NATO HANDBOOK ON THE MEDICAL ASPECTS OF NBC DEFENSIVE OPERATIONS AMedP-6(B)

PART I - NUCLEAR

ANNEX B

HAZARDS OF NUCLEAR WEAPONS ACCIDENTS

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ANNEX B

HAZARDS OF NUCLEAR WEAPONS ACCIDENTS

SECTION I - GENERAL

B.01. Introduction.

Nuclear weapons accidents can be a peacetime and wartime problem, and all elements of a military medical service should be prepared to provide the medical support required if they occur. To accomplish this most effectively, all medical facilities should have specific procedural guides readily available, so that even personnel who have not been specifically trained in the hazards of nuclear weapons can perform necessary actions effectively and safely with minimal supervision. To help accomplish these objectives, detailed information is included in the several sections of Annexes B and C. The sections of this Annex include general information concerning accidents and their hazards. The three sections in Annex C include information specifically organized to facilitate the development of procedural guidelines for the various departments and services of a medical facility. In wartime, the rigorous peacetime responses to accidents may not be fully implemented.

B.02. Accidental Detonations.

a. *High Explosive Detonations.* All nuclear weapons contain high explosive material. In any accident, there is a risk of either explosion of this material or fire. Either may occur immediately at the time of the accident or later if a weapon is severely damaged and fragments of high explosive and nuclear material are scattered. All personnel at an accident site must be aware of these hazards and conduct all operations and duties under the direction of experienced ordinance disposal personnel.

b. *Nuclear Detonations.* This is not considered to be a credible event.

B.03. Types of Radiation.

a. The principle fissionable materials in nuclear weapons (^{235}U and ^{239}Pu) are basically alpha particle emitters. However, there are several weak (up to 185 KeV) x and gamma ray emissions associated with alpha particle decay. The radiation intensity of x and gamma radiations at an accident site is generally low.

b. The weak x and gamma radiations from unfissioned bomb material are not very penetrating. The intensity is reduced by approximately one half by 5 mm of tissue or water. The principal hazard is from airborne alpha particle emitters.

B.04. Early Rescue and Evacuation of the Injured to Medical Facilities.

a. The victims of such accidents may have serious injuries, frequently multiple, requiring early, skilled treatment. These will include burns, fractures, head injuries, etc., typical of those sustained in serious accidents of all types.
b. Significant radiation injury will not be present. Contamination of the injured with varying amounts of radioactive material may be present, but this contamination should not be a serious, immediate hazard to either the injured or to personnel caring for them.
c. The number of accident victims may vary from very few to a large number depending on the circumstances of the accident. Immediate medical care should be obtained from the closest medical facility, either military or civilian.

SECTION II - GENERAL HAZARDS

B.05. Explosive and Fire Hazards.

a. As noted above, there is a significant risk of high explosive detonations and/or fire at a nuclear weapons accident site. This is increased in vehicular or aircraft accidents where oil or gasoline is present; and, as a result, burns would be a frequent and serious problem among the casualties of a nuclear weapons accident.
b. If there is a fire, the smoke will contain a large variety of burned material from the weapons, the transport vehicle, and the environment. Some of these materials can be dangerous if inhaled. The particle sizes in the smoke from a fire will be important; a percentage of particles smaller than about 10 microns, if inhaled, may penetrate deeply into the respiratory system where the probability of retention is high. This can result in significant damage to the lungs. The respiratory hazard is discussed more fully in Section III.

B.06. Contamination of the Injured with Hazardous Material.

Contamination of injured personnel may be due to either radioactive or toxic materials. In general, the hazard to both the patient and attending medical personnel will be so negligible that

NECESSARY MEDICAL OR SURGICAL TREATMENT MUST NOT BE DELAYED BECAUSE OF POSSIBLE CONTAMINATION.

Decontamination should be done as soon as possible during the care of such patients, and ideally, prior to admission to a hospital. However, this will not always be possible, and decontamination procedures should be part of the operational plans and guides of all divisions and departments of medical facilities, not just of emergency room or teams. This insures flexibility of response and action and will prevent delay in needed medical treatment. The simple removal of outer clothing and shoes will, in most instances, affect a 90-95% reduction in the patient's contamination.

B.07. Contamination of Hospital Facilities, Equipment, and Personnel.

a. Since the treatment of injured, contaminated personnel may result in the contamination of almost any part of a medical facility, a large number of the medical personnel procedures must be able to set up to accomplish the following:
   (1) Minimize the degree of contamination.
   (2) Identify and measure the extent of contamination.
   (3) Remove the contamination.

b. The removal of contamination is a two-part problem and includes decontamination of personnel as well as decontamination of equipment and facilities. The former must be started as soon as possible, even if monitoring facilities are not available. Standardized procedures of decontaminating personnel must be established and instituted. Personnel must not be released before they have been monitored and decontaminated completely. The monitoring capability would be obtained from the technical teams working at the accident site. This requires coordination and communication with the authorities responsible for overall management of the nuclear accident.

B.08. Contamination of Geographical Area Around Accident with Potential Hazard to Local Population.

Medical personnel may be called upon to give advice as to the nature and degree of public hazard associated with a given type and level of contamination. This hazard will rarely be an acute one but may well be a significant long term one. The advice given will be an essential factor in determining what methods are used to minimize and remove the hazard.

a. The most probable hazard will occur downwind from an accident site due to airborne particles of radioactive material which could be inhaled. Early after an accident, adequate information may not be available to determine the exact degree of the hazard from airborne contamination. As a result, a decision to evacuate an area close to an accident location may have to be made by local authorities without waiting for radiation measurements. No precise guidance can be given for these types of situations.

b. A much less frequent hazard would be contamination of water supplies if an accident occurred near a river source or reservoir. Dilution and settling of insoluble materials would further reduce this small hazard, and simple monitoring measures by trained personnel could be obtained before condemning the water supply. Water from other locations can be used temporarily until adequate measurements are made to determine whether there has been contamination or not. However, drinking water contaminated by plutonium is an insignificant hazard.

B.09. Decontamination Operations.

Exposure level criteria used in accident related operations are basically the same as peacetime industrial exposure limits, as defined by the laws of the country in which the accident occurs or by international agreement (wartime exposure limits may be higher). Emergency

exposures exceeding specified limits must be restricted as much as possible to those truly critical operations such as rescue of the injured. Once the emergency phase of a nuclear accident is over, decontamination must be carried out under strictly controlled medical supervision. This is a separate operation from care of the injured and requires the presence of specially trained physicians and health physicists.

SECTION III - INTERNAL HAZARDS

B.10. General.

a. At the typical accident site, there will be no significant external radiation hazard. A significant internal hazard can be present both early and late. The inhalation hazard is more serious immediately after an accident and during a fire, or following an explosion of conventional explosives when the plume may contain a percentage of respirable particles.

b. These particles settle to the ground but can be resuspended. They are diluted by dispersion. They may be inhaled if they are resuspended as dusts into the atmosphere by winds or movement of people and vehicles. The concentration of particles per unit volume of air under these circumstances will be much less than that in the smoke of the burning weapon, and the particle size distribution will be different.

c. The actual substances which may be inhaled include a wide variety of both radioactive and nonradioactive materials.

B.11. Radioactive Materials.

a. *Plutonium.* Plutonium (Pu) is a heavy metal (atomic number 94), which is artificially produced in reactions by bombardment of uranium 238 with neutrons. Most Pu so produced is ^{239}Pu. However, relatively small quantities of other isotopes are also produced, and ^{241}Pu, ^{242}Pu, and ^{244}Pu will be present in small quantities in the plutonium used in weapons.

(1) If plutonium particles are inhaled, they will be deposited at all levels of the respiratory system, depending on their size. The larger particles are deposited in the nasopharynx or high in the tracheobronchial tree. Only the very small particles, 10 microns in diameter or smaller, are deposited in the alveolar air sacs. The plutonium deposited in the terminal bronchioles above the alveolar air sacs will be cleared from the lungs by the action of the ciliated epitheliums making up the respiratory mucosa. These particles do not present any significant hazard. The possibility of any significant radiation damage while they are in transit out of the lungs or subsequently during their passage through the gastrointestinal system is almost nonexistent. Any cells which are damaged by radiation would be sloughed off and replaced during the normally high rate of cell turnover which occurs in these tissues.

(2) The plutonium remaining in the alveoli can cause damage, since much of it will remain there essentially for the lifetime of the individual. The rate of

removal of plutonium deposited in the air sacs is difficult to estimate, but animal experimentation has indicated that it would take at least several years for significant amounts to be removed. Some of the plutonium particles are phagocytized and picked up by the lymphatic system, but they will not be transported far since a large proportion will be trapped in regional lymph nodes of the lung. Only very negligible quantities will reach the blood stream.

(3) Radiation from plutonium and its daughter products trapped in the lung tissue can cause an inflammatory response and eventual fibrosis. The degree of fibrotic scarring will depend upon the amount of plutonium deposited and time. The overall reserve capacity of the lungs is so great, however, that this would only rarely become a serious problem. Carcinogenesis must also be considered the main hazard, but it is of small relevance in war. Most cells damaged by alpha radiation will be lethally damaged. A very small percentage will be non-lethally damaged. However, there is some x-ray and gamma radiation associated with plutonium and its impurities. The hazard of this radiation to an organ like the lungs is difficult to assess, but it is penetrating and must also be considered as a potential producer of both fibrosis and cancer. This x-ray or gamma radiation has a very low energy level (17 KeV and 60 KeV respectively) and is difficult to detect at low concentrations with standard x-ray sensitive instruments. Special probes are available as accessories to some alpha sensitive detection instruments and are of value in monitoring contamination by plutonium.

b. *Uranium.* Uranium (U) is also a heavy metal (atomic number 92) and an alpha emitter. On a gram for gram basis, the typical uranium alloy has only about 1/500 the radioactivity of an equivalent amount of ^{239}Pu. Therefore, the radiation hazard associated with uranium is much less than that associated with plutonium. Otherwise, the same factors governing deposition and retention in the pulmonary system apply to uranium. Uranium metal can cause chemical toxicity (heavy metal toxicity) at exposures of 0.1 mg/kg body weight. This is seen as damage to the cells of the lower portion of the proximal convoluted tubules of the kidney. There is usually a lag period of 6 hours to several days followed by chemical necrosis. Even after levels which cause necrosis, the kidneys show evidence of regeneration within 2 to 3 days, depending on the severity of the initial exposure. Both ethylenediaminetetraacetic acid (EDTA) and DTPA have been used to increase excretion in experimental animals.

c. *Tritium.*

(1) Tritium is an isotope of hydrogen. There are two other isotopes, protium or normal hydrogen (^{1}H) which has one proton in its nucleus and no neutrons, and deuterium (^{2}H) which has one neutron in its nucleus in addition to the proton. Deuterium is not radioactive and occurs in small quantities naturally. Tritium (^{3}T) is radioactive, emitting a low energy beta particle. It is extremely rare in nature and must be made artificially in reactors to meet the requirements for its scientific, industrial, and military uses. Tritium has a physical half life of 12.26 years. It can be readily absorbed into the body and

becomes diffusely distributed throughout the body water. It may be inhaled, ingested, or absorbed transcutaneously. If a large amount is incorporated into the body accidently, there is a serious risk of whole body beta irradiation and *acute* radiation sickness as described in Chapter 6 in this handbook.

(2) If patients are seen with suspected tritium contamination, the best treatment is to shorten the turnover time of the body water with forced fluid intake and diuretics. This essentially "flushes out" the tritium and can materially reduce the exposure time and the total dose of radiation received. Fortunately, tritium would not be a hazard in the usual accident situation because it dissipates so rapidly. Generally, it will not accumulate in an outside area, although tritium contamination of metal or other surfaces can be persistent. It would be a hazard if an accident occurred in an enclosed space so that dispersion could not occur.

d. *Magnesium-thorium alloys.* Magnesium-thorium alloys should also be considered as radioactive hazards since radioactive thorium is an alpha emitter. Many aircraft and missile structures contain significant amounts of magnesium-thorium (up to 4% of thorium), therefore, in an accident the radioactive thorium must be recovered and disposed as radioactive waste.

B.12. Non-Radioactive Materials.

In any modern weapon system, a fire involving the various components of airplanes, missiles, etc., will release a large variety of non-radioactive toxic materials into the atmosphere. Among these, beryllium is the most important because of the severity of the clinical effects which may be associated with any exposure to this quite hazardous material. This material is far more important than any others and is discussed first.

a. *Beryllium.* Beryllium is a light, gray-white metal. It is not radioactive. However, it is one of the most toxic metals known, If beryllium in any form is inhaled, a particularly severe pneumonitis (berylliosis) may follow. The resulting pulmonary disability is progressive and frequently fatal, either within a few months or after a period of several years. There is no specific treatment. In addition, beryllium can be a hazard if it contaminates wounds. Such contamination results in a severe local inflammatory response and the development of persistent granulomatous lesions, requiring surgical excision. Since beryllium is not radioactive, its presence at an accident site cannot be detected readily with radiac instrumentation. It should be suspected if accident victims have any symptoms or signs of pneumonitis.

b. *Lithium and Plastics.* Lithium, the lightest of all metals, is used extensively in the field of nuclear technology, often in the form of a hydride. If lithium hydride is exposed to water and carbon in the presence of a fire, a chemical reaction occurs which produces acetylene gas. This in turn increases the intensity of the fire. Also, a wide variety of plastics are used in modem military weapon systems. Many of these, if burned, produce toxic fumes.

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PART II - BIOLOGICAL

ANNEX B

CLINICAL DATA SHEETS FOR SELECTED BIOLOGICAL AGENTS

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ANNEX B

CLINICAL DATA SHEETS FOR SELECTED BIOLOGICAL AGENTS

B.01. Introduction.

a. The following information provides clinical information to assist in the recognition, diagnosis and management of selected diseases, well recognized for their potential as biological weapons. It is not intended to be comprehensive, nor should it be interpreted as a sanctioned "threat list." Likely agents are:

(1) Anthrax.
(2) Botulinum Toxins.
(3) Brucellosis.
(4) Cholera.
(5) Clostridium Perfringens Toxins.
(6) Crimean-Congo Hemorrhagic Fever.
(7) Melioidosis.
(8) Plague.
(9) Q Fever.
(10) Ricin.
(11) Rift Valley Fever.
(12) Saxitoxin.
(13) Smallpox.
(14) Staphylococcal Enterotoxin B.
(15) Trichothecene Mycotoxins.
(16) Tularemia.
(17) Venezuelan Equine Encephalitis.

b. Many products referenced in this annex are currently considered investigational new drugs (IND). This indicates that the product (drug, vaccine, antitoxin, etc.) has been shown to be safe and effective in animal studies and has been approved for limited use as an investigational product in humans. In general, IND products must be obtained through official channels from the government of the producing nation and administered under a research protocol approved by a recognized institutional review board.

B.02. Anthrax.

a. *Clinical Syndrome.*

(1) *Characteristics.* Anthrax is a zoonotic disease caused by *Bacillus anthracis.* Under natural conditions, humans become infected by contact with infected animals or contaminated animal products. Human anthrax is usually manifested by cutaneous lesions. A biological warfare attack with anthrax spores delivered by aerosol would cause inhalation anthrax, an extraordinarily rare form of the naturally occurring disease.

(2) *Clinical Features. The* disease begins after an incubation period varying from 1-6 days, presumably dependent upon the dose of inhaled organisms. Onset is gradual and nonspecific, with fever, malaise, and fatigue, sometimes in association with a nonproductive cough and mild chest discomfort. In some cases, there may be a short period of improvement. The initial symptoms are followed in 2-3 days by the abrupt development of severe respiratory distress with dyspnea, diaphoresis, strider, and cyanosis. Physical findings may include evidence of pleural effusions, edema of the chest wall, and meningitis. Chest x-ray reveals a dramatically widened mediastinum, often with pleural effusions, but typically without infiltrates. Shock and death usually follow within 24-36 hours of respiratory distress onset.

b. *Diagnosis.*

(1) *Routine Laboratory Findings.* Laboratory evaluation will reveal a neutrophilic leucocytosis. Pleural and cerebrospinal fluids may be hemorrhagic.

(2) *Deferential Diagnosis.* An epidemic of inhalation anthrax in its early stage with nonspecific symptoms could be confused with a wide variety of viral, bacterial, and fungal infections. Progression over 2-3 days with the sudden development of severe respiratory distress followed by shock and death in 24-36 hours in essentially all untreated cases eliminates diagnoses other than inhalation anthrax. The presence of a widened mediastinum on chest x-ray, in particular, should alert one to the diagnosis. Other suggestive findings include chest-wall edema, hemorrhagic pleural effusions, and hemorrhagic meningitis. Other diagnoses to consider include aerosol exposure to SEB; but in this case onset would be more rapid after exposure (if known), and no prodrome would be evident prior to onset of severe respiratory symptoms. Mediastinal widening on chest x-ray will also be absent. Patients with plague or tularemia pneumonia will have pulmonary infiltrates and clinical signs of pneumonia (usually absent in anthrax).

(3) *Specific Laboratory Diagnosis. Bacillus anthracis* will be readily detectable by blood culture with routine media. Smears and cultures of pleural fluid and abnormal cerebrospinal fluid may also be positive. Impression smears of mediastinal lymph nodes and spleen from fatal cases should be positive. Toxemia is sufficient to permit anthrax toxin detection in blood by immunoassay.

c. *Therapy*. Almost all cases of inhalation anthrax in which treatment was begun after patients were symptomatic have been fatal, regardless of treatment. Historically, penicillin has been regarded as the treatment of choice, with 2 million units given intravenously every 2 hours. Tetracycline and erythromycin have been recommended in penicillin-sensitive patients. The vast majority of anthrax strains are sensitive in vitro to penicillin. However, penicillin-resistant strains exist naturally, and one has been recovered from a fatal human case. Moreover, it is not difficult to induce resistance to penicillin, tetracycline, erythromycin, and many other antibiotics through laboratory manipulation of organisms. All naturally occurring strains tested to date have been sensitive to erythromycin,

chloramphenicol, gentamicin, and ciprofloxacin. In the absence of information concerning antibiotic sensitivity, treatment should be instituted at the earliest signs of disease with oral ciprofloxacin (1000 mg initially, followed by 750 mg po (orally) bid (twice daily)) or intravenous doxycycline (200 mg initially, followed by 100 mg q (every) 12 hrs). Supportive therapy for shock, fluid volume deficit, and adequacy of airway may all be needed.

d. *Prophylaxis.*

(1) *Vaccine.* A licensed, alum-precipitated preparation of purified *B. anthracis* protective antigen (PA) has been shown to be effective in preventing or significantly reducing the incidence of inhalation anthrax. Limited human data suggest that after completion of the first three doses of the recommended six-dose primary series (0, 2, 4 weeks, then 6, 12, 18 months), protection against both cutaneous and inhalation anthrax is afforded. Studies in rhesus monkeys indicate that good protection is afforded after two doses (10-16 days apart) for up to 2 years. It is likely that two doses in humans is protective as well, but there is too little information to draw firm conclusions. As with all vaccines, the degree of protection depends upon the magnitude of the challenge dose; vaccine-induced protection is undoubtedly overwhelmed by extremely high spore challenge. At least three doses of the vaccine (at 0, 2, and 4 weeks) are recommended for prophylaxis against inhalation anthrax. Contraindications for use are sensitivity to vaccine components (formalin, alum, benzethonium chloride) and/or history of clinical anthrax. Reactogenicity is mild to moderate: up to 6% of recipients will experience mild discomfort at the inoculation site for up to 72 hours (tenderness, erythema, edema, pruritus), while a smaller proportion (<1%) will experience more severe local reactions (potentially limiting use of the extremity for 1-2 days); modest systemic reactions (myalgia, malaise, low-grade fever) are uncommon, and severe systemic reactions (anaphylaxis, which precludes additional vaccination) are rare. The vaccine should be stored at refrigerator temperature (not frozen).

(2) *Antibiotics.* Choice of antibiotics for prophylaxis is guided by the same principles as that for treatment; i.e., it is relatively easy to produce a penicillin-resistant organism in the laboratory, and possible, albeit somewhat more difficult, to induce tetracycline resistance. Therefore, if there is information indicating that a biological weapon attack is imminent, prophylaxis with ciprofloxacin (500 mg po bid), or doxycycline (100 mg po bid) is recommended. If unvaccinated, a single 0.5 ml dose of vaccine should also be given subcutaneously. Should the attack be confirmed as anthrax, antibiotics should be continued for at least 4 weeks in all exposed. In addition, two 0.5 ml doses of vaccine should be given 2 weeks apart in the unvaccinated; those previously vaccinated with fewer than three doses should receive a single 0.5 ml booster, while vaccination probably is not necessary for those who have received the initial three doses within the previous 6 months (primary series). Upon discontinuation of antibiotics, patients should be closely observed; if clinical signs of anthrax occur, patients should be

treated as indicated above. If vaccine is not available, antibiotics should be continued beyond 4 weeks until the patient can be closely observed upon discontinuation of therapy.

B.03. Botulinum Toxins.

a. *Clinical Syndrome.*

(1) *Characteristics.* Botulism is caused by intoxication with the any of the seven distinct neurotoxins produced by the bacillus, *Clostridium botudinum.* The toxins are proteins with molecular weights of approximately 150,000, which bind to the presynaptic membrane of neurons at peripheral cholinergic synapses to prevent release of acetylcholine and block neurotransmission. The blockade is most evident clinically in the cholinergic autonomic nervous system and at the neuromuscular junction. A biological warfare attack with botulinum toxin delivered by aerosol would be expected to cause symptoms similar in most respects to those observed with food-borne botulism.

(2) *Clinical Features.* Symptoms of inhalation botulism may begin as early as 24-36 hours following exposure or as late as several days. Initial signs and symptoms include ptosis, generalized weakness, lassitude, and dizziness. Diminished salivation with extreme dryness of the mouth and throat may cause complaints of a sore throat. Urinary retention or ileus may also occur. Motor symptoms usually are present early in the disease; cranial nerves are affected first with blurred vision, diplopia, ptosis, and photophobia. Bulbar nerve dysfunction causes dysarthria, dysphonia, and dysphagia. This is followed by a symmetrical, descending, progressive weakness of the extremities along with weakness of the respiratory muscles. Development of respiratory failure may be abrupt. On physical examination, the patient is alert, oriented, and afebrile. Postural hypotension may be present. Ocular findings may include ptosis, extracelluar muscle paralysis, and fixed and dilated pupils. Mucous membranes of the mouth may be dry and crusted. Neurological examination shows flaccid muscle weakness of the palate, tongue, larynx, respiratory muscles, and extremities. Deep tendon reflexes vary from intact to absent. No pathologic reflexes are present, and the sensory examination generally is normal (although reports suggest that obtundation or sensory involvement may sometimes occur).

b. *Diagnosis.*

(1) *Routine Findings.* Routine laboratory findings are of no value in diagnosis. The cerebrospinal fluid is normal.

(2) *Differential Diagnosis.* The occurrence of an epidemic with large numbers of afebrile patients with progressive ocular, pharyngeal, respiratory, and muscular weakness and paralysis hints strongly at the diagnosis. Single cases may be confused with various neuromuscular disorders such as atypical Guillain-Barrè syndrome, myasthenia gravis, or tick paralysis. The edrophonium (tensilon) test may be transiently positive in botulism. Other considerations include enteroviral infections; but in these patients, fever is

present, paralysis is often asymmetrical, and the cerebrospinal fluid is abnormal. It may be necessary to distinguish nerve-agent and atropine poisoning from botulinum intoxication. Briefly, organophosphate nerve agent poisoning results in miotic pupils and copious secretions. In atropine poisoning, the pupils are dilated and mucous membranes are dry, but central nervous system excitation with hallucinations and delirium is present. (See Annex D for a more comprehensive differential.)

(3) *Specific Laboratory Findings.* Detection of toxin in serum or gastric contents from cases of food-borne botulism is often feasible by mouse inoculation. Toxin has also been detected in serum following inhalation exposure in experimental animals. Serum should be obtained from representative cases for such attempts. Survivors probably will not develop an antibody response due to the small amount of toxin necessary to cause death.

c. *Therapy*.

(1) Respiratory failure secondary to paralysis of respiratory muscles is the most serious complication and, generally, the cause of death. Reported cases of botulism prior to 1950 had a mortality of 60%. With tracheotomy and ventilator assistance, fatalities should be <5%. Intensive and prolonged nursing care may be required for recovery (which may take several weeks or even months).

(2) In isolated cases of food-borne botulism, circulating toxin is usually present, perhaps due to continued absorption through the gut wall. Equine antitoxin has been used in these circumstances and is probably helpful. After aerosol exposure, antitoxin can be effective, sometimes even after onset of signs of intoxication. Administration of antitoxin is reasonable if disease has not progressed to a stable state.

(3) There is no prospect for additional human antitoxin to be produced. A "despeciated" equine heptavalent antitoxin (*vs* types A, B, C, D, E, F, and G) has been prepared by cleaving the Fc fragments from horse immunoglobulin G (IgG) molecules, leaving F(ab)2 fragments. Its efficacy is inferred from its performance in animal studies. Use requires pretesting for sensitivity to horse serum (and desensitization for those allergic). Disadvantages include rapid clearance by immune elimination, as well as a theoretical risk of serum sickness.

d. *Prophylaxis.*

(1) A pentavalent toxoid of *Clostridium botulinum* types A, B, C, D, and E is available under IND status. This product has been administered to several thousand volunteers and occupationally at-risk workers and induces serum antitoxin levels that correspond to protective levels in experimental animal systems. The currently recommended schedule (0, 2, and 12 weeks, then a 1 year booster) induces solidly protective antitoxin levels in greater than 90 percent of those vaccinated after 1 year. Transient antitoxin levels are induced after three injections. Contraindications include sensitivity to alum, formaldehyde, and thimerosal, or hypersensitivity to a previous dose. Reactogenicity is mild, with 2-4% of vaccines reporting erythema, edema, or

induration which peaks at 24-48 hours then dissipates. The frequency of local reactions increases with each subsequent inoculation; after the second and third doses, 7-10% will have local reactions, with higher incidence (up to 20% or so) after boosters. Severe local reactions are rare, consisting of more extensive edema or induration. Systemic reactions are reported in up to 3%, consisting of fever, malaise, headache, and myalgia. Incapacitating reactions (local or systemic) are uncommon. The vaccine should be stored at refrigerator temperatures (not frozen).

(2) Three or more vaccine doses (0, 2, and 12 weeks, then 1 year, if possible, by deep subcutaneous injection) are recommended only to selected individuals or groups judged at high risk for exposure to botulinum toxin aerosols. There is no indication at present for use of antitoxin as a prophylactic modality except under extremely specialized circumstances (for example, known impending exposure of small numbers of individuals).

B.04. Brucellosis.

a. *Clinical Syndrome.*

(1) *Characteristics.* Brucellosis is a systemic zoonotic disease caused by one of four species of bacteria: *Brucella melitensis, B. abortus, B. suis,* and *B. canis;* virulence for humans decreases somewhat in the order given. These bacteria are small gram-negative, aerobic, non-motile coccobacilli that grow within monocytes and macrophages. They reside quiescently in tissue and bone-marrow, and are extremely difficult to eradicate even with antibiotic therapy. Their natural reservoir is domestic animals, such as goats, sheep, and camels *(B. melitensis);* cattle *(B. abortus);* and pigs *(B. suis). Brucella canis is* primarily a pathogen of dogs, and only occasionally causes disease in humans. Humans are infected when they inhale contaminated aerosols, ingest raw (unpasteurized) infected milk or meat, or have abraded skin or conjunctival surfaces that come in contact with the bacteria. Laboratory infections are quite common, but there appears to be no human-to-human transmission; isolation of infected patients is, therefore, not required. *Brucella* species long have been considered potential candidates for use in biological warfare. The organisms are readily lyophilized, perhaps enhancing their infectivity. Under selected environmental conditions (for example, darkness, cool temperatures, high $C0_2$), persistence for up to 2 years has been documented. When used as a biological warfare agent, *Brucellae* would most likely be delivered by the aerosol route; the resulting infection would be expected to mimic natural disease.

(2) *Clinical Features.* Brucellosis presents after an incubation period normally ranging from 3-4 weeks, but may be as short as 1 week or as long as several months. Clinical disease presents typically as an acute, non-specific febrile illness with chills, sweats, headache, fatigue, myalgias, arthralgias, and anorexia. Cough occurs in 15-25%, but the chest x-ray usually is normal. Complications include sacroiliitis, arthritis, vertebral osteomyelitis,

epididymo-orchitis, and rarely endocarditis. Physical findings include lymphadenopathy in 10-20% and splenomegaly in 20-30% of cases. Untreated disease can persist for months to years, often with relapses and remissions. Disability may be pronounced. Lethality may approach 6% following infection with *B. melitensis*, but the disease is rarely fatal (0.5% or less) after infection with other serotypes (usually after endocarditis develops).

b. *Diagnosis.*

(1) *Routine Laboratory Findings.* Noncontributory.

(2) *Differential Diagnosis.* The initial symptoms of brucellosis are usually nonspecific. The differential diagnosis is therefore very broad and includes bacterial, viral, and mycoplasmal infections. The systemic symptoms of viral and mycoplasmal illnesses, however, are usually present for only a few days, while they persist for prolonged periods in brucellosis. Brucellosis may be indistinguishable clinically from the typhoidal form of tularemia or from typhoid fever itself.

(3) *Specific Laboratory Diagnosis.* Serology by agglutination or enzyme-linked immunasorbant assay may suggest the diagnosis. A definitive diagnosis of brucellosis is established by culture of blood or bone marrow, which maybe positive in up to *70%* and 90% of cases, respectively.

c. *Therapy*. The recommended treatment is doxycycline (200 mg/day) plus rifampin (900 mg/day) for 6 weeks. Alternative effective treatment consists of doxycycline (200 mg/day) for 6 weeks plus streptomycin (1 gm/day) for 3 weeks. Trimethoprim-sulfamethoxazole given for 4-6 weeks is less effective. In 5-10% of cases, there may be relapse or treatment failure. Laboratory infections with brucellosis are quite common, but there is no human-to-human transmission and isolation is not required.

d. *Prophylaxis.* Killed and live attenuated human vaccines have been available in many countries but are of unproven efficacy. There is no information on the use of antibiotics for prophylaxis against human brucellosis.

B.05. Cholera.

a. *Clinical Syndrome.*

(1) *Characteristics.* Cholera is a diarrheal disease caused by *Vibrio cholera,* a short, curved, gram-negative bacillus. Humans acquire the disease by consuming water or food contaminated with the organism. The organism multiplies in the small intestine and secretes an enterotoxin that causes a secretory diarrhea. When employed as a BW agent, cholera will most likely be used to contaminate water supplies. It is unlikely to be used in aerosol form.

(2) *Clinical Features.* Cholera may present as mild diarrhea or as a fulminant disease characterized by profuse watery diarrhea with fluid losses exceeding 5 to 10 liters or more per day. Without treatment, death may result from severe dehydration, hypovolemia and shock. Vomiting is often present early in the illness and may complicate oral replacement of fluid losses. There is little or no fever or abdominal pain.

b. *Diagnosis.*

(1) *Routine Laboratory Findings.* On microscopic examination of stool samples there are few or no red cells or white cells. Serum electrolytes may demonstrate hypokalemia or if inappropriate fluid replacement has been given, may show hypernatremia or hyponatremia. Acidosis and renal failure may accompany severe dehydration.

(2) *Differential Diagnosis.* Watery diarrhea can also be caused by enterotoxigenic *E. coli,* rotavirus or other viruses, noncholera *vibrios,* or food poisoning due to ingestion of preformed toxins such as those of *Clostridium perfringens, Bacillus cereus,* or *Staphylococcus aureus.*

(3) *Specific Laboratory Diagnosis. Vibrios* can be identified in stool by darkfield or phase contrast microscopy, and *Vibrio cholera* can be grown on a variety of culture media. Bacteriologic diagnosis is not necessary to treat cholera or related watery diarrheas.

c. *Therapy*. Treatment of cholera depends primarily on replacement of fluid and electrolyte losses. This is best accomplished using oral dehydration therapy with the World Health Organization solution (3.5 g NaCL, 2.5 g NaHC03, 1.5 g KCl and 20 g glucose per liter). Intravenous fluid replacement is occasionally needed when vomiting is severe, when the volume of stool output exceeds 7 liters / day, or when severe dehydration with shock has developed. Antibiotics will shorten the duration of diarrhea and thereby reduce fluid losses. Tetracycline (250 mg every 6 hr for 3-5 days) or doxycycline (200 mg initially followed by 100 mg every 12 hr for 3-5 days) is generally adequate. Other effective drugs include ampicillin (250 mg every 6 hr for 5 days) and trimethoprim sulfamethoxazole (one tablet every 12 hr for 3-5 days).

d. *Prophylaxis.* Improved oral cholera vaccines are presently being tested. Vaccination with the currently available killed suspension of *V. cholera* provides about 50% protection that lasts for no more than 6 months. The initial dose is two injections given at least 1 week apart with booster doses every 6 months.

B.06. Clostridium Perfringens Toxins.

a. *Clinical Syndrome.*

(1) *Characteristics. Clostridium perfringens* is a common anaerobic bacterium associated with three distinct disease syndromes; gas gangrene or clostridial myonecrosis; enteritis necroticans (pig-bel); and clostridium food poisoning. Each of these syndromes has very specific requirements for delivering inocula of *C. perfringens* to specific sites to induce disease, and it is difficult to imagine a general scenario in which the spores or vegetative organisms could be used as a biological warfare agent. There are, however, at least 12 protein toxins elaborated, and one or more of these could be produced, concentrated, and used as a weapon. Waterborne disease is conceivable, but unlikely. The alpha toxin would be lethal by aerosol. This is a well-characterized, highly toxic phospholipase *C.* Other toxins from the organism might be co-weaponized and enhance effectiveness. For example, the epsilon

delivered by aerosol if used as a BW agent.

(2) *Clinical Features.*

(a) Typical cases present with sudden onset of fever and chills 3-12 days after tick exposure. Flushing, conjunctival injection, and mild hypotension may be present. After 2-3 days, perhaps with a temporary remission of fever, the patient develops bleeding manifestations such as petechiae, ecchymoses, oozing from puncture sites, melena, hematuria, and gastrointestinal (GI) hemorrhage. Crimean-Congo hemorrhagic fever may cause quite severe ecchymoses and extensive GI bleeding. There is severe headache, lumbar pain, nausea and vomiting, delirium, and prostration. Fatal cases are associated with extensive hemorrhage, coma, and shock. Other common physical findings are epigastric tenderness, modest hepatomegaly, and less frequently icterus.

(b) Mortality among cases recognized as hemorrhagic fever is 15-30%. Convalescence in survivors is prolonged with asthenia, dizziness, and often hair loss. Milder clinical disease occurs in an unknown proportion of infections. There may be geographic variations, possibly related to viral strain differences.

b. *Diagnosis.*

(1) *Differential Diagnosis.* Thrombocytopenia and elevated aspartate aminotransferase (AST) may provide a clue to suggest CCHF in the febrile patient seen early in the course of infection. Other viral hemorrhagic fevers, meningococcemia, rickettsial diseases, and similar conditions may resemble full-blown CCHF. Particular care should be taken in the case of massive GI bleeding not to confuse CCHF with surgical conditions.

(2) *Routine Laboratory Findings.* Leukopenia, thrombocytopenia, and elevated AST are all seen early. Abnormal coagulation tests are common and usually indicate disseminated intravascular coagulation (DIC). Platelets $\leq$ 20,000/ml, APT $\geq$ 260 sec, or AST $\geq$ 200U/ml carry a poor prognosis.

(3) *Specific Laboratory Diagnosis.* Most fatal cases and half the others will have detectable antigen by rapid enzyme-linked immunosorbant assay (ELISA) testing of acute serum samples. IgM ELISA antibodies occur early in recovery. IgG ELISA and fluorescent antibodies also show rising titers. Virus isolation in suckling mice is usually successful from acute sera.

c. *Therapy*.

(1) Supportive therapy with replacement of clotting factors is indicated. Crimean-Congo hemorrhagic fever virus is sensitive to ribavirin *in vitro* and clinicians have been favorably impressed in uncontrolled trials. Patients should be treated with intravenous ribavirin (30 mg/kg followed by 15 mg/kg q 6 h for 4 days and 7.5 mg/kg q 8 h for 6 days). Mild reversible anemia may occur. Immune globulin has also been recommended but is available only in Bulgaria.

(2) Because of several well-defined outbreaks within hospitals, protective measures for medical personnel are an issue. The weight of evidence points

to large droplets or fomites as the mediators of transmission and so strict barrier nursing is indicated and probably sufficient for the care of naturally acquired disease. The virus is aerosol-infectious and additional precautions (for example, respirators) might be considered in a biological warfare setting.

d. *Prophylaxis.*

(1) Although there is little field experience and no definitive data on efficacy, the sensitivity of the virus to ribavirin and the severity of disease suggests that prophylaxis of high-risk exposures is indicated. Persons with percutaneous exposure to contaminated needles or instruments and those exposed directly to fresh blood from CCHF patients should receive 400 mg ribavirin po tid (three times daily) for one day and then continue with 400 mg po tid for 7 days after the last exposure. If more than 48 hours have elapsed after the first such exposure, 30 mg/kg should be given intravenous (IV) followed by three IV doses of 15 mg/kg at 8 hourly intervals; then continue with 400 mg po q 8 hours. If there is GI intolerance, the 400 mg oral dose can be substituted with 180 mg IV. Monitoring for anemia is suggested.

(2) In the case of a suspected biological attack, ribavirin could be considered for prophylaxis, but there is insufficient information to make a firm recommendation for dosing. Use of 400 mg tid may result in mild to modest anemia in some recipients, GI intolerance in a small proportion, and the drug is embryopathic in rodents; there are unresolved issues of reversible testicular damage in rodents. An inactivated mouse-brain vaccine is used in Bulgaria, but there is no general experience with this product.

B.08. Melioidosis.

a. *Clinical Syndrome.*

(1) *Characteristics.* Melioidosis is an infectious disease of humans and animals caused by *Pseudomonas pseudomallei,* a gram-negative bacillus. It is especially prevalent in Southeast Asia but has been described from many countries around the world. The disease has a variable and inconstant clinical spectrum. A biological warfare attack with this organism would most likely be by the aerosol route.

(2) *Clinical Features.* Infection by inoculation results in a subcutaneous nodule with acute lymphangitis and regional lymphadenitis, generally with fever. Pneumonia may occur after inhalation or hematogenous dissemination of infection. It may vary in intensity from mild to fulminant, usually involves the upper lobes, and often results in cavitation. Pleural effusions are uncommon. An acute fulminant septicemia may occur characterized by rapid appearance of hypotension and shock. A chronic suppurative form may involve virtually any organ in the body.

b. *Diagnosis.*

(1) *Routine Laboratory Findings.* The white blood cell count may range from normal to 20,000 per mm^3, and a mild anemia may develop during the illness.

(2) *Differential Diagnosis.* Melioidosis should be considered in the differential

diagnosis of any febrile illness, especially if multiple pustular skin or subcutaneous lesions develop, if the illness presents with fulminant respiratory failure, or there is a chest x-ray pattern suggestive of tuberculosis but without acid-fast bacilli on smear.

(3) *Specific Laboratory Diagnosis.* Microscopic examination of sputum or purulent exudates will reveal small, gram-negative bacilli with bipolar staining using methylene blue or Wright's stain. *P. pseudomallei* can be cultured on routine media and identified by standard bacteriologic procedures. A number of serological tests are useful in diagnosis when they show a fourfold titer rise in paired sera.

c. Therapy. Antibiotic regimens that have been used successfully include tetracycline, 2-3 g / day; chloramphenicol, 3 g / day; and trimethoprim-sulfamethoxazole, 4 and 20 mg / kg per day. Ceftazidine and piperacillin have enjoyed success in severely ill patients as well. In patients who are toxic, a combination of two antibiotics, given parenterally, is advised. Treatment should be continued with oral drugs for 60-150 days, and adjusted based on *in vitro* sensitivity studies of the organism isolated from the patient.

d. *Prophylaxis.* There are no means of immunization. Vigorous cleansing of abrasions and lacerations may reduce the risk of disease after inoculation of organisms into the skin. There is no information available on the utility of antibiotic prophylaxis after a potential exposure before the onset of clinical symptoms.

B.09. Plague.

a. *Clinical Syndrome.*

(1) *Characteristics.* Plague is a zoonotic disease caused by *Yersinia pestis.* Under natural conditions, humans become infected as a result of contact with rodents, and their fleas. The transmission of the gram-negative coccobacillus is by the bite of the infected flea, *Xenopsylla cheopis,* the oriental rat flea, or *Pulex irritans,* the human flea. Under natural conditions, three syndromes are recognized: bubonic, primary septicemia, or pneumonic. In a biological warfare scenario, the plague bacillus could be delivered via contaminated vectors (fleas) causing the bubonic type or, more likely, via aerosol causing the pneumonic type.

(2) *Clinical Features.* In bubonic plague, the incubation period ranges from 2 to 10 days. The onset is acute and often fulminant with malaise, high fever, and one or more tender lymph nodes. Inguinal lymphadenitis (bubo) predominates, but cervical and axillary lymph nodes can also be involved. The involved nodes are tender, fluctuant, and necrotic. Bubonic plague may progress spontaneously to the septicemia form with organisms spread to the central nervous system, lungs (producing pneumonic disease), and elsewhere. The mortality is 50 percent in untreated patients with the terminal event being circulatory collapse, hemorrhage, and peripheral thrombosis. In primary pneumonic plague, the incubation period is 2 to 3 days. The onset is acute and fulminant with malaise, high fever, chills, headache, myalgia, cough with

production of a bloody sputum, and toxemia. The pneumonia progresses rapidly, resulting in dyspnea, strider, and cyanosis. In untreated patients, the mortality is 100 percent with the terminal event being respiratory failure, circulatory collapse, and a bleeding diathesis.

b. *Diagnosis.*

(1) *Presumptive.* Presumptive diagnosis can be made by identification of the gram-negative coccobacillus with safety-pin bipolar staining organisms in Giemsa or Wayson's stained slides from a lymph node needle aspirate, sputum, or cerebrospinal fluid (CSF) samples. When available, immunofluorescent staining is very useful. Elevated levels of antibody to *Y. pestis* in a nonvaccinated patient may also be useful.

(2) *Definitive. Yersinia pestis* can be readily cultured from blood, sputum, and bubo aspirates. Most naturally occurring strains of *Y. pestis* produce an "Fl" antigen *in vivo* which can be detected in serum samples by immunoassay. A fourfold rise of *Y. pestis* antibody levels in patient serum is also diagnostic.

(3) *Differential.* In cases where bubonic type is suspected, tularemia adenitis, staphylococcal or streptococcal adenitis, meningococcemia, enteric gram-negative sepsis, and rickettsiosis need to be ruled out. In pneumonic plague, tularemia, anthrax, and staphylococcal enterotoxin B (SEB) agents need to be considered. Continued deterioration without stabilization effectively rules out SEB. The presence of a widened mediastinum on chest x-ray should alert one to the diagnosis of anthrax.

c. *Therapy*. Plague may be spread from person to person by droplets. Strict isolation procedures for all cases are indicated. Streptomycin, tetracycline, and chloramphenicol are highly effective if begun early. Significant reduction in morbidity and mortality is possible if antibiotics are given within the first 24 hours after symptoms of pneumonic plague develop. Intravenous doxycycline (200 mg initially, followed by 100 mg every 12 hours), intramuscular streptomycin (1 g every 12 hours), or intravenous chloramphenicol (1 g every 6 hours) for 10-14 days are effective against naturally occurring strains. Supportive management of life-threatening complications from the infection, such as shock, hyperpyrexia, convulsions, and disseminated intravascular coagulation (DIC), need to be initiated as they develop.

d. *Prophylaxis.* A formalin-killed *Y. pestis* vaccine is produced in the United States and has been extensively used. Efficacy against flea-borne plague is inferred from population studies, but the utility of this vaccine against aerosol challenge is unknown. Reactogenicity is moderately high and a measurable immune response is usually attained after a 3-dose primary series: at 0, 1, and 4-7 months. To maintain immunity, boosters every 1-2 years are required. Live-attenuated vaccines are available elsewhere but are highly reactogenic and without proven efficacy against aerosol challenge.

B.10. Q Fever.

a. *Clinical Syndrome.*

(1) *Characteristics.* Q fever is a zoonotic disease caused by a rickettsia, *Coxiella burnetii.* The most common animal reservoirs are sheep, cattle and goats. Humans acquire the disease by inhalation of particles contaminated with the organisms. A biological warfare attack would cause disease similar to that occurring naturally.

(2) *Clinical Features.* Following an incubation period of 10-20 days, Q fever generally occurs as a self-limiting febrile illness lasting 2 days to 2 weeks. Pneumonia occurs frequently, usually manifested only by an abnormal chest x-ray. A nonproductive cough and pleuritic chest pain occur in about one-fourth of patients with Q fever pneumonia. Patients usually recover uneventfully. Uncommon complications include chronic hepatitis, endocarditis, aseptic meningitis, encephalitis, and osteomyelitis.

b. *Diagnosis.*

(1) *Routine Laboratory Findings.* The white blood cell count is elevated in one third of patients. Most patients with Q fever have a mild elevation of hepatic transaminase levels.

(2) *Differential Diagnosis.* Q fever usually presents as an undifferentiated febrile illness, or a primary atypical pneumonia, which must be differentiated from pneumonia caused by mycoplasma, legionnaire's disease, psittacosis or *Chlamydia pneumonia.* More rapidly progressive forms of pneumonia may look like bacterial pneumonias including tularemia or plague.

(3) *Specific Laboratory Diagnosis.* Identification of organisms by staining sputum is not helpful. Isolation of the organism is difficult and impractical. The diagnosis can be confirmed serologically.

c. *Therapy*. Tetracycline (250 mg every 6 hr) or doxycycline (100 mg every 12 hr) for 5-7 days is the treatment of choice. A combination of erythromycin (500 mg every 6 hr) plus rifampin (600 mg per day) is also effective.

d. *Prophylaxis.* Vaccination with a single dose of a killed suspension of *C. burnetii* provides complete protection against naturally occurring Q fever and >90% protection against experimental aerosol exposure in human volunteers. Protection lasts for at least 5 years. Administration of this vaccine in immune individuals may cause severe cutaneous reactions including necrosis at the inoculation site. Newer vaccines are under development. Treatment with tetracycline during the incubation period will delay but not prevent the onset of illness.

B. 11. Ricin.

a. *Clinical Syndrome.*

(1) *Characteristics.* Ricin is a glycoprotein toxin (66,000 daltons) from the seed of the castor plant. It blocks protein synthesis by altering the rRNA, thus killing the cell. Ricin's significance as a potential biological warfare agent relates to its availability world wide, its ease of production, and extreme

pulmonary toxicity when inhaled.

(2) *Clinical Features.* Overall, the clinical picture seen depends on the route of exposure. All reported serious or fatal cases of castor bean ingestion have taken approximately the same course: rapid onset of nausea, vomiting, abdominal cramps and severe diarrhea with vascular collapse; death has occurred on the third day or later. Following inhalation, one might expect nonspecific symptoms of weakness, fever, cough, and hypothermia followed by hypotension and cardiovascular collapse. In monkeys, inhalation toxicity is characterized by a dose dependent preclinical period of 24-36 hours followed by anorexia and progressive decrease in physical activity. Death occurs 36-48 hours post challenge. In mice, histopathologic change is characterized by necrotizing, suppurative airways lesions: rhinitis, laryngitis, tracheitis, bronchitis, bronchiolitis, and interstitial pneumonia with perivascular and alveolar edema. Histopathologic change in the airways is seen as early as 3 hours post challenge. The exact cause of death is unknown and probably varies with route of intoxication. High doses by inhalation appear to produce severe enough pulmonary damage to cause death.

b. *Diagnosis.*

(1) *Routine Laboratory Findings.* Laboratory findings are generally nonspecific. Neutrophilic leukocytosis beginning between 12-18 hours was reported in a case of human lethal intramuscular intoxication that was purposely inflicted. Leukocytosis, beginning 12-18 hours after challenge, also occurs following aerosol exposure of laboratory animals.

(2) *Differential Diagnosis.* In oral intoxication, fever, gastrointestinal involvement, and vascular collapse are prominent, the latter differentiating it from infection with enteric pathogens. With regard to inhalation exposure, nonspecific findings of weakness, fever, vomiting, cough, hypothermia, and hypotension in large numbers of patients might suggest several respiratory pathogens. The temporal onset of botulinum intoxication would be similar, but include ptosis and general muscular paralysis with minimal pulmonary effects. Staphylococcal enterotoxin B intoxication would likely have a more rapid onset after exposure and a lower mortality rate but could be difficult to distinguish. Nerve agent intoxication is characterized by acute onset of cholinergic crisis with dyspnea and profuse secretions.

(3) *Specific Laboratory Diagnosis.* Based on animal studies, ELISA (for blood) or immunohistochemical techniques (for direct analysis of tissues) may be useful in confirming ricin intoxication. Postmortem pathologic change is route specific: inhalation results in airways lesions; ingestion causes gastrointestinal hemorrhage with necrosis of liver, spleen, and kidneys; and intramuscular intoxication causes severe local muscle and regional lymph node necrosis with moderate involvement of visceral organs. Ricin is extremely immunogenic; sera should be obtained from survivors for measurement of antibody response.

c. *Therapy*. Management is supportive and should include maintenance of intravascular volume. Standard management for poison ingestion should be employed if

intoxication is by the oral route. There is presently no antitoxin available for treatment.

d. *Prophylaxis.* There is currently no prophylaxis approved for human use. Active immunization and passive antibody prophylaxis are under study, as both are effective in protecting animals from death following exposure by intravenous or respiratory routes. Ricin is not dermally active, therefore, respiratory protection is the most critical means of prevention.

B.12. Rift Valley Fever.

a. *Clinical Syndrome.*

(1) *Characteristics.* Rift Valley Fever (RVF) is a viral disease caused by RVF virus. The virus circulates in sub-Saharan Africa as a mosquito-borne agent. Epizootics occur when susceptible domestic animals are infected, and because of the large amount of virus in their serum, amplify infection to biting arthropods. Deaths and abortions among susceptible species such as cattle and sheep constitute a major economic consequence of these epizootics, as well as providing a diagnostic clue and a method of surveillance. Humans become infected by the bite of mosquitoes or by exposure to virus-laden aerosols or droplets. Although disease may occur during an unexceptional rainy season, outbreaks are typically associated with very high densities of arthropod vector populations that may occur during heavy and prolonged rains or in association with irrigation projects. During epidemics the virus may be transmitted by many species of mosquitoes; its potential for introduction into areas with susceptible livestock and dense mosquito populations is believed to be high, as exemplified by a major epidemic in the Nile valley in 1977-79. The human disease appears to be similar whether acquired by aerosol or by mosquito bite. A biological warfare attack, most likely delivered by aerosol, would be expected to elicit the rather specific spectrum of human clinical manifestations and to cause disease in sheep and cattle in the exposed area. If disease occurred in the absence of heavy vector populations or without domestic animals as amplifiers of mosquito infection, a BW attack would also be a likely cause. Domestic animals are probably susceptible to aerosol infection or could be covertly infected to initiate an epidemic which might propagate itself by the usual means.

(2) *Clinical Features.* The incubation is two to five days and is usually followed by an incapacitating febrile illness of similar duration. The typical physical findings are fever, conjunctival injection, and sometimes abdominal tenderness. A few petechiae or epistaxis may occur. A small proportion of cases (approximately one percent) will progress to a viral hemorrhagic fever syndrome, often with associated hepatitis. These cases may manifest petechiae, mucosal bleeding, icterus, anuria, and shock; mortality in this group is roughly 50 percent. A similar proportion will develop clinically significant ocular changes; macular lesions associated with retinal vasculitis,

hemorrhage, edema, and infarction. Ocular manifestations begin after the patient enters convalescence from acute illness and about half of the patients will have permanent visual defects. A small number of infections will lead to a late encephalitis. After apparent recovery from a typical febrile illness, the patient develops fever, meningeal signs, obtundation, and focal defects. These patients may die or often have serious sequelae.

b. *Diagnosis.*

(1) *Differential Diagnosis.* The clinical syndrome in an individual is not pathognomonic, but the occurrence of an epidemic with febrile disease, hemorrhagic fever, eye lesions, and encephalitis in different patients would be characteristic of RVF.

(2) *Routine Laboratory Findings.* In acute uncomplicated disease, there is often a transient leucopenia, but liver and clotting function tests are normal. In hemorrhagic fever, abnormalities of hepatic and coagulation tests are proportional to severity of disease. Disseminated intravascular coagulation may be present. Patients with encephalitis have up to several hundred cells/mm in CSF, predominantly lymphocytes.

(3) *Specific Laboratory Diagnosis.* Demonstration of viral antigen in blood by ELISA is rapid and successful in a high proportion of acute cases of uncomplicated disease or hemorrhagic fever. IgM antibodies appear with cessation of viremia and are present when ocular or central nervous system (CNS) manifestations are noted. False positive reactions may occasionally be noted in patients with multiple sandfly fever infections. Encephalitis patients have IgM and IgG antibodies in CSF. A proportion of cases should be studied by classical means such as determination of neutralizing antibodies and virus isolation. Wide-scale surveillance is readily accomplished by simultaneous determination of IgG (infection or vaccination at an indeterminate time) and IgM (recent exposure) antibodies in human or domestic animal blood.

c. *Therapy*. In hemorrhagic fever, supportive therapy may be indicated for hepatic and renal failure, as well as replacement of coagulation factors. The virus is sensitive to ribavirin *in vitro* and in rodent models. No studies have been performed in human or the more realistic monkey model to ascertain whether administration to an acutely ill patient would be of benefit. It would be reasonable to treat patients with early signs of hemorrhagic fever with intravenous ribavirin (30 mg/kg followed by 15 mg/kg q 6 hr for 4 days and 7.5 mg/kg q 8 hr for 6 days). This regimen is safe and effective in hemorrhagic fevers caused by some viruses, although a reversible anemia may appear. Therapy may be stopped 2-3 days after improvement begins or antibody appears. Penetration of ribavirin into the CNS is slow and perhaps limited, but in the absence of any other specific therapy, the drug might be used in ocular and encephalitic cases.

d. *Prophylaxis.* Avoidance of mosquitoes and contact with fresh blood from dead domestic animals and respiratory protection from small particle aerosols are the mainstays of prevention. An effective inactivated vaccine is available in limited quantities. The dose is one ml given sc on days 0, 7, and 28; exact timing is not critical. Protective antibodies begin to appear within 10-14 days and last for a year,

at which time a one ml booster should be given. A single injection probably is not protective, but two inoculations may provide marginal short-term protection. Ribavirin prophylaxis (400 mg q 8 hr) of a related sandfly fever virus was successful, but the dose used might be expected to produce anemia and other effects in some recipients. The utility of lower doses has not been determined. Interferon alpha in doses not expected to be reactogenic in humans (5 x 103 - 5 x 104 U / kg daily) is preventive in monkeys and might be considered for post-exposure prophylaxis in humans.

B.13. Saxitoxin.

a. *Clinical Syndrome.*

(1) *Characteristics.*

(a) Saxitoxin is the parent compound of a family of chemically related neurotoxins. In nature they are predominantly produced by marine dinoflagellates, although they have also been identified in association with such diverse organisms as blue-green algae, crabs, and the blue-ringed octopus. Human intoxications are principally due to ingestion of bivalve molluscs which have accumulated dinoflagellates during filter feeding. The resulting intoxication, known as paralytic shellfish poisoning (PSP), is known throughout the world as a severe, life-threatening illness requiring immediate medical intervention.

(b) Saxitoxin and its derivatives are water-soluble compounds that bind to the voltage-sensitive sodium channel, blocking propagation of nerve-muscle action potentials. Consistent with this mechanism of action, victims typically present with neurological symptoms and in severe cases, death results from respiratory paralysis.

(c) The natural route of exposure to these toxins is oral. In a BW scenario, the most likely route of delivery is by inhalation or toxic projectile. In addition, saxitoxin could be used in a confined area to contaminate water supplies.

(2) *Clinical Features.* After oral exposure, absorption of toxins from the gastrointestinal tract is rapid. Onset of symptoms typically begins 10-60 minutes after exposure, but may be delayed several hours depending upon the dose and individual idiosyncrasy. Initial symptoms are numbness or tingling of the lips, tongue and fingertips, followed by numbness of the neck and extremities and general muscular incoordination. Nausea and vomiting may be present, but typically occur in a minority of cases. Other symptoms may include a feeling of light headedness, or floating, dizziness, weakness, aphasia, incoherence, visual disturbances, memory loss and headache. Cranial nerves are often involved, especially those responsible for ocular movements, speech, and swallowing. Induced reflexes are normal and the patient remains conscious. Respiratory distress and flaccid muscular paralysis are the terminal stages and can occur 2-12 hours after intoxication. Death results from respiratory paralysis. Clearance of the toxin is rapid and

survivors for 12-24 hours will usually recover. Complete recovery may require 7-14 days. There are no known cases of inhalation exposure to saxitoxin in the medical literature, but data from animal experiments suggest the entire syndrome is compressed and death may occur in minutes.

b. *Diagnosis.*

(1) *Routine Laboratory Findings.* Routine laboratory evaluation is not particularly helpful. Cardiac conduction defects may develop. Elevation of serum creatine kinase levels in some patients has been reported.

(2) *Differential Diagnosis.* Exposure to tetrodotoxin or the ciguatera toxins can manifest very similar signs and symptoms. Ciguatoxins (by oral exposure) typically demonstrate a much greater degree of gastrointestinal involvement, and can also be differentiated by a history of eating finfish rather than shellfish. Tetrodotoxin intoxication is nearly identical to that caused by the saxitoxins except that hypotension typically plays a greater role in severe intoxication. Differential diagnosis may require toxin detection. Gas chromatographic analysis of food or stomach contents can rule out pesticide exposure.

(3) *Specific Laboratory Tests.* Diagnosis is confirmed by detection of toxin in the food, water, stomach contents or environmental samples. Saxitoxin, neosaxitoxin, and several other derivatives can be detected by ELISA or by mouse bioassay. Specific toxins can be differentiated by high pressure liquid chromatography (HPLC). The Association of Official Analytical Chemists has adopted an official method for mouse bioassay for the analysis of seafood.

c. *Therapy.* Management is supportive and standard management of poison ingestion should be employed if intoxication is by the oral route. Toxins are rapidly cleared and excreted in the urine, so diuresis may increase elimination. Charcoal hemoperfusion has been advocated, but remains unproven in its utility. Incubation and mechanical respiratory support may be required in severe intoxication. Timely resuscitation would be imperative, albeit very difficult, after inhalation exposure on the battlefield. Specific antitoxin therapy has been successful in animal models, but is untested in humans.

d. *Prophylaxis.* No vaccine against saxitoxin exposure has been developed for human use.

B.14. Smallpox.

a. *Clinical Syndrome.*

(1) *Characteristics.* Smallpox virus, an orthopoxvirus with a narrow host range confined to humans, was an important cause of morbidity and mortality in the developing world until recent times. Eradication of the natural disease was completed in 1977 and the last human cases (laboratory infections) occurred in 1978. The virus exists today in only 2 laboratory repositories in the U.S. and Russia. Appearance of human cases outside the laboratory would signal use of the virus as a biological weapon. Under natural conditions, the virus

is transmitted by direct (face-to face) contact with an infected case, by fomites, and occasionally by aerosols. Smallpox virus is highly stable and retains infectivity for long periods outside of the host. A related virus, monkeypox, clinically resembles smallpox and causes sporadic human disease in West and Central Africa.

(2) *Clinical Features.* The incubation period is typically 12 days (range, 10-17 days). The illness begins with a prodrome lasting 2-3 days, with generalized malaise, fever, rigors, headache, and backache. This is followed by defervescence and the appearance of a typical skin eruption characterized by progression over 7-10 days of lesions through successive stages, from macules to papules to vesicles to pustules. The latter finally form crusts and, upon healing, leave depressed depigmented scars. The distribution of lesions is centrifugal (more numerous on face and extremities than on the trunk). Lesions are in the same stage of development at any point in time. Fever may reappear around the 7th day after onset of rash. The case fatality rate is approximately 35% in unvaccinated individuals. A subset of patients develop a hemorrhagic diathesis with disseminated intravascular coagulopathy and have a poor prognosis. Other complications include arthritis, pneumonia, bacterial superinfection of skin lesions, osteomyelitis, and keratitis. Permanent joint deformities and blindness may follow recovery. Vaccine immunity may prevent or modify illness. Fully immune individuals exposed to the virus by the respiratory route may develop fever, sore throat, and conjunctivitis ("contact fever") lasting several days.

b. *Diagnosis.*

(1) *Routine Laboratory Findings.* Leukopenia is frequently present in severe cases of smallpox. The differential count shows granulocytopenia and a relative increase in lymphocytes. In the early hemorrhagic form, with onset of bleeding before the eruption, severe thrombocytopenia, global reduction in clotting factors, and circulating antithrombin are present, as well as a marked increase in immature lymphoid cells in the peripheral blood, sometimes mistaken for acute leukemia.

(2) *Differential Diagnosis.* The eruption of chickenpox (varicella) is typically centripetal in distribution (worse on trunk than face and extremities) and characterized by crops of lesions in different stages on development. Chickenpox papules are soft and superticial, compared to the firm, shotty, and deep papules of smallpox. Chickenpox crusts fall off rapidly and usually leave no scar. Monkeypox cannot be easily distinguished from smallpox clinically, although generalized lymphadenopathy is a more common feature of the disease. Monkeypox occurs only in forested areas of West and Central Africa as a sporadic, zoonotic infection transmitted to humans from wild squirrels. Person-to-person spread is rare and ceases after 1-2 generations. Mortality is 15%. Other diseases that are sometimes confused with smallpox include typhus, secondary syphilis, and malignant measles.

(3) *Specific Laboratory Diagnosis.* Skin samples (scrapings from papules,

vesicular fluid, pus, or scabs) may provide a rapid identification of smallpox by direct electron microscopy, agar gel immunoprecipitation, or immunofluorescence. Virus may be recovered from these samples or blood by inoculation of eggs or cell cultures, but culture techniques require several days. Serological tests may be useful for confirmation, or early presumptive diagnosis.

c. *Therapy*. There is no specific treatment available although some evidence suggests that vaccinia-immune globulin may be of some value in treatment if given early in the course of the illness. The antiviral drug, n-methylisatin ß-thiosemicarbazone (Marboran ®) is not thought to be of any therapeutic value.

d. *Prophylaxis.*

(1) *Vaccines.*

(a) Vaccinia virus is a live poxvirus vaccine that induces strong cross-protection against smallpox for at least 5 years and partial protection for 10 years or more. The vaccine is administered by dermal scarification or intradermal jet injection; appearance of a vesicle or pustule within several days is indication of a "take." Contraindications to vaccination are pregnancy, clinical immunosuppression, eczema, or leukemia/lymphoma. Complications are infrequent, but include: 1) progressive vaccinia in immunosuppressed individuals (case-fatality >75%); 2) eczema vaccinatum in persons with eczema or a history of eczema, or in contacts with eczema (case-fatality 10-15%); 3) postvaccinal encephalitis, almost exclusively seen after primary vaccination, occurring at an incidence of about 1/500,000, with a case-fatality rate of 25%; 4) generalized vaccinia, seen in immunocompetent individuals and having a good prognosis; and 5) autoinnoculation of the eye or genital area, with a secondary lesion.

(b) Vaccinia-immune human globulin at a dose of 0.3 mg/kg body weight provides $\geq$ 70% protection against naturally occurring smallpox if given during the early incubation period. Administration immediately after or within the first 24 hours of exposure would provide the highest level of protection, especially in unvaccinated persons.

(c) If vaccinia-immune globulin is unavailable, vaccination or revaccination should be performed as early as possible after (and within 24 hours of) exposure, with careful surveillance for signs of illness.

(2) *Antiviral Drug.* The antiviral drug, n-methylisatin ß-thiosemicarbazone (Marboran@) afforded protection in some early trials, but not others, possibly because of noncompliance due to unpleasant gastrointestinal side effects. Critical review of the published literature suggests a possible protective effect among unvaccinated contacts of naturally infected individuals.

(3) *Quarantine, Disinfection.* Patients with smallpox should be treated by vaccinated personnel using universal precautions. Objects in contact with the patient, including bed linens, clothing, ambulance, etc.; require disinfection by fire, steam, or sodium hypochlorite solution.

B.15. Staphylococcal Enterotoxin B.

a. *Clinical Syndrome.*

(1) *Characteristics.* Staphylococcal Enterotoxin B (SEB) is one of several exotoxins produced by *Staphylococcus aureus,* causing food poisoning when ingested. A BW attack with aerosol delivery of SEB to the respiratory tract produces a distinct syndrome causing significant morbidity and potential mortality.

(2) *Clinical Features.* The disease begins 1-6 hours after exposure with the sudden onset of fever, chills, headache, myalgia, and nonproductive cough. In more severe cases, dyspnea and retrosternal chest pain may also be present. Fever, which may reach 103-106° F, has lasted 2-5 days, but cough may persist 1-4 weeks. In many patients nausea, vomiting, and diarrhea will also occur. Physical findings are often unremarkable. Conjunctival injection may be present, and in the most severe cases, signs of pulmonary edema would be expected. The chest x-ray is generally normal, but in severe cases, there will be increased interstitial markings, atelectasis, and possibly overt pulmonary edema. In moderately severe laboratory exposures, lost duty time has been < 2 weeks, but, based upon animal data, it is anticipated that severe exposures will result in fatalities.

b. *Diagnosis.*

(1) *Routine Laboratory Findings.* Laboratory findings are noncontributory except for a neutrophilic leukocytosis and elevated erythrocyte sedimentation rate.

(2) *Differential Diagnosis.*

(a) In foodborne SEB intoxication, fever and respiratory involvement are not seen, and gastrointestinal symptoms are prominent. The nonspecific findings of fever, nonproductive cough, myalgia, and headache occurring in large numbers of patients in an epidemic setting would suggest any of several infectious respiratory pathogens, particularly influenza, adenovirus, or mycoplasma. In a BW attack with SEB, cases would likely have their onset within a single day, while naturally occurring outbreaks would present over a more prolonged interval. Naturally occurring outbreaks of Q fever and tularemia might cause confusion, but would involve much smaller numbers of individuals, and would more likely be accompanied by pulmonary infiltrates.

(b) The dyspnea of botulism is associated with obvious signs of muscular paralysis: its cholinergic blocking effects result in a dry respiratory tree, and patients are afebrile. Inhalation of nerve agent will lead to weakness, dyspnea, and copious secretions. The early clinical manifestations of inhalation anthrax, tularemia, or plague may be similar to those of SEB. However, rapid progression of respiratory signs and symptoms to a stable state distinguishes SEB intoxication. Mustard exposure would have marked vesication of the skin in addition to the pulmonary injury.

(3) *Specific Laboratory Diagnosis.* Toxin is cleared from the serum rapidly and

is difficult to detect by the time of symptom onset. Nevertheless, specific laboratory tests are available to detect SEB, and serum should be collected as early as possible after exposure. In situations where many individuals are symptomatic, sera should be obtained from those not yet showing evidence of clinical disease. Most patients develop a significant antibody response, but this may require 2-4 weeks.

c. *Therapy*. Treatment is limited to supportive care. No specific antitoxin for human use is available.

d. *Prophylaxis*. There currently is no prophylaxis for SEB intoxication. Experimental immunization has protected monkeys, but no vaccine is presently available for human use.

B.16. Trichothecene Mycotoxins.

a. *Clinical Syndrome.*

(1) *Characteristics.*

(a) The trichothecene mycotoxins are a diverse group of more than 40 compounds produced by fungi. They are potent inhibitors of protein synthesis, impair DNA synthesis, alter cell membrane structure and function, and inhibit mitochondrial respiration. Secondary metabolizes of fungi, such as T-2 toxin and others, produce toxic reactions called mycotoxicoses upon inhalation or consumption of contaminated food products by humans or animals. Naturally occurring trichothecenes have been identified in agricultural products and have been implicated in a disease of animals known as moldy corn toxicosis or poisoning.

(b) There are no well-documented cases of clinical exposure of humans to trichothecenes. However, strong circumstantial evidence has associated these toxins with alimentary toxic aleukia (ATA), the fatal epidemic seen in Russia during World War II, and with alleged BW incidents (“yellow rain”) in Cambodia, Laos and Afghanistan.

(2) *Clinical Features.*

(a) Consumption of these mycotoxins results in weight loss, vomiting, skin inflammation, bloody diarrhea, diffuse hemorrhage, and possibly death. Clinical signs in experimental animals (calves) given 0.08-0.64 mg T-2/kg/day for nine days included loss of appetite, weight loss, an increase in prothrombin time, and an increased serum aspartate amino transferase level. The onset of illness following acute exposure to T-2 (IV or inhalation) occurs in hours, resulting in the rapid onset of circulatory shock characterized by reduced cardiac output, arterial hypotension, lactic acidosis and death within 12 hours.

(b) Clinical signs and symptoms of ATA were hemorrhage, leukopenia, ulcerative pharyngitis, and depletion of bone marrow. The purported use of T-2 as a BW agent resulted in an acute exposure via inhalation and/or dermal routes, as well as oral exposure upon consumption of contaminated food products and water. Alleged victims reported painful skin lesions,

lightheadedness, dyspnea, and a rapid onset of hemomhage, incapacitation and death. Survivors developed a radiation-like sickness including fever, nausea, vomiting, diarrhea, leukopenia, bleeding, and sepsis.

b. *Diagnosis.*

(1) *Routine Laboratory Findings.* Hematological alterations in the rodent model (parenteral routes) include marked but transient leukocytosis, characterized by rapid lymphocytosis and a mild neutrophilia. This is followed by a leukopenia that returns to normal values 4-7 days post-exposure. There is a reduced hematocrit with the presence of nucleated erythrocytes. Serum proteins and enzymes are not significantly altered after this acute exposure.

(2) *Differential Diagnosis.* Other diagnoses to consider include radiation toxicity and plant or chemical toxicity.

(3) *Specific Laboratory Diagnosis.* Specific diagnostic modalities are limited to reference laboratories. Gas-liquid chromatography (GC) and high pressure liquid chromatography (HPLC) have been used for detecting T-2 and related trichothecene mycotoxins in plasma and urine. Polyclonal and monoclinal antibodies to trichothecenes are also available for detection in liquid or solid samples after solvent extraction. Because of their long “half-life” the toxin metabolizes can be detected as late as 28 days after exposure. Between 50-75% of the parent toxin and metabolizes are eliminated in urine and feces within 24 hours. Urine should be the biological fluid chosen for diagnostic purposes. A one time urine sample with 0.10CC concentrated hydrochloric acid (HCI) added per 100cc of urine, to kill unwanted bacteria, should be submitted for analysis if the exposure was a recent one. Trichothecene mycotoxins can be detected in the urine out to approximately 14 days after exposure but if several days have elapsed since exposure, a 24 hour urine collection with HCI added should be submitted instead of a one time collection. The urine does not need to be kept refrigerated.

c. *Therapy*. General supportive measures are used to alleviate acute T-2 toxicoses. Prompt (within 5-60 min of exposure) soap and water wash significantly reduces the development of the localized destructive, cutaneous effects of the toxin. After oral exposure management should include standard therapy for poison ingestion. Of note is a superactivated charcoal (such as Superchar™, Gulf Bio Systems, Inc., Dallas, TX). Superchar™ oral may offer an advantage over regular activated charcoal in that one needs to see approximately five times the dose of activated charcoal to gain an equivalent outcome to that if Superchar™ is used. Superactivated charcoal is becoming standard in emergency management of poison ingestion. This substance has an extremely large surface area, two to three times that of regular activated charcoal. Superchar™ oral treatment (1-7 g/kg, po) either immediately or 1 to 3 hours after toxin exposure significantly increases survival times of animals. Some benefit may be derived from giving activated charcoal as late as 5 hours after exposure to T-2 toxins. In animal studies, dexamethasone (1-10 mg/kg, IV) administered as late as 3 hours after exposure to T-2 toxin improved survival and reduced the incidence of massive bloody diarrhea. No antitoxin is presently available for human use.

d. *Prophylaxis.* Ascorbic acid (400-1200 mg/kg, inter-peritoneal (ip)) works to decrease lethality in animal studies, but has not been tested in humans. While not yet available for humans, administration of large doses of monoclinal antibodies directed against T-2 and metabolizes have shown prophylactic and therapeutic efficacy in animal models.

B.17. Tularemia.

a. *Clinical Syndrome.*

(1) *Characteristics.* Tularemia is a zoonotic disease caused by *Francisella tularensis,* a gram-negative bacillus. 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. A BW attack with *F. tularensis* delivered by aerosol would primarily cause typhoidal tularemia, a syndrome expected to have a case fatality rate which may be higher than the 5-10% seen when disease is acquired naturally.

(2) *Clinical Features.*

(a) A variety of clinical forms of tularemia are seen, depending upon the route of inoculation and virulence of the strain. In humans, as few as 10-50 organisms will cause disease if inhaled or injected intradermally, whereas 10^8 organisms are required with oral challenge. Under natural conditions, ulceroglandular tularemia generally occurs about 3 days after intradermal inoculation (range 2-10 days), and manifests as regional lymphadenopathy, fever, chills, headache, and malaise, with or without a cutaneous ulcer. In those 5-10% of cases with no visible ulcer, the syndrome may be known as glandular tularemia. Primary ulceroglandular disease confined to the throat is referred to as pharyngeal tularemia. Oculoglandular tularemia occurs after inoculation of the conjunctival with a hand or fingers contaminated by tissue fluids from an infected animal. Gastrointestinal tularemia occurs after drinking contaminated ground water, and is characterized by abdominal pain, nausea, vomiting, and diarrhea.

(b) Bacteremia probably is common after primary intradermal, respiratory, or gastrointestinal infection with *F. tularensis* and may result in septicemia or "typhoidal" tularemia. The typhoidal form also may occur as a primary condition in 5-15% of naturally-occurring cases; clinical features include 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. Pneumonic tularemia is a severe atypical pneumonia that may be fulminant, and can be primary or secondary. Primary pneumonia may follow direct inhalation of infectious aerosols, or may result from aspiration of organisms in cases of pharyngeal tularemia. Pneumonic tularemia causes fever, headache, malaise, substernal discomfort, and a non-productive cough; radiologic evidence of

simultaneously with human disease. Secondary spread by person-to-person \contact occurs at a negligible rate. However, a BW attack in a region populated by Equidae and appropriate mosquito vectors could initiate an epizootic/epidemic.

(2) *Clinical Features.* Nearly 100% of those infected suffer an overt illness. After an incubation period of 1-5 days, onset of illness is extremely sudden, with generalized malaise, spiking fever, rigors, severe headache, photophobia, myalgia in the legs and lumbosacral area. Nausea, vomiting, cough, sore throat, and diarrhea may follow. This acute phase lasts 24-72 hours. A prolonged period of aesthenia and lethargy may follow, with full health and activity regained only after 1-2 weeks. Approximately 470 of patients during natural epidemics develop signs of central nervous system infection, with meningismus, convulsions, coma, and paralysis. These necrologic cases are seen almost exclusively in children. The overall case-fatality rate is < 1%, but in children with encephalitis, it may reach 20%. Permanent neurological sequelae are reported in survivors. Aerosol infection does not appear to increase the likelihood of CNS disease. A VEE infection during pregnancy may cause encephalitis in the fetus, placental damage, abortion, or severe congenital neuroanatomical anomalies.

b. *Diagnosis.*

(1) *Routine Laboratory Findings.* The white blood cell count shows a striking leukopenia and lymphopenia. In cases with encephalitis, the cerebrospinal fluid may be under increased pressure and contain up to 1000 white cells/mm^3 (predominantly mononuclear cells) and mildly elevated protein concentration.

(2) *Differential Diagnosis.* An outbreak of VEE may be difficult to distinguish from influenza on clinical grounds. Clues to the diagnosis are the appearance of a small proportion of neurological cases or disease in Equidae, but these might be absent in a BW attack.

(3) *Specific Laboratory Diagnosis.* Viremia during the acute phase of illness is generally high enough to allow detection by antigen-capture enzyme immunoassay. Virus isolation may be made from serum, and in some cases throat swab specimens, by inoculation of cell cultures. A variety of serological tests are applicable, including the IgM ELISA, indirect fluorescent assay (FA), hemagglutination inhibition, complement-fixation, and neutralization. For persons without prior exposure to VEE complex viruses in tropical areas, a presumptive diagnosis may be made by finding antibodies in a single serum sample taken 5-7 days after onset of illness.

c. *Therapy*. There is no specific therapy. Patients with uncomplicated VEE infection may be treated with analgesics to relieve headache and myalgia. Patients who develop encephalitis may require anticonvulsant and intensive supportive care to maintain fluid and electrolyte balance, adequate ventilation, and to avoid complicating secondary bacterial infections.

d. *Prophylaxis.*

(1) *Vaccine.*

(a) An experimental vaccine, designated TC-83 is a live, attenuated cell-culture-propagated vaccine which has been used in several thousand persons to prevent laboratory infections. The vaccine is given as a single 0.5 ml subcutaneous dose. Febrile reactions occur in up to 18% of persons vaccinated, and may be moderate-to-severe in 5%, with fever, myalgia, headache, and prostration. Approximately 10% of vaccinees fail to develop detectable neutralizing antibodies, but it is unknown whether they are susceptible to clinical infection if challenged. Nonresponders may be revaccinated with TC-83. Contraindications for use include an intercurrent viral infection or pregnancy. TC-83 is a licensed vaccine for Equidae.

(b) A second investigational product that has been tested in humans is the C-84 vaccine, prepared by formalin-inactivation of the TC-83 strain. The vaccine is presently not recommended for primary immunization, on the basis of animal studies indicating that it may not protect against aerosol infection. However, it may be useful for aerosol protection for persons not responding to TC-83 (0.5 ml subcutaneously at 2 to 4 week intervals for up to 3 inoculations or until an antibody response is measured.)

(2) *Antiviral Drugs.* In experimental animals, alpha-interferon and the interferon-inducer poly-ICLC (lysine-polyadenosine) have proven highly effective for post-exposure prophylaxis of VEE. There are no clinical data on which to assess efficacy in humans.

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PART III - CHEMICAL

ANNEX B

PHARMACOLOGY OF OXIMES

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ANNEX B

PHARMACOLOGY OF OXIMES

B.01. Composition of Oximes.

a. The oximes comprise a group of compounds possessing one or more pyridinium rings and bearing one or more aldoxime groups. A large number of such compounds has been synthesised and are divided into:

(1) Mono pyridinium oximes such as pralidoxime (pyridine-2-aldoxime methyl chloride, PAM Cl, pralidoxime methylsulphonate) (Figure B-I).

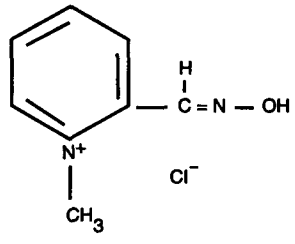

Figure B-I. Formula of Pralidoxime

(2) Bispyridinium oxides including obidoxime (Toxogonin ®) with the formula as shown in Figure B-II.

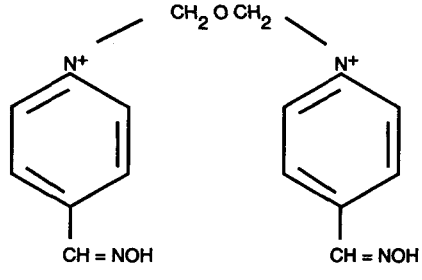

Figure B-II. Formula of Obidoxime

b. Recently the new Hagedorn (H) oximes have been synthesised and these include the compounds H16 and HS6 as shown in Figure B-III.

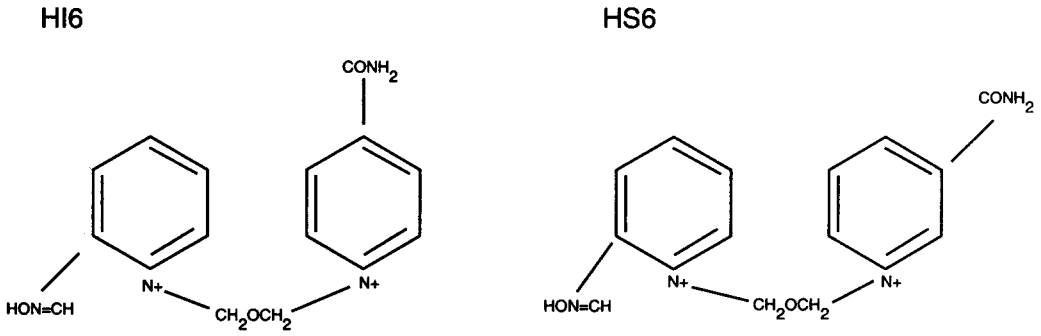

Figure B-III. Formula of Hagedorn Oximes

c. The oximes are thought to act by combining with the modified nerve agent molecule and removing it from the acetylcholinesterase enzyme. They also have other pharmacological effects which may contribute to their efficacy.

d. The sequence of reactions shown in Figure B-IV represents the reactivation of GB inhibited enzyme by pralidoxime.

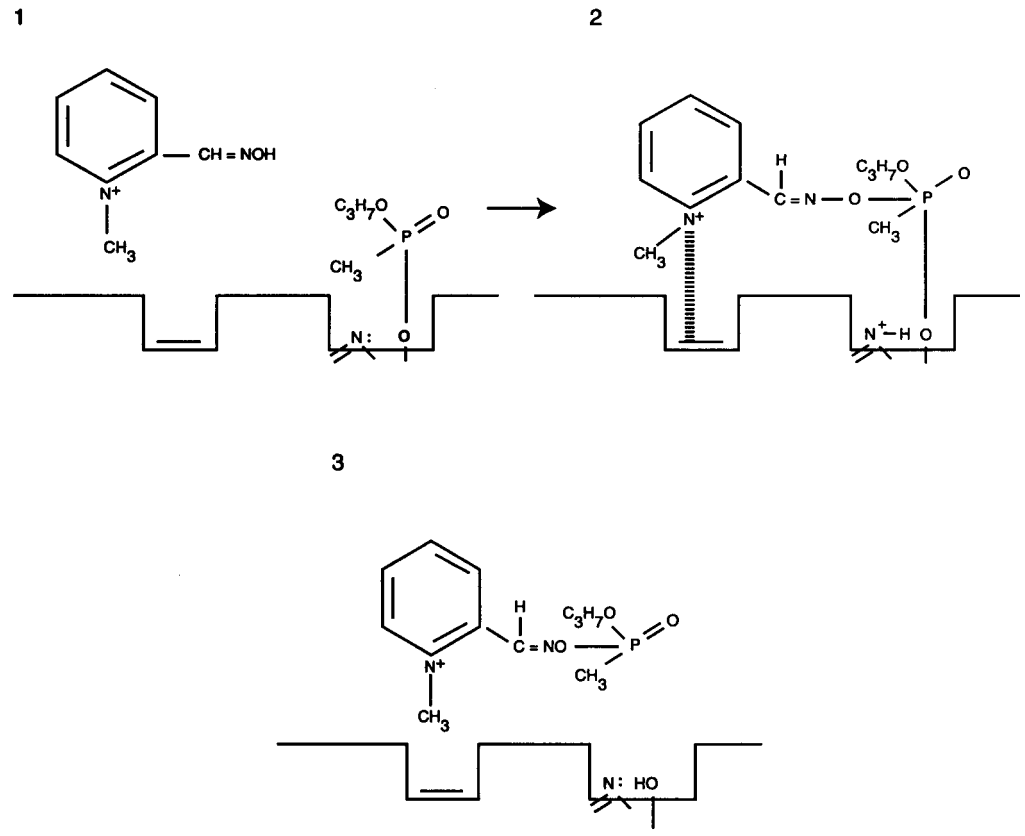

Figure B-IV. Reactivation of GB Inhibited Enzyme by Pralidoxime

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PART I - NUCLEAR

ANNEX C

GENERAL GUIDELINES FOR MEDICAL SUPPORT IN NUCLEAR ACCIDENTS

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ANNEX C

GENERAL GUIDELINES FOR MEDICAL SUPPORT IN NUCLEAR ACCIDENTS

SECTION I - GENERAL

C.01. Introduction.

a. The following guidelines will be of use to medical personnel required to plan the medical support a hospital facility would provide in case of a nuclear weapons accident. They could be used by either military or civilian facilities and can act as basic background information to aid in the development of specific procedural guides.

b. Copies of the separate guidelines should be made available to hospitals in sufficient quantities so that they would be available to all personnel at the time of an accident. Thus, untrained personnel would have guidelines they could apply.

SECTION II - GUIDELINES FOR MEDICAL ADVISORS

C.02. General.

a. Selected medical personnel should be given the responsibility of planning the medical support required for nuclear weapons accidents. They should maintain up-to-date plans and be prepared to train and supervise other medical personnel. They should have prepared procedural guides available for distribution to any medical facility which may become involved in the support of such accidents. They can act as medical advisors to such facilities and can facilitate greatly the early care of patients and subsequent decontamination of medical facilities if it is required.

b. These medical advisors must also be prepared to deal with the question of how much hazard there is to the local population in the area of an accident. The hazard to be considered is the long term one to people living their entire lifetimes in the area. The guides to be used are the laws of the country or recommendations of the International Committee on Radiation Protection for protection of the population at large. These peacetime standards are very strict and would not be applied in war.

c. The potential public health hazard is fairly minimal. Neither plutonium nor uranium is soluble as an oxide and neither is incorporated into the metabolic cycles of plants. As a result there is very little chance of these elements being ingested either by animals or humans. Even if ingested, their insolubility all but completely precludes any absorption from the gastrointestinal tract. The major hazard is inhalation of the material if it is suspended in the atmosphere. Retention of such materials in the lungs can result in tissue damage as noted above in Annex B, Paragraph B. 11. However, the amounts required to cause any real risk of significant pulmonary disease are very much greater than will normally be present, particularly once material from the accident is dispersed widely on the ground. Therefore, the

inhalation hazard to people living near an accident area is minimal except during times when extensive cleanup operations are going on and materials are being resuspended in the atmosphere.

d. Monitoring of the degree of atmospheric resuspension of hazardous materials with specially designed air samplers must be carried out during such operations. If the areas of contamination and the subsequent cleanup operations are large, enough of these devices to give adequate geographical coverage is required. At times, around the clock monitoring may be essential.

C.03. Management of Contamination.

There are several methods of dealing with radioactive contamination.

a. The half life of ^{239}Pu is 2.43×10^{4} years, and that of ^{235}U is 7.1×10^{8} years so that waiting for decay is impractical (not an option).

b. Resuspension of materials into the atmosphere would be the most serious hazard and extensive monitoring would be required. Wetting down the area with airborne water tankers might be required.

c. If the levels of activity allow cleanup operations to proceed, terrain may have to be removed and buried in sealed containers. The levels to which decontamination is carried out, or the levels at which other activities such as evacuation are initiated, are laid down by individual countries for peacetime use.

C.04. Personnel Precautions.

When it is necessary to work in an environment containing significant concentrations of hazardous materials, control measures must be instituted to limit individual exposures. These measures may range from limitations on the length of time that personnel may stay in an environment to the provision of respirators and protective clothing. In certain circumstances, self-contained air supply systems may be needed. Two primary requirements must be met by any protective equipment. First, it must protect, i.e., its use should ensure safety of the using personnel; and second, the equipment must be reasonably comfortable, or it will not be used. An example of this latter problem is frequently seen in the use of protective masks or respirators, where the quality of the seal of the mask to the face determines the effectiveness of the protection. It has been found that many half-face masks, in particular, can be effectively sealed only by tightening the straps to the point of pain. As a result, users of these masks often do not tighten the straps sufficiently to obtain a seal, and therefore, are less well protected.

C.05. Protective Masks.

Protective masks may be classified in several different ways. Some of these are by their principle of operation such as filtration, by the type of face piece, half-face or full-face, and by the degree of protection. The most convenient classification is by method of operation into two broad groups: Air Supplying and Filtration Type.

a. *Air Supplying Masks.* Air supplying masks are made up of a face piece and an air

source and the necessary tubing and valves for connecting the two. A mask of this type is essential for work in spaces which are deficient in oxygen and is the only effective protection against the gaseous form of hydrogen or its isotopes. The face piece of such a breathing apparatus should be of the full-face type. The tanks should have an air supply of at least 30 minutes under conditions of normal exertion and should have both visible gauges indicating the pressure and some type of an alarm system to warn the user when expiration of the air supply is imminent.

b. *Filtration Type Masks.* Filtration type masks are relatively simple and compact since they are not dependent upon a separate air supply. There is no limitation, essentially, to the length of time they can be worn. The life time of the canister or filter system is the limiting factor. The deficiency of these masks is that they have a tendency to leak unless they are properly fitted to the face. They generally come in two forms: the half-face or the full-face form. The typical military full-face masks are generally quite effficient and afford good protection against particulate contamination. It is essential, however, that the masks chosen fit the user comfortably and without leaking. It is recommended that, where practicable, such masks be tested in a special chamber containing an irritant smoke or other suitable agent.

C.06. Protective Clothing.

a. The purpose of protective clothing is to keep contaminating material away from the skin of the individual and to assist with decontamination.

b. In common practice, the protective clothing requirements are not strictly met and most protective clothing is only partially protective. For instance, protective clothing is readily penetrated by tritium.

(1) Coveralls made of closely woven materials are generally used. Two pair of such coveralls are usually worn, along with cotton or rubber gloves, rubber boots, and protective caps or hoods. All openings, such as where the gloves overlap the sleeves, are sealed, usually with adhesive masking tape. It has been found that untreated cotton fabric is a reasonably effective barrier to dust and that it is easily decontaminated by normal laundering procedures. Furthermore, water vapor can penetrate the fabric, thus enabling normal body cooling mechanisms to function.

(2) The clothing must be worn with an efficient full-face mask in order to achieve reasonable protection against particulate aerosols with a high percentage of very small particles. Finally, clothing worn for protection against particulate contamination will become contaminated itself and must be removed as an individual leaves a contaminated area. The way in which the clothing is removed must be carefully supervised so personnel do not contaminate themselves during the procedure.

C.07. Decontamination of Equipment.

In most cases of contamination of equipment and buildings, the material will be removed by a mixture of normal house cleaning methods. Vacuum cleaners which can handle wet material

and have high efficiency filters are particularly useful. Some surfaces may require repeating scrubbing and vacuuming before they are free of contamination. Obviously, these procedures must be carried out or supervised by specially trained personnel.

SECTION III - GUIDELINES FOR MEDICAL FACILITIES

C.08. Guidelines for Medical Personnel Involved in the Rescue and Evacuation of the Injured at a Nuclear Accident Site.

a. When an accident involving a nuclear weapon occurs, there is a definite probability that a number of casualties with result. The number should be small, but the injuries may be severe and multiple, much like those sustained in serious vehicle accidents. *Emergency personnel sent to an accident site must be well trained in first aid of trauma.* By the time medical personnel arrive at the scene, initial rescue may have been effected and some first aid given. The medical personnel should assist in further rescue operations and begin evacuation to the *closest medical facility* as soon as possible. They should notify the receiving facility of the nature of the accident and the number and type of patients involved.

b. The radiation given off by plutonium or uranium is short range alpha and is not a hazard to attending personnel unless the actual radioactive material itself is inhaled. Nonmedical personnel already on the scene may direct medical personnel to wear protective masks. These directions should be complied with because there may be an inhalation hazard at the accident site. Standard military protective masks are excellent protection. They should be worn by personnel inside ambulances until the patients are brought to the medical facility. Hospital personnel can wear a standard surgical mask with safety.

c. After the patients have been brought to a medical facility and turned over to hospital personnel for further care, ambulance personnel and the ambulances should be decontaminated. Decontamination of personnel should be started as soon as possible, even if monitoring facilities are not available. These personnel must not be released, however, until monitoring is possible and indicates that they are no longer contaminated. This requires special alpha sensitive radiation equipment, *not* generally available at hospitals. This equipment must be obtained from teams at the accident site.

(1) The place for decontamination of ambulance personnel can be the same place used by other hospital personnel such as the Emergency Room Staff, ideally away from the Emergency Room.

(2) The place should have two entrances and a shower. There should be a number of laundry bags setup and tagged. The personnel should strip off all clothing, putting them in appropriate bags. If necessary, large tags should be attached to the clothing. Personal item, such as watches and jewelry, should be put in plastic bags. Their protective masks should also be put in a special bag.

(3) A complete set of clean clothing should be made available. If this is not possible, clean scrub suits should be provided personnel until such time as clean clothing can be obtained. Complete monitoring is essential after showering.

C.09. Guidelines for Nursing Service and Emergency Room Involved in Initial Care, Resuscitation, and Admission of Contaminated Patients.

a. Basically, any medical facility must have a plan for the handling of patients which does not change fundamentally the operation of the facility or techniques of patient care. This is best accomplished by restricting changes in basic operations to those which are absolutely essential. The most important objective is to give injured patients proper, efficient, and rapid care without spreading contamination. Restriction of contamination is best accomplished by restricting and controlling traffic in the facility.

b. A traffic diagram to be used in case contaminated patients must be handled should be developed by each medical facility and should be posted in the emergency room area.

c. If there is a choice of rooms in which patients can be treated, contaminated patients should be treated in that room to which they can be brought without crossing main thoroughfares in the building.

d. If the hospital has been warned of possible contamination, the route over which the patients are to be brought may be covered with paper. After the patients are in the treatment room, this paper should be carefully rolled up by personnel wearing caps, gowns, masks, and gloves. The paper then should be put in tagged bags. The process can be repeated as often as necessary. If patients are brought in over uncovered floors, immediately cover the floors with paper and leave in place until personnel with the proper monitoring equipment arrive to help evaluate the hazard. Traffic over the paper must be limited to that which is absolutely essential.

e. There should be several laundry hampers in the treatment rooms and in the adjacent hallways which are tagged so that all linens and clothing can be properly identified for later decontamination.

f. *A treatment team should be organized to function much as do operating room teams.* This system requires a moderate amount of prior planning and training so that it will function smoothly and effectively.

(1) All members of this team should wear caps, gowns, masks, and gloves.

(2) The physician and the assistant, if required, would be restricted to the area immediately around the patient.

(3) Circulating personnel in the room would bring supplies to the physician but would not touch the patient or the equipment being used by the treatment team. *These personnel would not leave the room.*

(4) There should be other circulating personnel who would bring supplies to the room but who would not enter the room.

g. The treatment priorities of a contaminated patient will vary with the seriousness and nature of the basic injuries. While life saving resuscitative measures are progressing, certain decontamination procedures can be carried out without compromising the basic care of the patient.

(1) The patient's clothing should be removed carefully and put into a tagged bag for later decontamination or disposal. Valuables should be put into a tagged bag (preferably plastic) and held in a specially designated place for

monitoring and decontamination. They should not be mixed with the valuables of other patients.

(2) The patients must be thoroughly washed off, especially exposed surfaces. The rinse water must be collected. Disposal later must be done in accordance with the limitations of the laws of the country in which the accident occurred. Consultation with expert personnel from among those at the accident site will be necessary to assure that this is done properly.

h. *Normal surgical management of wounds will be more than adequate for removal of radioactive contamination and special procedures are not required.* Again, the rinse water or sponges should not be disposed of until expert consultations have been obtained. Material objects from the wounds must be saved and if separable from the rest of the waste, put in specially marked bags. These fragments will be studied by technical experts and require special disposal.

i. Patients should be admitted to specially designated wards or rooms and kept in semi-isolation to prevent or limit spread of contamination.

(1) All personnel should put on gowns and gloves, caps and masks, and shoe covers to enter room and remove them after each visit.

(2) All waste materials and linens must be marked and monitored.

j. Frequent monitoring by trained health physics personnel will be required to determine when it is proper to discontinue isolation techniques.

k. If the patient urinates, the urine should be saved for analysis for radiological contamination. Normal urinalyses can be done on portions of the sample with safety, but the laboratory should be notified that there is a potential contamination with radioactive material. It is essential that a record be kept by the laboratory of the volumes of urine so that later calculations can be made of estimated body burdens of radioactive materials by appropriate laboratories. Fecal samples should also be taken and retained in addition to nose blows and swabs.

C.10. Guidelines for Operating Rooms Involved in Care of Contaminated Patients.

a. Among the patients from a nuclear accident, there will probably be a number who are severely enough injured to require extensive surgical care. These patients may be contaminated with any of a variety of materials, both radioactive and nonradioactive. Most of these materials will not constitute a significant hazard to operating room personnel, providing certain fairly simple precautions are taken. The basic organization and routine of the operating room should not be changed. However, in order to minimize and restrict contamination, certain additional precautions should be taken.

b. Since the hazard from any contaminating material will be respiratory, all personnel in the operating room area should wear masks in place at all times when potentially contaminated patients are being cared for. When monitoring personnel and equipment are available, they will be able to advise the operating staff when it is safe to unmask. The staff should not unmask until so advised.

c. It would be preferable to restrict the use of operating rooms so as to limit potential contamination. However, this may not be possible if there is a significant number

of accident victims requiring surgery. Once an operating room has been used for the surgical care of nuclear accident patients, monitoring and decontamination will be necessary before it can be used for normal surgical cases. Therefore, the Surgical Service must be prepared to lose the use of the rooms involved for the period of time necessary to accomplish these procedures. In some instances, it may be practical for a hospital to set up a temporary operating room close to, but not in, the regular operating room area. In other instances this will not be possible.

d. The actual surgery can be managed according to Standard Operating Procedures for handling cases contaminated with infectious hazards with the following additions or exceptions.

(1) All waste material will be saved in suitable containers. Large plastic bags are the most suitable since they do not leak if properly handled. These must be tagged so that they can be identified later and examined by qualified personnel from among the technical teams responsible for salvage and disposal at a nuclear accident.

(2) When personnel remove their surgical gowns, caps, and gloves, they must be considered as contaminated also. They must be removed carefully and the people assisting in their removal must be capped, gowned, and wearing gloves. The masks should be put in a specially marked container.

(3) All personnel must shower completely after working on such cases and must not be released from the area until after monitoring. This monitoring is essential and must be done by qualified personnel with special equipment. These personnel will come from the technical teams working at the accident site.

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PART II - BIOLOGICAL

ANNEX C

POTENTIAL BIOLOGICAL AGENTS OPERATIONAL DATA CHARTS

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ANNEX C

POTENTIAL BIOLOGICAL AGENTS OPERATIONAL DATA CHARTS

Table C-1. Bacteria

Serial	Disease	Likely methods of dissemination	Transmissibility man to man	Infectivity	Incubation* time	Duration of illness	Lethality	Persistance	Vaccination	Antimicrobial therapy	Antisera
a	b	c	d	e	f	g	h	i	j	k	l
1	(Inhalation) Anthrax	Spores in aerosols	No	Moderate	1-6 days	3-5 days	High	Spores are highly stable	Yes	Little effect	Experimental
2	Brucellosis	1. Aerosol 2. Sabotage (food supply)	No	High	Days to months	Weeks to years	Low	Long persistence in wet soil & food	Yes	Moderately effective	No
3	Cholera	1. Sabotage (food/water supply) 2. Aerosol	Negligible	Low	1-5 days	1 or more weeks	Moderate to high	Unstable in aerosols & pure water More so in poluted water	Yes	Moderately effective	No
4	Melioidosis	Aerosol	Negligible	High	Days to years	4-20 days	Variable	Stable	None	Moderately effective	No
5	(Pneumonic) Plague	1. Aerosol 2. Infected vectors	High	High	2-3 days	1-2 days	Very high	Less important because of high transmissibility	Yes	Moderately effective	No
6	Tularemia	Aerosol	No	High	2- 10 days	2 or more weeks	Moderate if untreated	Not very stable	Yes	Effective	No
7	Typhoid Fever	1. Sabotage (food/water supply) 2. Aerosol	Negligible	Moderate	7-21 days	Several weeks	Moderate if untreated		Yes	Moderately effective	No

* Incubation applies to infectious disease. With toxins, it's application refers to the period between exposure and appearance of the symptoms and signs of poisoning.

Table C-II. Rickettsiae

Serial	Disease	Likely methods of dissemination	Transmissibility man to man	Infectivity	Incubation* time	Duration of illness	Lethality	Persistance	Vaccination	Antimicrobial therapy	Antisera
a	b	c	d	e	f	g	h	i	j	k	l
8	Epidemic Typhus	1. Aerosol 2. Infected vectors	No	High	6-16 days	Weeks to months	High	Not very stable	No	Effective	No
9	Q-Fever	1. Aerosol 2. Sabotage (food supply)	No	High	10-20 days	2 days to 2 weeks	Very low	Stable	Yes	Effective	No
10	Rocky Mountain Spotted Fever	1. Aerosol 2. Infected vectors	No	High	3-10 days	2 weeks to months	High	Not very stable	No	Effective	No
11	Scrub Typhus	1. Aerosol 2. Infected vectors	No	High	4-15 days	Up to 16 days	Low	Not very stable	No	Effective	No

* Incubation applies to infectious disease. With toxins, it's application refers to the period between exposure and appearance of the symptoms and signs of poisoning.

Table C-III. Chlamydia

Serial	Disease	Likely methods of dissemination	Transmissibility man to man	Infectivity	Incubation* time	Duration of illness	Lethality	Persistance	Vaccination	Antimicrobial therapy	Antisera
a	b	c	d	e	f	g	h	i	j	k	l
12	Psittacosis	Aerosol	Negligible	Moderate	4-15 days	Weeks to months	Very low	Stable	No	Effective	No
13	Coccidioido-mycosis	Aerosol	No	High	1-2 weeks	Weeks to months	Low	Stable	No	Not very effective	No
14	Histoplas-mosis	Aerosol	No	High	1-2 weeks	Weeks to months	Low	Long persis-tence in soil	No	Not very effective	No

* Incubation applies to infectious disease. With toxins, it's application refers to the period between exposure and appearance of the symptoms and signs of poisoning.

Table C-IV. Viruses

Serial	Disease	Likely methods of dissemination	Transmissibility man to man	Infectivity	Incubation* time	Duration of illness	Lethality	Persistance	Vaccination	Antimicrobial therapy	Antisera
a	b	c	d	e	f	g	h	i	j	k	l
15	Chikun-Gunya Fever	Aerosol	None	High	2-6 days	2 weeks	Very low	Relatively stable	Experimental	Not effective	No
16	Crimean-Congo Hemorrhagic Fever	Aerosol	Moderate	High	3-12 days	Days to weeks	High	Relatively stable	Experimental (Bulgaria)	Effective	Yes (Bulgaria only)
17	Dengue Fever	Aerosol	None	High	3-6 days	Days to weeks	Low	Relatively unstable	Experimental	Not effective	No
18	Eastern Equine Encephalitis	Aerosol	None	High	5-15 days	1-3 weeks	High	Relatively unstable	Yes	Not effective	No
19	Ebola Fever	Aerosol	Moderate	High	7-9 days	5-16 days	High	Relatively unstable	No	Not effective	No
20	Korean Hemorrhagic Fever (Hantaan)	Aerosol	None	High	4-42 days	Days to weeks	Moderate	Relatively stable	Experimental	Effective	No
21	Lassa Fever	Aerosol	Low to moderate	High	10-14 days	1-4 weeks	Unknown	Relatively stable	No	Effective	Experimental
22	Omsk Hemorrhagic Fever	1. Aerosol 2. Water	Neglible	High	3-7 days	7-10 days	Low	Relatively unstable	Experimental	Not effective	No
23	Rift Valley Fever	1. Aerosol 2. Infected vectors	Low	High	2-5 days	Days to weeks	Low	Relatively stable	Yes	Effective	No
24	Russian Spring-Summer Encephalitis	1. Aerosol 2. Milk	None	High	8-14 days	Days to months	Moderate	Relatively unstable	Yes	Not effective	Yes
25	Smallpox	Aerosol	High	High	10-17 days	1-2 weeks	High	Stable	Yes	Not effective	Yes
26	Western Equine Encephalitis	Aerosol	No	High	1-20 days	1-3 weeks	Low	Relatively unstable	Yes	Not effective	No
27	Venezuelan Equine Encephalitis	1. Aerosol 2. Infected vectors	Low	High	1-5 days	Days to weeks	Low	Relatively unstable	Yes	Not effective	No
28	Yellow Fever	Aerosol	None	High	3-6 days	1-2 weeks	High	Relatively unstable	Yes	Not effective	No

* Incubation applies to infectious disease. With toxins, it's application refers to the period between exposure and appearance of the symptoms and signs of poisoning.

Table C-V. Toxins

Serial	Disease	Likely methods of dissemination	Transmissibility man to man	Infectivity	Incubation* time	Duration of illness	Lethality	Persistance	Vaccination	Antimicrobial therapy	Antisera
a	b	c	d	e	f	g	h	i	j	k	l
29	Botulinum Toxin	1. Sabotage (food/water supply) 2. Aerosol	No		Variable (hours to days)	24-72 hours Months if lethal	High	Stable	Yes	Not effective	Yes No
30	Clostridium Perfringens Toxins	1. Sabotage 2. Aerosol	No		8-12 hours	24 hours	Low	Stable	No	Not effective	No
31	Trichothecene Mycotoxins	1. Aerosol 2. Sabotage	No		Hours	Hours	High	Stable	No	Not effective	No
32	Palytoxin	1. Aerosol 2. Sabotage	No		Minutes	Minutes	High	Stable	No	Not effective	No
33	Ricin	Aerosol	No		Hours	Days	High	Stable	Under development	Not effective	No
34	Saxitoxin	1. Sabotage 2. Aerosol	No		Minutes to hours	Minutes to days	High	Stable	No	Not effective	No
35	Staphylococcal enterotoxin B	1. Aerosol 2. Sabotage	No		1-6 hours	Days to weeks	Low	Stable	Under development	Not effective	No
36	Tetrodotoxin	1. Sabotage 2. Aerosol	No		Minutes to hours	Minutes to days	High	Stable	No	Not effective	No

* Incubation applies to infectious disease. With toxins, it's application refers to the period between exposure and appearance of the symptoms and signs of poisoning.

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PART III - CHEMICAL

ANNEX C

SUMMARY OF THE EFFECTS OF CHEMICAL AGENTS

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ANNEX C
SUMMARY OF THE EFFECTS OF CHEMICAL AGENTS

Table C-I. Effects of Chemical Agents

Agent	Symbol	Odour	Mechanism of action	Eyes (pupils)	Eyes (conjunctivae)	Rest of eye
Tabun; Sarin; Soman; GF.	GA GB GD GF	None or faint sweetishness, fruity or paint-like.	Anticholinesterase agents.	Miosis.	Redness.	Pain, especially on focusing, dimness of vision, headache, lachrymation.
VX	VX	None.				
Mustard and nitrogen mustard.	H HD HN	Garlic or horseradish, irritating. None or fishy, irritating.	Vesicants. Bone marrow depressant. Alkylating agents, damages DNA.	Mydriasis.	Redness, oedema, irritation, gritty pain.	Oedema of lids, pain, blepharospasm, photophobia, lachrymation, corneal ulceration and possibly scarring.
Lewisite and other arsenical vesicants.	L	Fruity to geranium-like. Irritating.	Vesicants. Arsenical poisons.		Prompt redness, oedma, irritation.	Immediate burning sensation, iritis, corneal injury.
Mustard/lewisite mixture.	HL	Garlic-like.	Like lewisite and mustard.	Like HD, HN and L	Like HD, HN and L.	Like HD, HN and L.
Phosgene oxime.	CX	Unpleasant and irritating.	Powerful vesicant.		Violently irritating, redness, oedema.	Corneal injury with blindness, lachrymation.
Phosgene.	CG	Green corn, grass or new-mown hay.	Lung damaging agent.		Irritation.	Lachrymation (after respiratory symptoms).
Hydrogen cyanide.	AC	Faint bitter almonds.	Interferes with oxygen utilisation at cellular level.			
Cyanogen chloride.	CK	Very irritating.	Like hydrogen cyanide, lung irritant.		Irritation.	Lachrymation.
Vomiting agents.	DM DA DC	Burning fireworks, very irritating.	Local irritant, induces vomiting.		Irritation.	Lachrymation.
Irritant agents.	CN CA	Irritating.	Local irritant.		Redness, irritation.	Pain, blepharospasm, profuse lachrymation, photophobia.
	CS CR	Very irritating, pungent, pepper-like.	Local irritant.		Intense irritation.	Pain, blepharospasm, lachrymation, photophobia.
Incapacitiating agents.	BZ	None.	Anticholinergic.	Mydriasis.		Blurred vision.
	LSD	None.	Psychomimetic.	Mydriasis.		

Table C-I. Effects of Chemical Agents (continued)

Symbol	Nose and throat	Respiratory tract	Skin	GI tract	Cardiovascular system
GA GB GD GF VX	Increased salivation. Rhinorrhoea.	Tightness in the chest, bronchoconstriction, occasional wheezing, increased bronchial secretion, cough, dyspnoea, substernal tightness.	Sweating, pallor then cyanosis.	Salivation, anorexia, nausea, vomiting, abdominal cramps, epigastic tightness, heartburn, eruction, diarrhorea, tenesmus, involuntary defecation.	Occasional early transient tachycardia and/or hypotension followed by bradycardia and hypotension.
H HD HN	Swelling, irritation, ulceration, discharge, occasional oedema of lamyx.	Slowly developing irritation, hoarseness, aphonia, cough, tightness, dyspnoea, rales. Pneumonia, fever, pulmonary oedema, in severe cases. Risk of secondary infection.	No immediate signs. After minutes to hours, redness and burning. Several hours later blisters surrounded by redness and itching. Several days later necrosis, generally limited to epidermis. Delayed hyper- and hypo-pigmentation. Moist areas affected most. Risk of secondary infection.	Pain, nausea, vomiting, diarrhoea.	Shock after severe exposure.
L	Prompt irritation.	Rapid irritation, hoarseness, aphonia, cough, pneumonia, fever, pulmonary oedema, pleural effusion in severe cases.	Prompt burning. Red within 30 minutes. Blisters on 1st or 2nd day. Pain worse and necrosis deeper than H.	Diarrhoea, nausea, vomiting, hepatic failure.	Shock after severe exposure. Haemolytic anaemia, haemo-concentration.
HL					
CX	Very irritating to mucous membranes.	Rapid irritation and coughing. Later pulmonary oedema.	Immediate severe irritation and intense pain. Within I minute the affected area turns white, surrounded by erythema. Swollen within 1 hour; blistered after 24 hours. Necrosis may occur. Long recovery (1-3 months).		
CG	Irritation.	Coughing, choking, chest tightness on exposure. Latent period, then pulmonary oedema, dyspnoea, frothy sputum, rales, pneumonia and fever.	Possible cyanosis following pulmonary oedema.	Nausea, occasional vomiting after respiratory symptoms.	Shock after severe exposure, hypotension and tachycardia.
AC		Deep respiration followed rapidly by dyspnoea, gasping then cessation of respiration.	Initially pinker that usual; may change to cyanosis.	Nausea.	Profound hypotension.
CK	Irritation.	Irritation, cough, choking, dyspnoea; pulmonary oedema can be rapid.		Like hydrogen cyanide.	
DM DA DC	Pain, rhinorrhoea, tightness, sneezing.	Tightness and pain, uncontrollable coughing.	Stinging, (especially of face), occasional dermatitis.	Salivation, nausea vomiting.	
CN CA	Irritation, burning.	Tightness and irritation if concentration is high.	Stinging, (especially of face) occasional dermatitis, may blister.	Occasional vomiting.	
CS CR	Irritation, burning, tightness.	Tightness in chest and difficulty breathing.	Stinging, occasional dermatitis, may blister.	Nausea and vomiting.	
BZ	Extreme dryness.		Dry, flushed.	Constipation.	Tachycardia, elevated blood pressure.
LSD			Sweaty palms, cold extremities.		Tachycardia.

Table C-I. Effects of Chemical Agents (continued)

Symbol	Genito-urinary system	Central nervous system	Other	Treatment
GA GB GD GF VX	Frequent micturition, urinary incontinence.	Apprehension, giddiness, insomnia, headache, drowsiness, difficulty concentrating, poor memory, confusion, slurred speech, ataxia, weakness, coma with areflexia, Cheyne-Stokes respiration, convulsions.	Fasciculations, easy fatigue, cramps, weakness (including respiratory muscles), paralysis.	Pre-treatment with pyridostigmine. Post-exposure therapy: a. Cholinergic blockage - atropine. b. Enzyme reactivation - oximes. c. Anticonvulsant - diazepam. d. Assisted ventilation. e. Suction for respiratory secretions.
H HD HN		Anxiety, depression.	Late depression of bone marrow, malaise and prostration.	Eyes: antibiotics, cyclopegics and systemic analgesia. Skin: local dressings and antibiotics for infection. Antibiotics for respiratory infection. IV fluids.
L	Renal failure.	Anxiety, depression.	Systemic arsenic poisoning.	Like sulphur and nitrogen, mustards. BAL in oil IM for systemic chelation. BAL ointment for eyes and skin.
HL		Anxiety, depression.		Like sulphur mustard, nitrogen mustard and lewisite.
CX		Anxiety, depression.		Apply dressings of sodium bicarbonate. Systemic analgesics. Treat as any other necrotic skin lesion.
CG		Anxiety, depression.		Corticosteroids IV and by inhalation promptly may be life-saving. Rest, oxygen, antibiotics.
AC		May have initial excitation; then depression, giddiness, headache, irrational behaviour, ataxia, convulsions or coma.		Drugs binding cyanide: a. Methaemoglobin formers; nitrites or DMAP. b. Scavengers; dicobalt edetate and hydroxocobalamin. Provision of S-groups; thiosulphate. Assisted ventilation. Oxygen.
CK				Like hydrogen cyanide and phosgene.
DM DA DC		Severe headache, mental depression.	May cause desire to remove respirator.	Wear mask in spite of symptoms. Spontaneous improvement.
CN CA		Headache.		Spontaneous improvement. Analgesic eye and nose drops if necessary.
CS CR		Headache.		Symptoms disappear rapidly in fresh air.
BZ	Urgency, urinary retention.	Headache, giddiness, drowsiness, disorientation, hallucinations and occasional maniacal behavior. Ataxia and/or lack of coordination.		Restraint, cool environment. Physostigmine. Treatment may be required over several days.
LSD		Mental excitation, poor concentration, tremor indecisiveness, inability to act in a sustained or purposeful manner. Hallucinations.	Pyrexia.	Reassurance, restraint, prompt evacuation, diazepam.

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PART II - BIOLOGICAL

ANNEX D

PATIENT MANAGEMENT CHARTS

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ANNEX D

PATIENT MANAGEMENT CHARTS

Table D-I. Differentiation Among Botulinum, Nerve Agent, and Atropine Intoxications

Item	Botulinum toxin	Nerve agent	Atropine
Sensorium	Usually normal.	Disorientation, agitation, coma, seizures.	DIsorientation, excitation, agitation, irritability, coma.
Ocular abnormalities	Dilated and fixed pupils, distorted blurred vision, ptosis, extraocular muscle paralysis.	Constricted pupils, dim vision (if vapor or aerosol exposure), little if any change if exposed via skin.	Weak effects if usual doses given causing pupillary dilation and paralysis of accommodation.
Paralysis	Flaccid paralysis. Early bulbar signs (dysphonia dysphagia) descending to upper and lower extremities. Respiratory failure.	Rigid paralysis with twitching, jerking. Seizures.	None of significance.
Autonomic findings	Dry mouth and skin, constipation, ileus, urinary retention. Early emesis and diarrhea after food ingestion.	Excess salivation, increased sweating, involuntary defecation and urination. Severe rhinorrhea and bronchoconstriction occur if exposure is by inhalation.	Dry mouth and skin, constipation, ileus, urinary retention. Early emesis and diarrhea after food ingestion.
Onset	24-36 hours by inhalation exposure. Not absorbed through intact skin; 12-72 hours onset by oral exposure.	1-10 minutes by inhalation exposure; 1-2 hours by dermal exposure.	Minutes after injection, can be exacerbated by dehydration and heat exposure.

A number of infectious diseases may be rapidly fatal if specific therapy is not immediately instituted. Crimean-Congo hemorrhagic fever may be readily transmitted to hospital personnel, with lethal consequences. The following algorithm (Figure D-I) is designed to prevent lethal oversight in the initial management of acutely ill febrile patients.

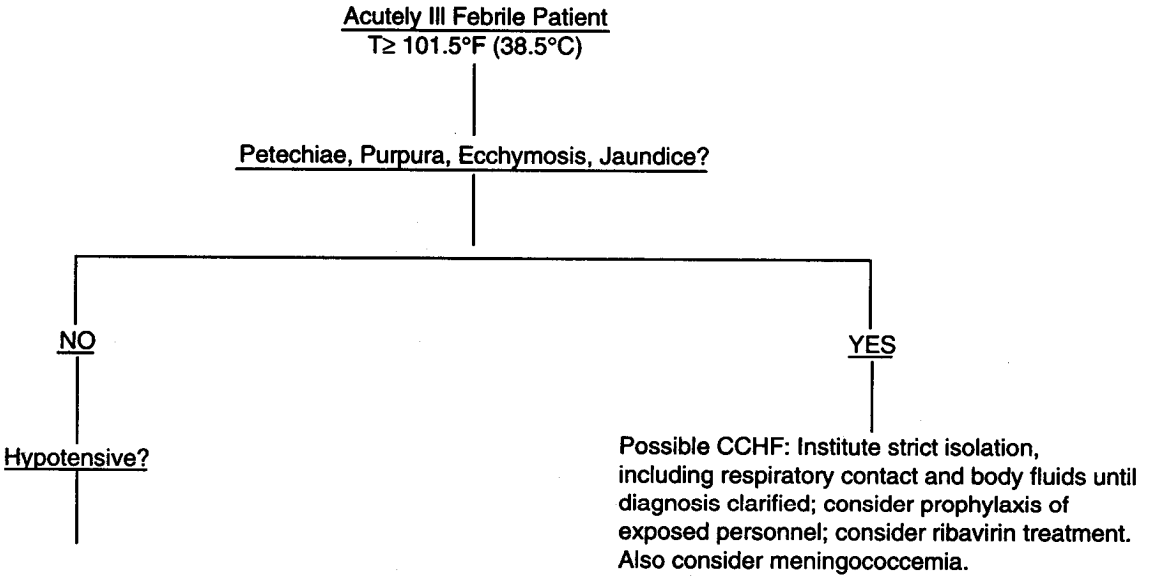

Figure D-I. Model for an Approach to the Acutely Ill Febrile Patient (Example from the Middle East) (1 of 6)

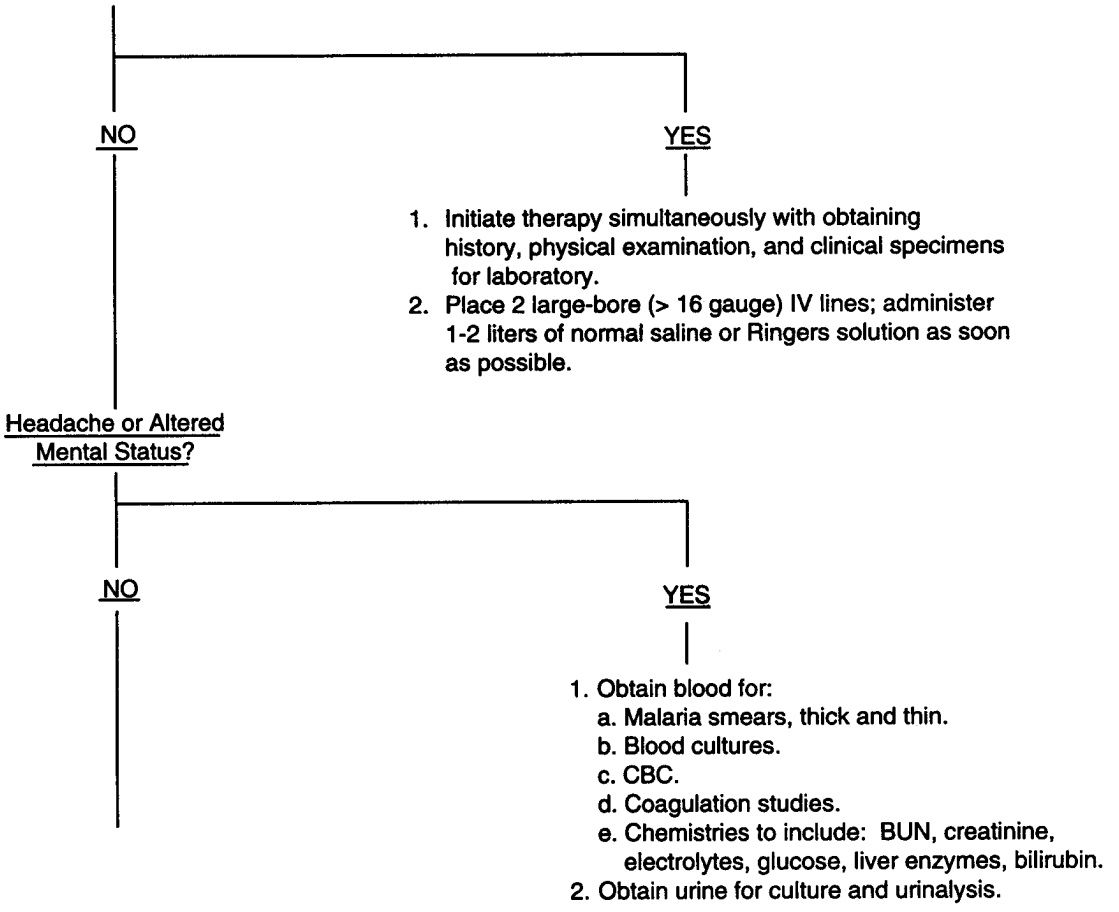

Figure D-I. Model for an Approach to the Acutely Ill Febrile Patient (Example from the Middle East) (2 of 6)

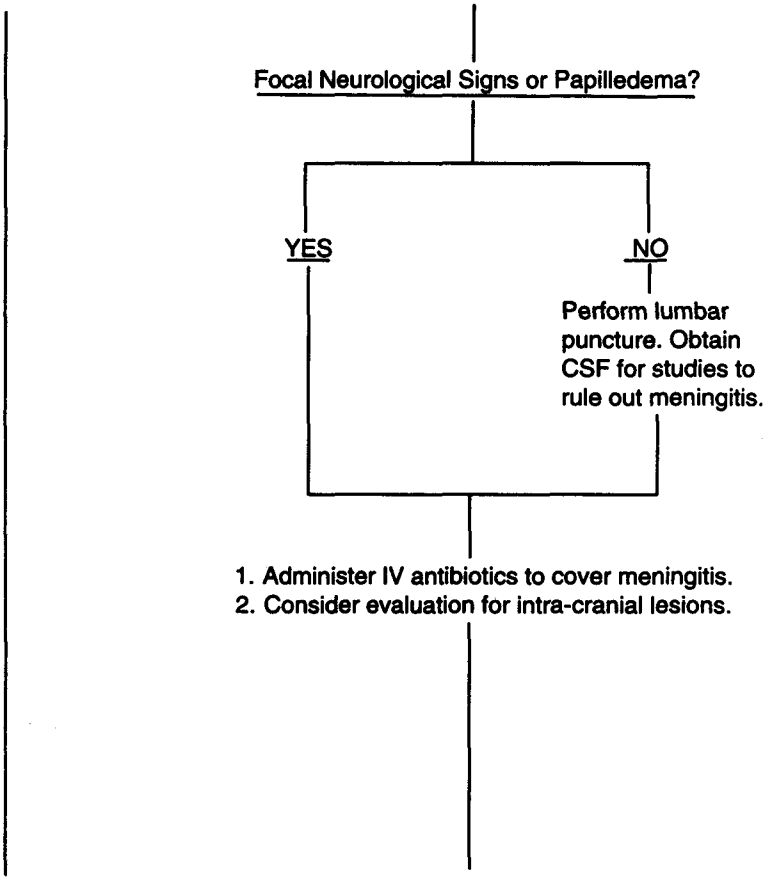

Figure D-I. Model for an Approach to the Acutely Ill Febrile Patient (Example from the Middle East) (3 of 6)

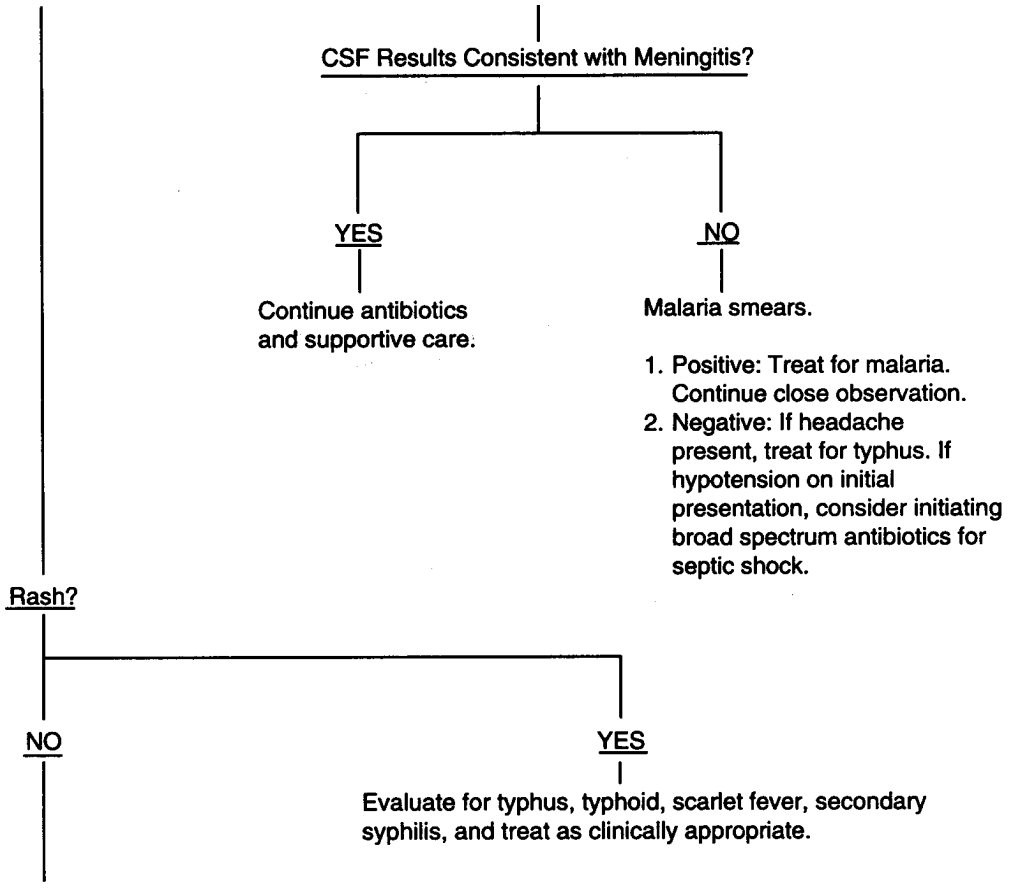

Figure D-I. Model for an Approach to the Acutely Ill Febrile Patient (Example from the Middle East) (4 of 6)

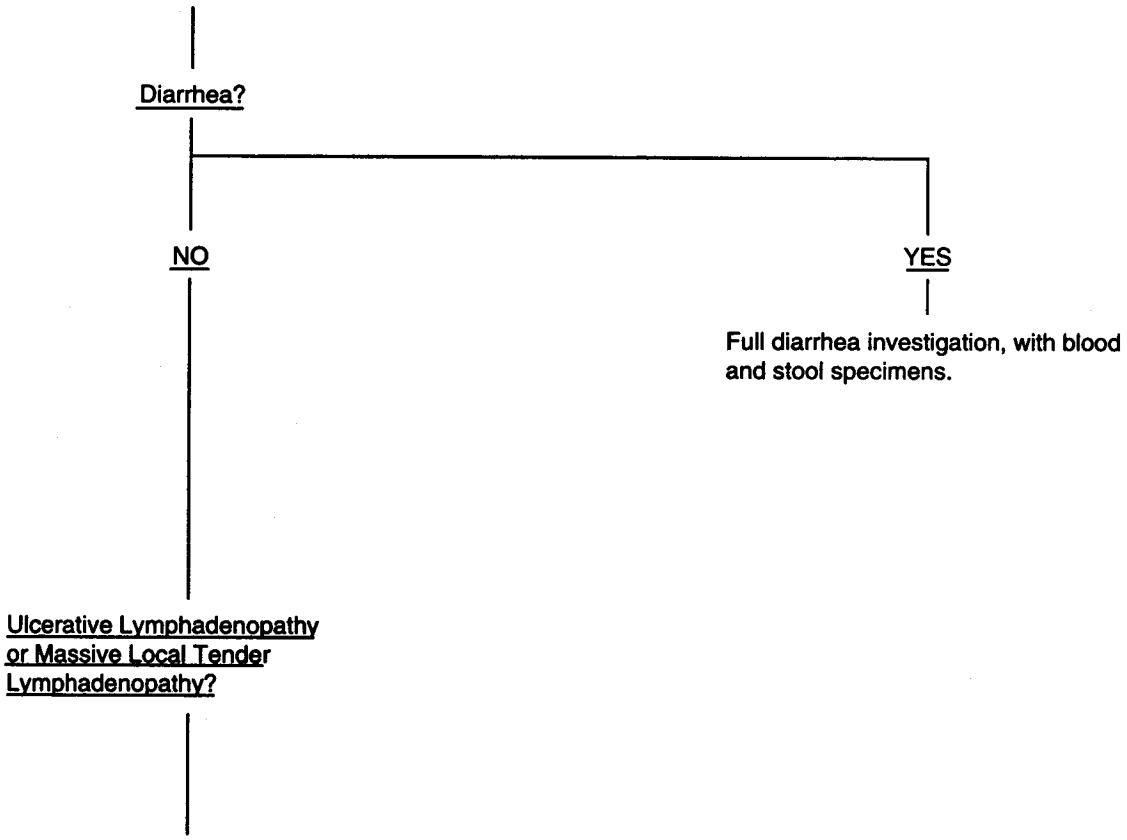

Figure D-I. Model for an Approach to the Acutely Ill Febrile Patient (Example from the Middle East) (5 of 6)

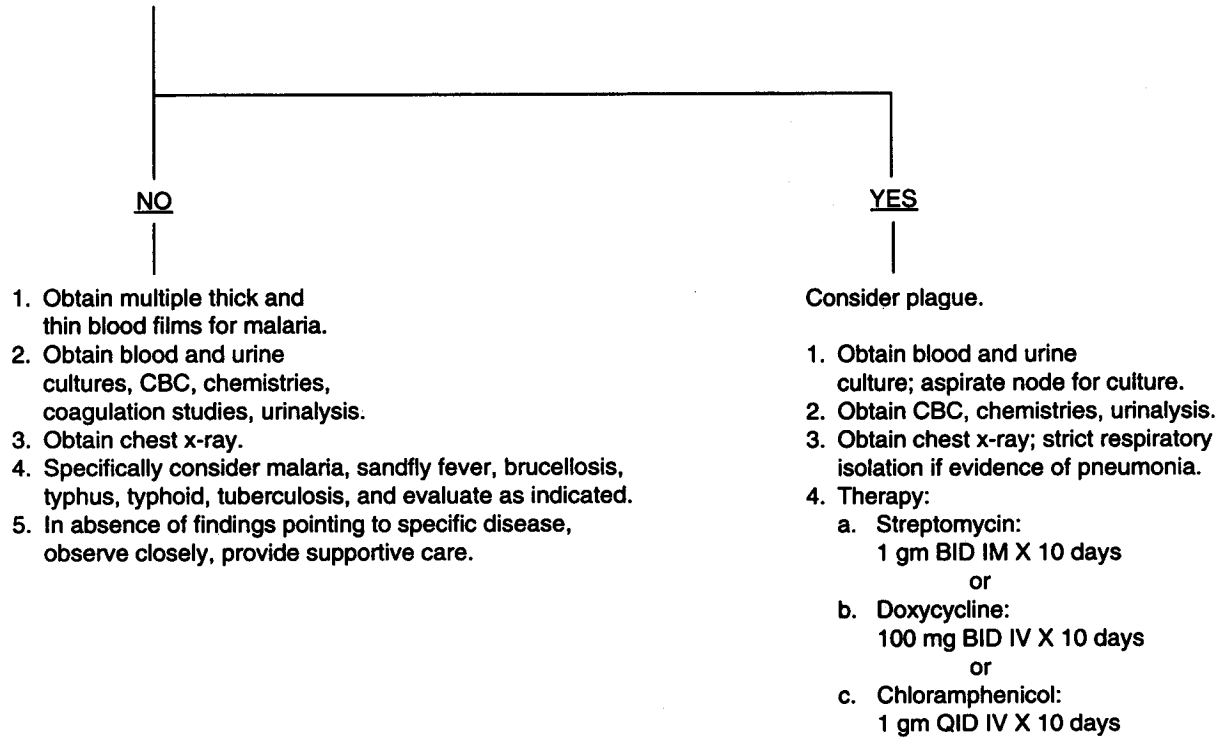

Figure D-I. Model for an Approach to the Acutely Ill Febrile Patient (Example from the Middle East) (6 of 6)

Table D-II. An Approach to Potential BW Agents by Predominant Clinical Finding or Syndrome

Syndrome	General characteristics	Potential causes*
Fever		Any (Toxins less likely)
Grippe-like	Fever, chills, malaise, headache, myalgia, eye pain, hyperaesthesias	Brucellosis Rift Valley fever Venezuelan equine encephalitis Q-fever Influenza Dengue fever Chikungunya fever Inhalation anthrax (early)
Pharyngitis	Sore throat, dysphagia, with or without fever	Lassa Botulinum toxins Ebola/Marburg Tularemia Trichothecene mycotoxins Ricin
Rash-maculopapular	All rash syndromes typically accompanied by fever	Rocky Mountain spotted fever Scrub typhus Epidemic typhus Ebola/Marburg Argentine hemorrhagic fever Bolivian hemorrhagic fever Dengue fever Chikungunya fever Tularemia (uncommon) Psittacosis (uncommon) Smallpox (early)
Rash-vesiculopustular		Smallpox Melioidosis Tularemia
Rash-granulomatous or ulcerative		Melioidosis Tularemia

Table D-II. An Approach to Potential BW Agents by Predominant Clinical Finding or Syndrome (Continued)

Syndrome	General characteristics	Potential causes*
Rash-petechial/ ecchymotic		Korean hemorrhagic fever Crimean-Congo hemorrhagic fever Rocky Mountain spotted fever Plague Smallpox (rare, fulminant) Argentine hemorrhagic fever Bolivian hemorrhagic fever Lassa Dengue fever Ebola/Marburg Rift Valley fever (infrequent) Omsk hemorrhagic fever Yellow fever Scrub typhus Epidemic typhus Trichothecene mycotoxins
Diarrhea-dysentery	Typically with fever	Shigella
Diarrhea-watery	With or without fever	Cholera Staphylococcus enterotoxin B Lassa Ebola/Marburg
Jaundice	With or without fever	Yellow fever Lassa Ebola/Marburg Toxins (especially aflatoxin)
Hemorrhagic fever	Fever; hypotension, with or without fever	Lassa Ebola/Marburg Crimean-Congo hemorrhagic fever Omsk hemorrhagic fever Argentine hemorrhagic fever Bolivian hemorrhagic fever Yellow fever Dengue fever Trichothecene mycotoxins Plague Korean hemorrhagic fever Rift Valley fever (infrequent)

Table D-II. An Approach to Potential BW Agents by Predominant Clinical Finding or Syndrome (Continued)

Syndrome	General characteristics	Potential causes*
Encephalitis/ encephalopathy	With or without fever	Eastern equine encephalitis Western equine encephalitis Venezuelan equine encephalitis Russian spring-summer encephalitis Argentine hemorrhagic fever Bolivian hemorrhagic fever Lassa Psittacosis Plague Rift Valley fever (infrequent)
Stiff neck syndrome	Typically with fever	Eastern equine encephalitis Western equine encephalitis Venezuelan equine encephalitis Psittacosis Histoplasmosis
Flaccid paralysis	Sensory paresthesias, flaccid weakness, cranial nerve abnormalities	Botulinum toxins Saxitoxin Tetrodotoxin
Oliguric renal failure	Typically with fever	Korean hemorrhagic fever Yellow fever Psittacosis (rarely)
Pulmonary syndrome	Pneumonia, respiratory insufficiency, respiratory distress; usually with f	Anthrax Tularemia Plague Psittacosis Q fever Histoplasmosis Coccidiodomycosis Influenza Omsk hemorrhagic fever Crimean-Congo hemorrhagic fever Korean hemorrhagic fever Ricin Staphlococcus enterotoxin B Botulinum toxin

Table D-II. An Approach to Potential BW Agents by Predominant Clinical Finding or Syndrome (Continued)

Syndrome	General characteristics	Potential causes*
Polyarthritis/ polyarthralgia	Typically with fever	Chikungunya fever
Rapid death syndrome	Death within minutes; fever may be present	Saxitoxin Tetrodotoxin Botulinum toxins Trichothecene mycotoxins Other toxins Chemical agents

* This list is crossed-referenced to Annex A, and is not intended to be comprehensive. It does not suggest that clinical presentation of a given agent will necessarily be that of a syndrome listed. This table should serve only as a guide; additional clinical findings must be considered in each case in an attempt to obtain a definitive diagnosis.

GLOSSARY

A_0	original activity
amu	atomic mass unit
atm	atmospheres of pressure
Bq	becquerel
CBF	cerebral blood flow
cGy	centiGray
Ci	curie
cm	centimeter(s)
co	cobalt
DNA	deoxyribonucleic acid
DTPA	diethylenetriamine pentaacetic acid (pentetic acid)
EBq	exabecquerel (10^{18}Bq)
EDTA	ethylenediaminetetraacetic acid (edetic acid)
EMP	electro-magnetic pulse
ER	enhanced radiation
ETI	early transient incapacitation
ETI-PD	early transient incapacitation and performance decrement
Ev	electron volt
Gy	gray
HOB	height-of-burst
HVL	half-value layer
KBq	thousand Becquerels
KeV	thousand electron volts
Km	kilometer(s)
kPa	kiloPascals
Kt	kiloton(s)
Kvp	kilovolts (peak)
LD	lethal dose
LET	linear energy transfer
m	meter(s)
MeV	million electron volts
mm	millimeter(s)
mm^3	cubic millimeters
Mt	megaton
Na	sodium
NATO	North Atlantic Treaty Organization
PBq	pets-becquerel (10^{18}Bq)
PD	performance decrement
Pu	plutonium
rad	radiation absorbed dose
RBE	relative biological effectiveness
REM	roentgen equivalent, man

RPL	radiophotoluminescent
SD	skin dose
sec	second(s)
SI	systems international
Sv	sievert (SI unit of radioactive dose equivalent)
TLD	thermoluminescent dosimeter
TNT	trinitrotoluene
U	uranium
Z/A	ratio of atomic number to atomic mass
μ	micro (10-6)
μCi	micro Curie

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RVF	Rift Valley fever
SEB	staphylococcal enterotoxin B
tid	*ter in die (three* times daily)
VEE	Venezuelan equine encephalitis

GLOSSARY

2,4,5-T	2,4,5-trichlorophenoxyacetic acid
2,4,-D	2-4-dichlorophenoxyacetic acid
AC	hydrogen cyanide
ACh	acetylcholine
AChE	acetylcholinesterase
BA	bromoacetone
BAL	British anti lewisite
BZ	3-quinuclidinyl benzilate (an incapacitating agent)
C	celsius
CA	bromobenzyl cyanide (irritant agent)
CARM	chemical agent resistant material
CG	phosgene
CK	cyanogen chloride
cl	chlorine
cm	centimeter
CN	chloracetophenone (irritant agent)
CNS	central nervous system
Co-A	coenzyme-A
CR	dibenzoxazepine
CS	orthochlorobenzylidine malononitrile
CSA	chlorosulphonic acid
CSR	combat stress reaction
Ct	concentration time
CW	chemical warfare
CX	phosgene oxime
DA	diphenylchlorarsine
DC	diphenylcyanarsine
DM	diphenylaminearsine chloride (adamsite)
DMSA	meso-dimercaptosuccinic acid
DMAP	4-dimethylaminophenol-hydrochloride
DMPA	N-(2,3-dimercaptopropyl)-phthalamidic acid
DMPS	2,3-dimercapto-1-propanesulfonic acid
DNA	deoxyribonucleic acid
DP	diphosgene
ECG	electrocardiogram
F	Fahrenheit
FM	titanium tetrachloride
GA	tabun
G-agent	a non-persistent nerve agent
GB	sarin
GD	soman

H	sulphur mustard
Hb	hemoglobin
HC	zinc chloride smoke mixture
HCl	hydrochloric acid
HCN	hydrogen cyanide
HD	distilled sulphur mustard
HI6	type of oximide
HN	nitrogen mustard
HN1	N-ethy1-2,2'di(chloroethyl)amine (type of nitrogen mustard)
HN2	N methyl-2,2'di(chloroethyl)amine (type of nitrogen mustard)
HN3	2,2',2''tri(chloroethyl)amine (type of nitrogen mustard)
ICt	incapacitating concentration time
ID	incapacitating dose
IPE	individual protective equipment
IPPB	intermittent positive pressure breathing
IPPV	intermittent positive pressure ventilation
kg	kilogram
kg^{-1}	per kilogram
L	lewisite
LCt	lethal concentration time
LD	lethal dose
LSD	lysergic acid diethylamide
m^{-3}	cubic meter
metHb	methaemoglobin
ug	microgram
mg	milligram
Mg	magnesium
mm	millimeter
mmHg	millimeters of mercury
Na	sodium
NA	nerve agent
NATO	North Atlantic Treaty Organisation
NBC	nuclear, biological and chemical
OP	organophosphate
P_2S	pralidoxime
PEEP	positive end-expiratory pressure
PFIB	perfluoroisobutylene
ppm	parts per million
PS	chloropicrin
RNA	ribonucleic acid
RP	red phosphorus
SH	(percentage) saturation of hemoglobin
STANAG	standardization agreement
TH	thermite

V-agent	a persistent nerve agent
VX	methylphosphonothioic acid
WBGT	wet bulb gradient temperature
WP	white phosphorus

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B.07. Contamination of Hospital Facilities, Equipment, and Personnel.

a. Since the treatment of injured, contaminated personnel may result in the contamination of almost any part of a medical facility, a large number of the medical personnel procedures must be able to set up to accomplish the following:
   (1) Minimize the degree of contamination.
   (2) Identify and measure the extent of contamination.
   (3) Remove the contamination.

b. The removal of contamination is a two-part problem and includes decontamination of personnel as well as decontamination of equipment and facilities. The former must be started as soon as possible, even if monitoring facilities are not available. Standardized procedures of decontaminating personnel must be established and instituted. Personnel must not be released before they have been monitored and decontaminated completely. The monitoring capability would be obtained from the technical teams working at the accident site. This requires coordination and communication with the authorities responsible for overall management of the nuclear accident.

B.08. Contamination of Geographical Area Around Accident with Potential Hazard to Local Population.

Medical personnel may be called upon to give advice as to the nature and degree of public hazard associated with a given type and level of contamination. This hazard will rarely be an acute one but may well be a significant long term one. The advice given will be an essential factor in determining what methods are used to minimize and remove the hazard.

a. The most probable hazard will occur downwind from an accident site due to airborne particles of radioactive material which could be inhaled. Early after an accident, adequate information may not be available to determine the exact degree of the hazard from airborne contamination. As a result, a decision to evacuate an area close to an accident location may have to be made by local authorities without waiting for radiation measurements. No precise guidance can be given for these types of situations.

b. A much less frequent hazard would be contamination of water supplies if an accident occurred near a river source or reservoir. Dilution and settling of insoluble materials would further reduce this small hazard, and simple monitoring measures by trained personnel could be obtained before condemning the water supply. Water from other locations can be used temporarily until adequate measurements are made to determine whether there has been contamination or not. However, drinking water contaminated by plutonium is an insignificant hazard.

B.09. Decontamination Operations.

Exposure level criteria used in accident related operations are basically the same as peacetime industrial exposure limits, as defined by the laws of the country in which the accident occurs or by international agreement (wartime exposure limits may be higher). Emergency

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By Order of the Secretaries of the Army, the Navy, and the Air Force:

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