Purpose: This is written to provide general pre-arrival information for suspected hazardous materials (HazMat) and weapons of mass destruction (WMD) incidents.

NOTE: This information is designed to augment other established protocols. All Marquette County EMS providers are to have completed WMD Awareness Training.

I. First Responder/ EMS Issues

A. **Chemical agents** pose a threat during every phase of their existence: production, packaging, storage and delivery to the intended target. Many common hazardous materials used in industry pose the same threat to emergency responders as the chemicals classified as nerve, blister, blood, and choking agents.
B. **Biological threats** may be intentional or natural. Either may affect large segments of the population and will not necessarily present immediately.
C. **Radiological threats** affecting a significant portion of the population will most likely be associated with the explosion of a nuclear device or with the intentional release of radioactive material, including associated with a 'dirty bomb'.

II. Signs and Symptoms of Attack

A. Unlike an attack with explosives, the fact that a terrorist has attacked with a chemical or biological agent may not always be obvious at first.
B. Many of the early signs and symptoms produced by chemical warfare agents may resemble those of a variety of disorders, including stress, psychological withdrawal, palpitations, gastrointestinal distress, headaches, dizziness, and inattentiveness.
C. The patient's clinical presentation will offer clues about the type of toxic substance used.
D. **CHEMICAL INCIDENT**

Responders should be alert for the following signs that a chemical agent may have been dispersed:

- a. Explosions that dispense liquids, vapors or gases
- b. Explosions that seem only to destroy a package or bomb device
- c. Unscheduled and unusual spray being disseminated
- d. Abandoned spray devices
- e. Numerous dead animals, fish and birds
- f. Lack of insect life
- g. Mass casualties without obvious trauma
- h. Definite pattern of casualties and common symptoms
- i. Civilian panic in potential target areas (government buildings, public assemblies, etc.)
- j. Any clustering of symptoms or unusual age distribution (e.g., chemical exposure in children).

E. **BIOLOGICAL INCIDENT**

1. Responders should be alert for the following signs that a biological agent may have been dispersed:
   - a. An unusual increase in the number of individuals seeking care, especially with similar symptoms such as respiratory, neurological, gastrointestinal or dermatological symptoms.
   - b. Any clustering of patients in time or location (e.g., persons who attended the same public event).

F. **RADIOLOGICAL INCIDENT**

1. Notification of the detonation of a nuclear device.
2. Explosion with mushroom cloud and devastation of a large geographical area (atypically large for an incendiary device)
3. Dirty bomb

III. MEDICAL RESPONSE

A. If a chemical attack is suspected, first responding units must approach with caution.
B. Approach upwind, uphill and upstream.
C. Utilize resource materials such as the Emergency Response Guidebook or Emergency Care for Hazardous Materials Exposure.
D. Utilize appropriate PPE.
E. Be aware of contaminated terrain and contaminated objects.
F. Hazmat response protocols must be initiated, as well as unified incident command.

I. Maintain a safe distance.
J. Attempt to identify the nature of the exposure by looking for placards, mode of dispersal (vehicle explosion, bomb, aerosolized gas, etc.)
K. Victims and potential victims must be evacuated rapidly from the contaminated area and decontaminated as quickly as possible, if necessary. In certain situations, treatment may be initiated within the hot and/or warm zones of an incident by properly trained, protected and equipped personnel.
L. Be alert for secondary devices.

IV. Select Agents of Terrorism

A. Chemical Agents

A chemical agent may be defined as a compound that, through its chemical properties, produces lethal or damaging effects in humans, animals, plants or materials. Chemical agents are usually man-made through the use of industrial chemical processes.

1. Chemical agents are classified by their effects:
   - **a.** **Lethal agents** are designed to kill, and are broken down into two subcategories:
     - i. Nerve agents
       1. Nerve agents, the most deadly of all chemical agents, disrupt nerve transmission within organs and are quickly fatal in cases of severe exposure.
     - ii. Blood agents
       1. Blood agents (cyanides) interfere with the blood's ability to transport!oxygen throughout the body; often rapidly fatal.
   - **b.** **Blister agents,** or vesicants, cause a blistering of the skin and mucous membranes, especially the lungs.
   - **c.** **Choking agents,** or pulmonary agents, irritate the lungs, causing them to fill with fluid.
   - **d.** **Incapacitating agents,** cause an intense (but temporary) irritation of eyes and respiratory tract.
2. The potential of the agent to do damage is measured by how readily it disperses. Chemical agents are either *persistent* or *non-persistent.* Wind and rain will increase the dispersion rate of a chemical agent. Heavy rains act to dilute both persistent and non-persistent agents and facilitate penetration into the ground.
   - **a.** **Persistent agents** have low volatility, evaporate slowly and are particularly hazardous in liquid form. They stay around for long periods of time (24 hours or longer) and contaminate not only the air but objects and terrain as well. Mustard and the nerve agent VX are examples of persistent agents.
   - **b.** **Non-persistent agents** are volatile and evaporate quickly, within several hours. Gases, aerosols, and highly volatile liquids tend to disperse rapidly after release. Phosgene, cyanide and the G series of nerve agents (with the exception of GD-Soman) are non-persistent agents. Because of their volatility, they pose an immediate respiratory hazard but are not particularly hazardous in liquid form.

B. Biological Agents

Micro-organisms and toxins, generally, of microbial, plant or animal origin to produce disease and/or death in humans, livestock and crops

1. Biological agents
   - a. Bacterial Agents
     - i. Anthrax
     - ii. Cholera
     - iii. Plague
     - iv. Tularemia
     - v. Q-Fever
   - b. Viral Agents
     - i. Smallpox

ii. Venezuelan Equine Encephalitis

c. Viral Hemorrhagic Fevers

d. Biological Toxins

i. Botulinum Toxins

ii. Staphylococcal Enterotoxin B

iii. Ricin

iv. Trichothecene Mycotoxins (T2)

2. Biological agents utilized as a WMD may not become evident until hours, days or weeks after the exposure due to the various incubation periods for each pathogen.

V. Personal Protective Equipment

A. NIOSH/OSHA/EPA classification system:

Level A: Fully encapsulating, chemical resistant suit, gloves and boots, and a pressure demand, self-contained breathing apparatus (SCBA) or a pressure-demand supplied air respirator (air hose) and escape SCBA. (Maximum protection against vapor and liquids)

Level B: Non-encapsulating, splash-protective, chemical-resistant suit that provides Level A protection against liquids but is not airtight. (Full respiratory protection is required but danger to skin from vapor is less)

Level C: Utilizes a splash suit along with a full-faced positive or negative pressure respirator (a filter type gas mask) rather than an SCBA or air line.

Level D: Limited to coveralls or other work clothing, boots and gloves

B. Universal Precautions:

1. Universal precautions: assume that all patients are potentially contagious and use appropriate barriers to prevent the transmission of pathogenic organisms. PPE include gloves, gowns, HEPA respirators, face shields and appropriate handwashing.
2. If a chemical exposure is suspected, coated Tyvex suits, and respirators with Organic Vapor/HEPA cartridges are recommended.

AUTHENTICATION AND APPROVAL

Richard L. Ippracan DO ______________________ 6/29/2004

Marquette County EMS Medical Director — Date

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APPENDIX A – BIOLOGICAL AGENTS OF WARFARE

BACTERIAL AGENTS

Bacteria are unicellular organisms. They vary in shape and size from spherical cells - cocci - with a diameter of 0.5-1.0 (m (micrometer), to long rod-shaped organisms - bacilli - which may be from 1-5 (m in size. Chains of bacilli may exceed 50 (m. The shape of the bacterial cell is determined by the rigid cell wall. The interior of the cell contains the nuclear material (DNA), cytoplasm, and cell membrane that are necessary for the life of the bacterium. Many bacteria also have glycoproteins on their outer surfaces which aid in bacterial attachment to surface receptors on cells and are of special importance in their ability to cause disease. Under special circumstances some types of bacteria can transform into spores. The spore of the bacterial cell is more resistant to cold, heat, drying, chemicals and radiation than the bacterium itself. Spores are a dormant form of the bacterium and, like the seeds of plants, they can germinate when conditions are favorable.

Bacteria can cause diseases in human beings and animals by means of two mechanisms which differ in principle: in one case by invading the tissues, in the other by producing poisons (toxins). In many cases pathogenic bacteria possess both properties. The diseases they produce often respond to specific therapy with antibiotics. This manual will cover several of the bacteria or rickettsia considered to be potential BW threat agents: Bacillus anthracis (Anthrax), Vibrio cholerae (Cholera), Yersinia pestis (Plague), Francisella tularensis (Tularemia), and Coxiella burnetii (Q-Fever).

ANTHRAX

Bacillus anthracis is a rod-shaped, gram-positive, sporulating organism, the spores constituting the usual infective form. Anthrax is a zoonotic disease with cattle, sheep and horses being the chief domesticated animal hosts, but other animals may be infected. The disease may be contracted by the handling of contaminated hair, wool, hides, flesh, blood and excreta of infected animals and from manufactured products such as bone meal, as well as by purposeful dissemination of spores. Transmission is made through scratches or abrasions of the skin, wounds, inhalation of spores, eating insufficiently cooked infected meat, or by flies. All human populations are susceptible. Recovery from an attack of the disease may be followed by immunity. The spores are very stable and may remain viable for many years in soil and water. They will resist sunlight for varying periods.

Signs and Symptoms: Incubation period is 1-6 days. Fever, malaise, fatigue, cough and mild chest discomfort is followed by severe respiratory distress with dyspnea, diaphoresis, stridor, and cyanosis. Shock and death occurs within 24-36 hours of severe symptoms.

Diagnosis: Physical findings are non-specific. Possible widened mediastinum. Detectable by Gram stain of the blood and by blood culture late in the course of illness.

Treatment: High dose antibiotic treatment with penicillin, ciprofloxacin, or doxycycline should be undertaken. Supportive therapy may be necessary.

Prophylaxis: A licensed vaccine for use in those considered to be at risk of exposure. Vaccine schedule is 0, 2, and 4 weeks for the initial series, followed by boosts at 6, 12, and 18 months and then a yearly booster. Oral ciprofloxacin may be used for known or imminent exposure.

Decontamination: Secretion and lesion precautions should be practiced. After an invasive procedure or autopsy is performed, the instruments and area used should be thoroughly disinfected with a sporicidal agent (iodine or chlorine).

CHOLERA

Vibrio cholerae is a short, curved, motile, gram-negative, non-sporulating rod. There are two serogroups, O1 and O139, which have been associated with cholera in humans. The O1 serotype exists as 2 biotypes, classical and El Tor. The organisms are facultative anaerobes, growing best at a pH of 7.0, but able to tolerate an alkaline environment. They do not invade the intestinal mucosa, but rather "adhere" to it. Cholera is the prototype toxigenic diarrhea, which is secretory in nature. All strains elaborate the same enterotoxin, a protein molecule with a molecular weight of 84,000 Daltons. The entire clinical syndrome is caused by the action of the toxin on the intestinal epithelial cell. Fluid loss in cholera originates in the small intestine with the colon being relatively insensitive to the toxin. The large volume of fluid produced in the upper intestine overwhelms the capacity of the lower intestine to absorb. Transmission is made through direct or indirect fecal contamination of water or foods, and by heavily soiled hands or utensils. All populations are susceptible, while natural resistance to infection is variable. Recovery from an attack is followed by a temporary immunity which may furnish some protection for years. The organism is easily killed by drying. It is not viable in pure water, but will survive up to 24 hours in sewage, and as long as 6 weeks in certain types of relatively impure water containing organic matter. It can withstand freezing for 3 to 4 days. It is readily killed by dry heat at 117 (C, by steam and boiling, by short exposure to ordinary disinfectants, and by chlorination of water.

Signs and Symptoms: Incubation period is 12-72 hours. Vary from asymptomatic to severe with sudden onset and include vomiting, headache, intestinal cramping with little or no fever followed rapidly by painless, voluminous diarrhea. Fluid losses may exceed 5 to 10 liters per day. Without treatment, death may result from severe dehydration, hypovolemia and shock.

Diagnosis: Clinical diagnosis. 'Rice water' diarrhea and dehydration. Microscopic exam of stool samples reveals few or no red or white cells. Can be identified by dark-field or phase contrast microscopy and by direct visualization of darting motile Vibrio.

Treatment: Fluid and electrolyte replacement. Antibiotics (tetracycline, ciprofloxacin or erythromycin) will shorten the duration of diarrhea and shedding of the organism.

Prophylaxis: A licensed, killed vaccine is available but provides only about 50 percent protection that lasts for no more than 6 months. Vaccination schedule is at 0 and 4 weeks, with booster doses every 6 months.

Decontamination: Personal contact rarely causes infection; however, enteric precautions and careful hand-washing should be employed. Bactericidal solutions (hypochlorite) would provide adequate decontamination.

PLAGUE

Yersinia pestis is a rod-shaped, non-motile, non-sporulating, gram-negative, bipolar staining, facultative anaerobic bacterium. Plague is a zoonotic disease. Rodents (rats, mice, ground squirrels) in areas where plague is present can be infected with the bacteria. Fleas which live on the rodents can sometimes pass the bacteria to human beings, who then suffer from the bubonic form of plague. The pneumonic form of the disease would be seen as the primary form after purposeful aerosol dissemination of the organisms. The bubonic form would be seen after purposeful dissemination through the release of infected fleas. All human populations are susceptible. Recovery from the disease may be followed by temporary immunity. The organism will probably remain viable in water and moist meals and grains for several weeks. At near freezing temperatures, it will remain alive from months to years but is killed by 15 minutes exposure to 72 (C. It also remains viable for some time in dry sputum, flea feces, and buried bodies but is killed with several hours of exposure to sunlight.

Signs and Symptoms: Pneumonic plague: incubation period is 2-3 days (High fever, chills, headache, hemoptysis, and toxemia, progressing rapidly to dyspnea, stridor, and cyanosis). Death results from respiratory failure, circulatory collapse, and a bleeding diathesis. Bubonic plague: incubation period is 2 to 10 days. Malaise, high fever, and tender lymph nodes (buboes); may progress spontaneously to the septicemic form, with spread to the CNS, lungs, and elsewhere.

Diagnosis: Clinical diagnosis. After an incubation period varying from 2-3 days for primary pneumonic plague, presumably dependent upon the dose of inhaled organisms, onset is acute and often fulminant. The presentation is one of malaise, high fever, chills, headache, myalgia, cough with production of a bloody sputum, and toxemia. A presumptive diagnosis can be made by Gram or Wayson stain of lymph node aspirates, sputum, or CSF. Plague can also be cultured.

Treatment: Early administration of antibiotics is very effective. Supportive therapy for pneumonic and septicemic forms is required.

Prophylaxis: A licensed, killed vaccine is available. Initial dose followed by a second smaller dose 1-3 months later, and a third 3-6 months later. A booster dose is given at 6, 12 and 18 months and then every 1-2 years. This vaccine may not protect against aerosol exposure.

Decontamination and Isolation: Secretion and lesion precautions with bubonic plague. Strict isolation of patients with pneumonic plague is required. Heat, disinfectants and exposure to sunlight renders bacteria harmless.

TULAREMIA

Francisella tularensis is a small, aerobic, gram-negative cocco-bacillus, often varying in size and shape. It is non-motile and non-sporulating. Tularemia (also known as rabbit fever and deer fly fever) is a zoonotic disease and humans acquire the disease under natural conditions through inoculation of skin or mucous membranes with blood or tissue fluids of infected animals, or bites of infected deerflies, mosquitoes, or ticks. Less commonly, inhalation of contaminated dusts or ingestion of contaminated foods or water may produce clinical disease. Respiratory exposure by aerosol would cause typhoidal tularemia often having a pneumonic component. The organism can remain viable for weeks in water, soil, carcasses, and hides, and for years in frozen rabbit meat. It is resistant for months to temperatures of freezing and below. It is rather easily killed by heat and disinfectants.

Signs and Symptoms: Ulceroglandular tularemia presents with a local ulcer and regional lymphadenopathy, fever, chills, headache and malaise. Typhoidal or septicemic tularemia presents with fever, headache, malaise, substernal discomfort, prostration, weight loss and a non-productive cough.

Diagnosis: Clinical diagnosis. Physical findings are usually non-specific. Chest x-ray may reveal a pneumonic process, mediastinal lymphadenopathy or pleural effusion. Routine culture is possible but difficult. The diagnosis can be established retrospectively by serology. After an incubation period varying from 2 to 10 days, presumably dependent upon the dose of organisms, onset is usually acute. Ulceroglandular disease usually manifests as regional lymphadenopathy, fever, chills, headache, and malaise, with or without a cutaneous ulcer. In those 5 to 10 percent of cases with no visible ulcer, the syndrome is known as glandular tularemia. Primary ulceroglandular disease confined to the throat is referred to as pharyngeal tularemia. Oculoglandular tularemia occurs after inoculation of the conjunctivae with infectious material.

Typhoidal or septicemic tularemia manifests as fever, prostration, and weight loss, but without adenopathy. Diagnosis of primary typhoidal tularemia is difficult, as signs and symptoms are non-specific and there frequently is no suggestive exposure history. Respiratory symptoms of substernal discomfort and a non-productive cough may also be present. Radiologic evidence of pneumonia or mediastinal lymphadenopathy may or may not be present in all forms of tularemia but is most common with typhoidal disease.

Identification of organisms by staining ulcer fluids or sputum is generally not helpful. Routine culture is difficult, due to unusual growth requirements and/or overgrowth of commensal bacteria. The diagnosis can be established retrospectively by serology.

Treatment: Administration of antibiotics (streptomycin or gentamicin) with early treatment is very effective.

Prophylaxis: A live, attenuated vaccine is available as an investigational new drug. It is administered once by scarification. A two week course of tetracycline is effective as prophylaxis when given after exposure.

Decontamination: Secretion and lesion precautions should be practiced. Strict isolation of patients is not required. Organisms are relatively easy to render harmless by heat and disinfectants.

Q-FEVER

The endemic form of Q fever is a zoonotic disease caused by a rickettsia, Coxiella burnetii. Its natural reservoir is sheep, cattle and goats, in which it grows to especially high concentrations in placental tissues. Exposure to infected animals at parturition is an important risk factor for the endemic disease. It is excreted also in animal milk, urine, and feces. Humans acquire the disease by inhalation of aerosols contaminated with the organisms. Farmers and abattoir workers are at greatest risk occupationally. A biological warfare attack with Q fever would cause a disease similar to that occurring naturally. Q fever is also a significant hazard in laboratory personnel who are working with the organism.

Signs and Symptoms: Fever, cough, and pleuritic chest pain may occur as early as ten days after exposure. Patients are not generally critically ill, and the illness lasts from 2 days to 2 weeks.

Diagnosis: Q fever is not a clinically distinct illness and may resemble a viral illness or other types of atypical pneumonia. The diagnosis is confirmed serologically. Following the usual incubation period of from 10 to 20 days, Q fever generally occurs as a self-limiting febrile illness lasting 2 days to 2 weeks. The incubation period varies according to the numbers of organisms inhaled, with longer periods between exposure and illness with lower numbers of inhaled organisms (up to forty days in some cases). The disease generally presents as an acute non-differentiated febrile illness, with headaches, fatigue, and myalgias as prominent symptoms.

Treatment: Q fever is generally a self-limited illness even without treatment. Tetracycline or doxycycline are the treatments of choice and are given orally for 5 to 7 days. Q fever endocarditis (rare) is much more difficult to treat.

Prophylaxis: Treatment with tetracycline during the incubation period may delay but not prevent the onset of symptoms. An inactivated whole cell vaccine is effective in eliciting protection against exposure, but severe local reactions to this vaccine may be seen in those who already possess immunity.

Decontamination: Patients who are exposed to Q fever by aerosol do not present a risk for secondary contamination or re-aerosolization of the organism. Decontamination is accomplished with soap and water or by the use of weak (0.5 percent) hypochlorite solutions.

VIRAL AGENTS

Viruses are the simplest type of microorganism and consist of a nucleocapsid protein coat containing genetic material, either RNA or DNA. In some cases the virus particle is also surrounded by an outer layer of lipids. Viruses are much smaller than bacteria and vary in size from 0.02 (m to 0.2 (m (1 (m = 1/1000 mm). Viruses lack a system for their own metabolism and are therefore dependent on the synthetic machinery of their host cells: viruses are thus intracellular parasites. This also means that the virus, unlike the bacterium, cannot be cultivated in synthetic nutritive solutions but requires living cells in order to multiply. The host cells can be from human beings, animals, plants, or bacteria. Every virus needs its own special type of host cell because a complicated interaction is required between the cell and virus if the virus is to be able to multiply. Many virus-specific host cells can be cultivated in synthetic nutrient solutions and afterwards can be infected with the virus in question. Another usual way of cultivating viruses is to let them grow on chorioallantoic membranes (from fertilized eggs). The cultivation of viruses is a costly, demanding, and time-consuming process. A virus normally brings about changes in the host cell such that the cell dies. This handbook will cover a virus considered by some to be the most likely viral agent that would be used in a BW attack, the alpha-virus that causes Venezuelan equine encephalitis, known as VEE. The handbook also covers the smallpox viruses and some viruses that cause hemorrhagic manifestations; both could potentially be employed as BW agents.

SMALLPOX

Variola virus is the cause of smallpox. It is an Orthopox virus and occurs in at least two strains, one of which causes variola major, and the other causes a milder disease, variola minor. Despite widespread availability of a vaccine, the potential weaponization of variola continues to pose a military threat. This threat can be attributed to the aerosol infectivity of the virus, the relative ease of large-scale production, and an increasingly Orthopoxvirus-naive populace. Although the fully-developed cutaneous eruption of smallpox is unique, earlier stages of the rash could be mistaken for varicella. Secondary spread of infection constitutes a nosocomial hazard from the time of onset of a smallpox patient's exanthem until scabs have separated. Quarantine with respiratory isolation should be applied to secondary contacts for 17 days post-exposure.

Signs and Symptoms: The incubation period of smallpox averages 12 days, and contacts are quarantined for a minimum of 16-17 days following exposure. Clinical manifestations begin acutely with malaise, fever, rigors, vomiting, headache, and backache. 2-3 days later lesions appear which quickly progress from macules to papules, and eventually to pustular vesicles. They are more abundant on the extremities and face, and develop synchronously.

Diagnosis: Electron and light microscopy are not capable of discriminating variola from vaccinia, monkeypox or cowpox. The new PCR diagnostic techniques may be more accurate in discriminating between variola and other Orthopoxviruses.

Treatment: At present there is no effective chemotherapy, and treatment of a clinical case remains supportive.

Prophylaxis: Immediate vaccination or revaccination should be undertaken for all personnel exposed.
Vaccinia-immune globulin (VIG) is of value in post-exposure prophylaxis of smallpox when given within the first week following exposure.

Isolation: Strict quarantine with respiratory isolation for a minimum of 16-17 days following exposure for all contacts. Patients should be considered infectious until all scabs separate.

VENEZUELAN EQUINE ENCEPHALITIS

Venezuelan equine encephalitis (VEE) virus is an arthropod-borne alphavirus that is endemic in northern South America, Trinidad, Central America, Mexico, and Florida. Eight serologically distinct viruses belonging to the VEE complex have been associated with human disease; the two most important of these pathogens are designated subtype I, variants A/B, and C. These agents also cause severe disease in horses, mules, burros and donkeys (Equidae). Natural infections are acquired by the bites of a wide variety of mosquitoes. Equidae serve as amplifying hosts and source of mosquito infection. In natural human epidemics, severe and often fatal encephalitis in Equidae always precedes disease in humans. The virus is rather easily killed by heat and disinfectants.

Signs and Symptoms: VEE is characterized by inflammation of the meninges of the brain and of the brain itself, thus accounting for the predominance of CNS symptoms in the small percentage of infections that develop encephalitis. The disease is usually acute, prostrating and of short duration. Sudden onset of illness with generalized malaise, spiking fevers, rigors, severe headache, photophobia, and myalgias. Nausea, vomiting, cough, sore throat, and diarrhea may follow. Full recovery takes 1-2 weeks.

Diagnosis: Clinical diagnosis. Physical findings are usually non-specific. The white blood cell count often shows a striking leukopenia and lymphopenia. Virus isolation may be made from serum, and in some cases throat swab specimens.

Treatment: Supportive only.

Prophylaxis: A live, attenuated vaccine is available as an investigational new drug. A second, formalin-inactivated, killed vaccine is available for boosting antibody titers in those initially receiving the live vaccine.

Decontamination: Blood and body fluid precautions should be practiced. Human cases are infectious for mosquitoes for at least 72 hours. The virus can be destroyed by heat (80 degrees centigrade for 30 minutes) and ordinary disinfectants.

VIRAL HEMORRHAGIC FEVERS

The viral hemorrhagic fevers are a diverse group of human illnesses that are due to RNA viruses from several different viral families: the Filoviridae, which consists of Ebola and Marburg viruses; the Arenaviridae, including Lassa fever, Argentine and Bolivian hemorrhagic fever viruses; the Bunyaviridae, including various members from the Hantavirus genus, Congo-Crimean hemorrhagic fever virus from the Nairovirus genus, and Rift Valley fever from the Phlebovirus genus; and Flaviviridae, such as Yellow fever virus, Dengue hemorrhagic fever virus, and others. The viruses may be spread in a variety of ways, and for some there is a possibility that humans could be infected through a respiratory portal of entry. Although evidence for weaponization does not exist for many of these viruses, many are included in this handbook because of their potential for aerosol dissemination or weaponization, or likelihood for confusion with similar agents which might be weaponized.

Signs and Symptoms: VHFs are febrile illnesses which can be complicated by easy bleeding, petechiae, hypotension and even shock, flushing of the face and chest, and edema. Constitutional symptoms such as malaise, myalgias, headache, vomiting, and diarrhea may occur in any of the hemorrhagic fevers.

Diagnosis: Definitive diagnosis rests on specific virologic techniques. Significant numbers of military personnel with a hemorrhagic fever syndrome should suggest the diagnosis of a viral hemorrhagic fever.

Treatment: Intensive supportive care may be required. Antiviral therapy with ribavirin may be useful in several of these infections. Convalescent plasma may be effective in Argentine hemorrhagic fever.

Prophylaxis: The only licensed VHF vaccine is yellow fever vaccine. Prophylactic ribavirin may be effective for Lassa fever, Rift Valley fever, CCHF, and possibly HFRS.

Decontamination and Isolation: Decontamination with hypochlorite or phenolic disinfectants. Isolation measures and barrier nursing procedures are indicated.

BIOLOGICAL TOXINS

Toxins are defined as any toxic substance of natural origin produced by an animal, plant, or microbe. They are different from chemical agents such as VX, cyanide, or mustard in that they are not man-made. They are non-volatile, are usually not dermally active (mycotoxins are an exception), and tend to be more toxic per weight than many chemical agents. Their lack of volatility also distinguishes them from many of the chemical threat agents, and is very important in that they would not be either a persistent battlefield threat or be likely to produce secondary or person to person exposures. Many of the toxins such as low molecular weight toxins and some peptides are quite stable, where as the stability of the larger protein bacterial toxins is more variable. The bacterial toxins, such as botulinum toxins or shiga toxin, tend to be the most toxic in terms of dose required for lethality, whereas the mycotoxins tend to be among the least toxic compounds, thousands of times less toxic than the botulinum toxins. Some toxins are more toxic by the aerosol route than when delivered orally or parenterally (ricin, saxitoxin, and T2 mycotoxins are examples), whereas botulinum toxins have lower toxicity when delivered by the aerosol route than when ingested. Botulinum is so toxic inherently, however, that this characteristic does not limit its potential as a biological warfare agent. The utility of many toxins as military weapons is potentially limited by their inherent low toxicity (too much toxin would be required), or by the fact that some which are very toxic, such as saxitoxin, can only feasibly be produced in minute quantities. The lower the lethal dose for fifty percent of those exposed (LD50), in micrograms per kilogram, the less agent would be required to cover a large sized area. The converse is also true, and means that for some agents such as ricin; very large quantities (tons) would be needed for an effective open-air attack.

BOTULINUM TOXINS

The botulinum toxins are a group of seven related neurotoxins produced by the bacillus Clostridium botulinum. These toxins, types A through G, could be delivered by aerosol over concentrations of people. When inhaled, these toxins produce a clinical picture very similar to food borne intoxication, although the time to onset of paralytic symptoms may actually be longer than for food borne cases, and may vary by type and dose of toxin. The clinical syndrome produced by one or more of these toxins is known as "botulism".

Signs and Symptoms: Ptosis, generalized weakness, dizziness, dry mouth and throat, blurred vision and diplopia, dysarthria, dysphonia, and dysphagia followed by symmetrical descending flaccid paralysis and development of respiratory failure. Symptoms begin as early as 24-36 hours but may take several days after inhalation of toxin.

Diagnosis: The onset of symptoms of inhalation botulism may vary from 24 to 36 hours, to several days following exposure. Botulinum toxins act by binding to the presynaptic nerve terminal at the neuromuscular junction and at cholinergic autonomic sites. These toxins then act to prevent the release of acetylcholine presynaptically, and thus block neurotransmission. This interruption of neurotransmission causes both bulbar palsies and the skeletal muscle weakness seen in clinical botulism.

Unlike nerve agents, where there is in effect too much acetylcholine due to inhibition of acetylcholinesterase, the problem in botulism is lack of the neurotransmitter in the synapse. Thus, pharmacologic measures such as atropine are not helpful in botulism and could even exacerbate symptoms.

Treatment: Intubation and ventilatory assistance for respiratory failure. General supportive care. Administration of botulinum antitoxin may decrease progression to respiratory failure and hasten recovery.

Prophylaxis: Pentavalent toxoid vaccine (types A, B, C, D, and E) is available as an IND product for those at high risk of exposure.

Decontamination: Hypochlorite (0.5% for 10-15 minutes) and/or soap and water. Toxin is not dermally active and secondary aerosols are not a hazard from patients.

STAPHYLOCOCCAL ENTEROTOXIN B

Staphylococcus aureus produces a number of exotoxins, one of which is Staphylococcal enterotoxin B, or SEB. Such toxins are referred to as exotoxins since they are excreted from the organism; however, they normally exert their effects on the intestines and thereby are called enterotoxins. SEB is one of the pyrogenic toxins that commonly causes food poisoning in humans after the toxin is produced in improperly handled foodstuffs and subsequently ingested. SEB has a very broad spectrum of biological activity. This toxin causes a markedly different clinical syndrome when inhaled than it characteristically produces when ingested. Significant morbidity is produced in individuals who are exposed to SEB by either portal of entry to the body.

Signs and Symptoms: Relevant exposures to SEB are projected to cause primarily clinical illness and incapacitation. However, higher exposure levels can lead to septic shock and death. Intoxication with SEB begins 3 to 12 hours after inhalation of the toxin. Victims may experience the sudden onset of fever, headache, chills, myalgias, and a nonproductive cough. More severe cases may develop dyspnea and retrosternal chest pain. Nausea, vomiting, and diarrhea will also occur in many patients due to inadvertently swallowed toxin, and fluid losses can be marked. The fever may last up to five days and range from 103 to 106 F, with variable degrees of chills and prostration. The cough may persist up to four weeks, and patients may not be able to return to duty for two weeks.

Diagnosis: Diagnosis is clinical. Patients present with a febrile respiratory syndrome without CXR abnormalities. Large numbers of soldiers presenting with typical symptoms and signs of SEB pulmonary exposure would suggest an intentional attack with this toxin.

Treatment: Treatment is limited to supportive care. Artificial ventilation might be needed for very severe cases, and attention to fluid management is important.

Prophylaxis: Use of protective mask. There is currently no human vaccine available to prevent SEB intoxication.

Decontamination: Hypochlorite (0.5% for 10-15 minutes) and/or soap and water. Destroy any food that may have been contaminated.

RICIN

Ricin is a potent protein toxin derived from the beans of the castor plant (Ricinus communis). Castor beans are ubiquitous worldwide, and the toxin is fairly easily produced from them. Ricin is therefore a potentially widely available toxin. When inhaled as a small particle aerosol, this toxin may produce pathologic changes within 8 hours and severe respiratory symptoms followed by acute hypoxic respiratory failure in 36-72 hours. When ingested, ricin causes severe gastrointestinal symptoms followed as well by vascular collapse and death. This toxin may also cause disseminated intravascular coagulation, microcirculatory failure and multiple organ failure if given intravenously in laboratory animals.

Signs and Symptoms: Weakness, fever, cough and pulmonary edema occur 18-24 hours after inhalation exposure, followed by severe respiratory distress and death from hypoxemia in 36-72 hours.

Diagnosis: Signs and symptoms noted above in large numbers of geographically clustered patients could suggest an exposure to aerosolized ricin. The rapid time course to severe symptoms and death would be unusual for infectious agents. Lab findings are nonspecific but similar to other pulmonary irritants which cause PE. Specific serum ELISA is available. Acute and convalescent sera should be collected.

Treatment: Management is supportive and should include treatment for pulmonary edema. Gastric decontamination measures should be used if ingested.

Prophylaxis: There is currently no vaccine or prophylactic antitoxin available for human use, although immunization appears promising in animal models. Use of the protective mask is currently the best protection against inhalation.

Decontamination: Weak hypochlorite solutions and/or soap and water can decontaminate skin surfaces. Ricin is not volatile, so secondary aerosols are generally not a danger to health care providers.

TRICHOTHECENE MYCOTOXINS (T2)

The trichothecene mycotoxins are low molecular weight nonvolatile compounds produced by filamentous fungi (molds) of the genera Fusarium, Myrotecium, Trichoderma, Stachybotrys and others. The structures of approximately 150 trichothecene derivatives have been described in the literature. Heating to 500 F for 30 minutes is required for inactivation, while brief exposure to NaOH destroys toxic activity. The potential for use as a BW toxin was demonstrated to the Russian military shortly after World War II when flour contaminated with species of Fusarium was baked into bread that was ingested by civilians. Some developed a protracted lethal illness called alimentary toxic aleukia (ATA) characterized by initial symptoms of abdominal pain, diarrhea, vomiting, prostration, and within days fever, chills, myalgias and bone marrow depression with granulocytopenia and secondary sepsis. Survivals beyond this point allowed the development of painful pharyngeal/laryngeal ulceration and diffuse bleeding into the skin (petechiae and ecchymosis), melena, bloody diarrhea, hematuria, hematemesis, epistaxis and vaginal bleeding. Pancytopenia, and gastrointestinal ulceration and erosion were secondary to the ability of these toxins to profoundly arrest bone marrow and mucosal protein synthesis and cell cycle progression through DNA replication.

Signs and Symptoms: Exposure causes skin pain, pruritus, redness, vesicles, necrosis and sloughing of epidermis. Effects on the airway include nose and throat pain, nasal discharge, itching and sneezing, cough, dyspnea, wheezing, chest pain and hemoptysis. Toxin also produces effects after ingestion or eye contact. Severe poisoning results in prostration, weakness, ataxia, collapse, shock, and death.

Diagnosis: Should be suspected if an aerosol attack occurs in the form of "yellow rain" with droplets of yellow fluid contaminating clothes and the environment. .

Treatment: There is no specific antidote. Super activated charcoal should be given orally if swallowed.

Prophylaxis: The only defense is to wear a protective mask and clothing during an attack. No specific immunotherapy or chemotherapy is available for use in the field.
Decontamination: The outer uniform should be removed and exposed skin should be decontaminated with soap and water. Eye exposure should be treated with copious saline irrigation. Once decontamination is complete, isolation is not required.