaning that they are capable of infecting someone if barrier methods are not used.
- Blood and body fluid protocols should be used regardless of bioterrorism threat, but respiratory protection should be added if airborne disease may be a concern.

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Biological Weapons

- There are a large number of diseases that could be used for bioterrorism, and the actual pathogen is likely to remain unknown to first responder until a hospital diagnosis or perhaps analysis by national laboratories.
- The first responder will see potential victims of bioterrorism first; prior to diagnosis, the outbreak will appear to be an increase in normal disease.

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Biological Weapons

- The lung is commonly infected by aerosols of bioterrorism agents because of the deposit of infective particles in the lung; therefore the likely condition a first responder would see would be pneumonia.
- Pneumonia is a common first responder encounter, but severe life-threatening pneumonia is primarily seen in the elderly, the very young, and the chronically ill.
Biological Weapons

- Bioterrorism agents that would present in this manner include:
  - Anthrax (inhaled)
  - Ricin (inhaled)
  - T-2 Mycotoxin (inhaled)
  - Staph Enterotoxin B (inhaled)
  - Plague
  - Tularemia
  - Brucella
  - Influenza (Super-Flu)

Biological Weapons

- Neurologic conditions
  - Neurologic conditions are also a potential presentation of bioterrorism
  - These presentations can be strange numbness, paralysis, or loss of function

Biological Weapons

- Neurologic conditions
  - Most of the toxins or agents in this class are lethal in small amounts and capable of being transmitted in an aerosol (mist) or by food or water contamination
Biological Weapons

- Neurologic conditions
  - Botulinum toxin is an example of a biological toxin that occurs both naturally and as a bioterrorism disease
  - In botulism, a person is slowly paralyzed starting with the face and progressing downward
  - Most botulism outbreaks are related to improperly stored or prepared foods; therefore a dietary history is helpful to establish a source of infection

Biological Weapons

- Neurologic conditions
  - Botulism occurs in those who consume the contaminated foodstuff, and treatment of asymptomatic individuals will be guided by this information
  - Bioterrorism-related botulism may be transmitted by aerosol contamination or may have a food-borne association
  - Multiple individuals presenting with neurologic symptoms are the cause for concern for first responders

Biological Weapons

- Neurologic conditions
  - Bioterrorism agents that present with neurologic symptoms include:
    - Botulism
    - Venezuelan equine encephalitis (also Eastern and Western encephalitis)
    - Venoms
      - Various snake venoms
        - Tetrodotoxin
        - Ciguatoxin
        - Maitotoxin
Biological Weapons

- Neurologic conditions
  - Protective gear for nerve agents

Biological Weapons

- Hemorrhagic viral diseases
  - Hemorrhagic viral diseases such as Ebola are a class of potential bioterrorism agents
  - There are relatively few hemorrhagic diseases found in the United States; therefore persons with fever and abnormal bleeding are of high concern

Biological Weapons

- Hemorrhagic viral diseases
  - Abnormal bleeding may take the form of rectal bleeding, vomiting blood, excessive bruising, petechiae, or bleeding gums
Biological Weapons

- Hemorrhagic viral diseases
  - A useful test for the first responder is called the \textit{tourniquet test}
    - Place a standard venous tourniquet (like starting an IV), and wait for 1 minute
    - If spontaneous petechiae develop or abnormal bruising occurs, hemorrhagic disease is suspected

- Hemorrhagic viral diseases may be quite contagious
  - Bioterrorism agents that present with abnormal hemorrhagic disease include:
    - Ebola
    - Congo-Crimean hemorrhagic fever
    - Korean hemorrhagic fever
    - Rift Valley fever

Biological Weapons

- Gastroenteritis-causing diseases
  - Gastroenteritis-causing disease is common with food contaminations of both intentional and unintentional causes
  - Common food poisoning is caused by improperly stored or prepared foods
  - Infectious food-borne disease is commonly encountered by first responders in outbreaks associated with unsanitary food preparation
  - Food-borne illness is a good method of choice for terrorists intending to escape detection because of the confusion between naturally occurring disease and intentional causation
Biological Weapons

- Gastroenteritis-causing diseases
  - Unusually severe or unusually large outbreaks should alert the first responder to the potential of intentional contamination

Biological Weapons

- Gastroenteritis-causing diseases
  - Biological agents associated with food-borne illness include:
    - Staph enterotoxin B (ingested)
    - Anthrax (ingested)
    - Ricin (ingested)
    - T-2 Mycotoxin (ingested)
    - Salmonella
    - Shigella
    - Campylobacter

Biological Weapons

- Infectious skin diseases
  - Infectious skin disease is commonly encountered by first responders during chickenpox outbreaks
  - Unusually severe disease associated with rashes, or unusual rashes in a number of unrelated victims, would indicate a potential bioterrorism act
Biological Weapons

- Infectious skin diseases
  - Smallpox is the major rash-producing disease and it is very contagious
  - Smallpox can be transmitted by coughing and by contact, so full infection control practices are required for first responders caring for smallpox victims

Biological Weapons

- Infectious skin diseases
  - Bioterrorism agents that are associated with abnormal rashes include:
    - Smallpox
    - Anthrax (contact)
    - T-2 Mycotoxin (contact)

Biological Weapons

- Infectious skin diseases
  - If a first responder is concerned about bioterrorism through the observation of unusual disease, unusually severe disease, or an odd cluster of illness, the first responder must take protective measures to ensure no further spread of the disease occurs
    - Barrier protection
    - High-efficiency particulate air (HEPA) filter mask (N-95 or better)
    - Communication with medical command
    - Communication with receiving facility to ensure quarantine can be maintained
    - Decontamination of transport vehicle prior to return to service depending on the suspected agent involved
Radiological Devices

- Radiation devices range from a simple radiological source to a nuclear explosion.
- A simple radiological source is defined as a piece of radioactive material placed at a well-traveled location intended to irradiate all those who pass.
- A simple radiological source is a stealthy device as it does not explode and continues to do its damage until detected.

Radiological Devices

- Another form of this type of attack would be a silent radiation release, either in food or water.
- Radioactive material introduced into commonly consumed food or water may not be detectable by taste.
- A radiation dispersal device or RDD combines a simple radioactive source with a conventional bomb to create a low-level contamination event.
- The actual radiation risk, however, is rather small in the RDD: what radiation is contained within the bomb has been spread over the area of the blast and therefore the amount of radiation in any single point is smaller.

Radiological Devices

- Radiation is the one most easily and accurately measured.
  - A standard Geiger counter is the primary instrument needed to determine the presence or absence of radioactivity at a scene.
  - In addition to being easy to detect, the human body is relatively radiation resistant.
  - Low levels of radiation are delivered in computerized axial tomography (CAT) scans, heart catheterizations, stress tests, chest x-rays, and a variety of other medicinal uses.
  - Working in a low-level radiation environment is relatively safe provided precautions are taken to avoid inhalation and ingestion of radiation contamination.
  - Radiation in high doses or in lower doses over time causes radiation syndrome.
Radiological Devices

- Radiation syndrome is caused by the damaging effects of radiation on the deoxyribonucleic acid (DNA) replication within dividing cells.
- Like the vesicants, radiation causes failure of the bone marrow and the gastrointestinal tract if given in high enough doses.
- The result of radiation syndrome is overwhelming infection and failure of the immune system.
  - These effects, however, take days to weeks to present and are not of concern to the first responder.
  - Triage and care of a RDD casualty is according to his or her other injuries.
  - Other than decontamination of radioactive material, there is no other step a first responder can take to improve the survival of a RDD casualty.

Common Management Strategies

- The challenge of WMD terrorism is significant for first responders—there are a large number of chemicals, infectious agents, and other substances that can not only cause complicated medical decisions, but also can cause harm to the caregiver.

- The most important thing a first responder can do to protect himself or herself in the course of duty is recognize an event as a potential terrorist target.
Common Management Strategies

- Unusual clusters of ill patients associated by some characteristic, unusual disease or illness, and the occurrence of severe disease in healthy adults are the primary medical findings associated with terrorism.

- Should a high threat event be combined with a medical finding of concern, that concern should be immediately transmitted to medical command, the receiving hospital, and to law enforcement as soon as possible.

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Common Management Strategies

- Should a worrisome event occur, first responders must protect themselves from harm, prior to the full recognition of the WMD agent.

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Common Management Strategies

- For chemical weapons, that means personal protective equipment (PPE):
  - The key characteristics of chemical PPE are respiratory filtration or supplied air and a barrier suit.
  - Encapsulated within such garments, a first responder may be able to function for considerable time within a chemical environment.
Common Management Strategies

- Biological weapons require the addition of HEPA filtration to the standard blood and body fluid precautions

- Should contagious disease be considered, the transport vehicle cannot be reused for noninfectious patients or it will serve to spread the disease

Common Management Strategies

- Radiation events require careful measurement of the radiation risk and protective gear to ensure no inhalation ingestion or contamination of the first responder occurs

- Victims, first responders, and their vehicles must be decontaminated if they are exposed to harmful chemicals, infectious disease, or radiation contamination

Common Management Strategies

- Each WMD agent has a specific antidote or critical resource (e.g., atropine is needed for nerve agent resuscitation, and quarantine rooms are needed to manage Ebola victims)

- The amount of resources will certainly be insufficient in the early stages of any crisis; therefore wise use of resources is the key to managing an event
Key New Skills and Knowledge Critical to First Responder Preparedness

- Nerve agent management
- Chemical asphyxiant management
- Blast injury
- Personal protective equipment training
- Decontamination training
- Infection control training

Summary

- Terrorism
- Agents of Terrorism
  - Chemical Weapons
  - Biological Weapons
  - Radiological Devices
- Common Management Strategies