Chapter 12

MILITARY WORKING DOGS IN CONTAMINATED ENVIRONMENTS

This chapter is adapted from: Headquarters, Department of the Army. *Veterinary Service Tactics, Techniques, and Procedures.* Washington, DC: HQDA; December 2004. FM 4-02.18.

Introduction

This chapter is intended for military working dog (MWD) handlers, veterinary personnel, and nonveterinary healthcare providers who may encounter MWDs that have chemical, biological, radiological, or nuclear (CBRN) injuries. The majority of information for human CBRN casualties, CBRN protection, and decontamination can generally be applied to all animals; however, some signs and symptoms associated with human chemical or biological exposure may not present in animals, making it harder to recognize the severity of the injuries or illness.

Information on CBRN exposures in MWDs can also be found in the US Army Office of the Surgeon General's brochure *The Military Working Dog Handler's Guide for the Use of Medical Chemical, Biological, Radiological and Nuclear Defense Materiel* (NSN 7610-01-564-2341). Initial issue guidelines for MWD medical CBRN defense materiel (MCDM) can be found in *Army Medical Department Supply Information* (Department of the Army Supply Bulletin 8-75-S7, 20 July 2013).

Currently, protection of MWDs in a CBRN environment is difficult. Although no CBRN protective equipment for MWDs exists in the inventory and CBRN doctrine for animals is incomplete, both equipment and doctrine for MWDs are under development. The information below on protective

measures applies particularly to the MWD but can be used with other animals. After discussing measures to protect dogs and equipment from all agents, this chapter will describe specific agents, signs and symptoms of exposure to each of them, and treatment for exposed MWDs.

Protective Measures

Providing dogs with CBRN protection decreases or eliminates the amount of decontamination and treatment needed after an exposure. Ideally, MWDs would not require decontamination or treatment. However, in the absence of MWD-specific protective equipment or shelters, protecting dogs is difficult if they cannot be placed in an available shelter. If a CBRN attack is likely, the only reliable method of MWD protection is removal from the area. For immediate field-expedient protection, the MWD can be covered with wet weather gear, a tarp, or similar impervious materials, which will provide some protection while the MWD is evacuated from the area.

If an MWD must remain on site, limited protection may be provided by:

- Placing the MWD in a collective protection shelter with the handler. This is the preferred method.
- Moving the MWD into an existing structure or vehicle that has been sealed with tape, tarps, or tentage to prevent inflow of contaminated air. **NOTE:** The risk of heat injury to an MWD in a sealed vehicle may be higher than the risk of a chemical or biological injury during a potential attack.
- Placing the MWD into a transportable kennel covered with tarps, tentage, or plastic to limit contamination by droplet or liquid agent.
- If the dog must walk through a contaminated area, decontaminating its paws and then placing chemical-impervious barriers on the paws. Ideally, the MWD should not be walked through any area with ground contamination, but if it's necessary, the following items may provide limited protection if placed over the paws and taped at the carpus or tarsus:

- Mylar (DuPont, Wilmington, DE; polyethylene terephthalate) specimen bags,
- outer bag from an MRE (meal, ready-to-eat),
- extra butyl-rubber protective gloves or Joint Service Lightweight Integrated Suit Technology gloves, or
- tape or canvas over wrap on the surface of the paws that contact the ground.

Kennel Facility Protection

In the absence of specific MWD kennel collective protection shelters, the principles of field expedient protection covered in *Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical (NBC) Protection* (Washington, DC: US Army, Marine Corps, Navy, Air Force; 31 December 2009; FM 3-11.4/MCWP 3-37.2/NTTP 3-11.27/AFTTP (I) 3-2.46) should be followed. MWDs should be housed in chemical-biological protective shelters or joint expeditionary collective protection shelters, if available.

Protection of Military Working Dog Rations and Equipment

Bagged MWD food and equipment (such as leather leashes and collars and leather or plastic muzzles) are subject to contamination and may be difficult to decontaminate. One set of MWD handling equipment and a short-term supply (1–4 weeks) of food for each dog should be stored in an impervious and easily decontaminated container. Tightly sealed plastic cans (NSN 7240-01-094-4305) may be used for these items and stored in a nearby chemical protective shelter or protected vehicle.

Pretreatment of Military Working Dogs

The Department of Defense Military Working Dog Veterinary Service, a subordinate unit of the US Army Public Health Command, does not recommend the use of soman nerve agent pyridostigmine pretreatment (SNAPP) in MWDs because its effect on a dog's detection performance has not been evaluated. SNAPP will only be issued when expressly authorized by the Army Office of the Surgeon General, and its use must also be authorized by a veterinarian and

the MWD unit commander. When its use is authorized, the recommended SNAPP regimen is a half tablet (15 mg) every 8 to 12 hours. Follow precautions regarding SNAPP in *Multiservice Tactics, Techniques, and Procedures for Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries* (Washington, DC: US Army, Marine Corps, Navy, Air Force; September 2007; FM 4-02.285/ MCRP 4-11.1A/NTRP 4-02.22/AFTTP (I) 3-2.69).

Before an MWD goes on duty, its handler must evaluate the dog's ability to perform assigned tasks, taking into consideration whether it has received SNAPP. Any MWDs under the influence of the SNAPP must be identified prior to entry into a contaminated environment.

Nerve Agents

- Agents include tabun (GA), sarin (GB), soman (GD), GF, and VX.
- Clinical signs of mild exposure include unexplained runny nose, unexplained tearing, excessive salivation (drooling), pinpoint pupils, heavy panting, and muscle twitching.
- Clinical signs of severe exposure include severely pinpointed pupils; red eyes with excessive tearing; coughing, difficulty breathing; urination, defecation, vomiting; severe muscle twitching; convulsions; and loss of consciousness.
- Decontamination: for dogs, use Reactive Skin Decontamination Lotion (RSDL) and large amounts of soap and water; for MWD equipment, use the M295 Individual Equipment Decontamination Kit (IEDK) and 5% hypochlorite (bleach).
- Immediate management for mild exposure: administer two Antidote Treatment Nerve Agent Autoinjector (ATNAAs).
- Immediate management for severe exposure: administer three ATNAAs, three atropine autoinjectors, and one Convulsive Antidote, Nerve Agent (CANA; diazepam).

Absorption

Nerve agents dispersed by aerosol, vapor, or spray can be absorbed through a dog's respiratory tract, eyes, mouth, gastrointestinal tract, and skin. Respiratory absorption is the greatest concern because of the speed of absorption and

toxicity. Absorption of nerve agent through the mouth may occur simultaneously with respiratory exposure. However, oral and gastrointestinal absorption is of greater concern when a dog ingests nerve agent by eating contaminated food, drinking contaminated water, or licking its contaminated paws or hair. Because of the combination of hair and lack of sweat glands, the risk of nerve agent absorption through the skin is of less concern in dogs than in people; however, the risk is still significant. Absorption through the paws is the greatest concern for dermal absorption because a dog's footpads have sweat glands and no hair.

Effects on Food and Water

Liquid nerve agents or vapors of nerve agents can contaminate food and water. MWDs should not drink from water holes or trenches in contaminated areas or drink surface water that has run off from contaminated areas. Water suspected of being contaminated should be tested by preventive medicine or public health personnel, and only water found to be safe should be used for consumption. Contaminated food or food that is suspected of being contaminated should not be fed to MWDs unless approved by veterinary personnel. Food and water packaged in sealed, airtight cans, bottles, or other impermeable containers can be decontaminated according to procedures in *Multiservice Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Decontamination* (Washington, DC: US Army, Marine Corps, Navy, Air Force; April 2006; FM 3-11.5/MCWP 3-37.3/NTTP 3-11.26/AFTTP (I) 3-2.60).

Clinical Signs

Nerve agents generally produce similar effects, although the onset and severity of signs may vary depending upon the route and degree of exposure.

Eyes. Exposure to nerve agent vapors produces local ocular and respiratory effects before other effects. These signs usually appear within 5 minutes of exposure. The initial ocular effect is pinpoint pupils (miosis). More severe exposures may cause eye pain and visual impairment.

Respiratory tract. Respiratory exposure is manifested by rapid, heavy panting and an increase in upper respiratory secretions resulting in watery nasal discharge. Increased upper respiratory secretions with bronchoconstriction will cause coughing, rattling sounds in the throat, wheezing, and respiratory distress.

Systemic. Systemic absorption of enough nerve agent through the respiratory or gastrointestinal system will increase the severity of local effects and also cause generalized systemic effects. Respiratory distress becomes marked as a result of profuse bronchial secretions, bronchoconstriction, and airway obstruction. The distressed animal will gasp, and the mucous membranes of its mouth will become blue (cyanotic) as a result of decreased oxygenation. Other effects that may occur are slowing of the heart rate, profuse salivation and frothing, loss of fecal and urinary control, defecation, vomiting, and abdominal pain. Muscular effects also occur, including weakness, twitching, and trembling. As weakness and paralysis of the respiratory muscles progress, breathing becomes increasingly labored, shallow, rapid, and finally intermittent, and the animal quickly becomes oxygen deficient.

In severe exposures, the onset and progression of signs are very rapid. The animal may tremble violently, become uncoordinated, collapse, and go into generalized convulsive seizures. Loss of consciousness may ensue with a total loss of reflexes. Convulsions may become intermittent, with the animal showing a rapid panting respiration between convulsive episodes. Marked generalized convulsions are usually followed by complete flaccid paralysis, central respiratory and circulatory depression, asphyxiation, and death.

Skin. The signs of cutaneous exposure to liquid nerve agents are similar to respiratory exposure to nerve agent vapors. One difference is that the initial signs take longer to develop and the transition from mild to severe signs may be slower. In fatal cases of skin exposure, the survival period may last hours, whereas in inhalation exposure most deaths occur in a few minutes. Cutaneous exposure causes local twitching at the site of contamination, increased gastrointestinal activity, salivation, pinpoint pupils (miosis), generalized tremors, prostration, and convulsions. In contrast to inhalation exposure, dyspnea is not a

pronounced sign of early cutaneous exposure. Decreased mental activity occurs during the prolonged convulsive phase. A lethal factor in cutaneous exposure is the rapid and very considerable rise in body temperature to heatstroke levels caused by the prolonged convulsions.

Decontamination

For MWD nerve agent decontamination, use RSDL, large amounts of soap and warm water, or both. MWD equipment can be decontaminated using an M295 IEDK or 5% hypochlorite (bleach).

Initial Treatment

The initial MCDM issue for nerve agent treatment is three ATNAAs, five additional atropine autoinjectors, and four CANAs. **NOTE:** Keep used autoinjectors with the dog during evacuation.

Initial treatment by the MWD handler depends on the severity of nerve agent exposure. For mild MWD nerve agent exposure, administer two ATNAAs into the back of the dog's thigh. This initial dosage of two ATNAAs includes 4 mg of atropine and 1,200 mg of pralidoxime chloride (2-PAM Cl). CAUTION: MWDs should not need additional 2-PAM Cl injections. For severe MWD nerve agent exposure, administer three ATNAAs, three atropine autoinjectors, and one CANA (diazepam) autoinjector into the back of the thighs of the dog (Figure 12-1). This is similar to the buddy aid provided by one soldier to another suffering from severe nerve agent poisoning.

Follow-Up Treatment for Severe Nerve Agent Exposure

1. Single atropine autoinjectors may be given every 10 to 20 minutes until the nerve agent effects have subsided or signs of atropinization appear (this is equivalent to combat lifesaver aid for soldiers with severe nerve agent poisoning).

   Signs of *effective* atropinization include dry mouth and mucous membranes, increased heart rate, and increased body temperature. Signs of *excessive* atropinization and

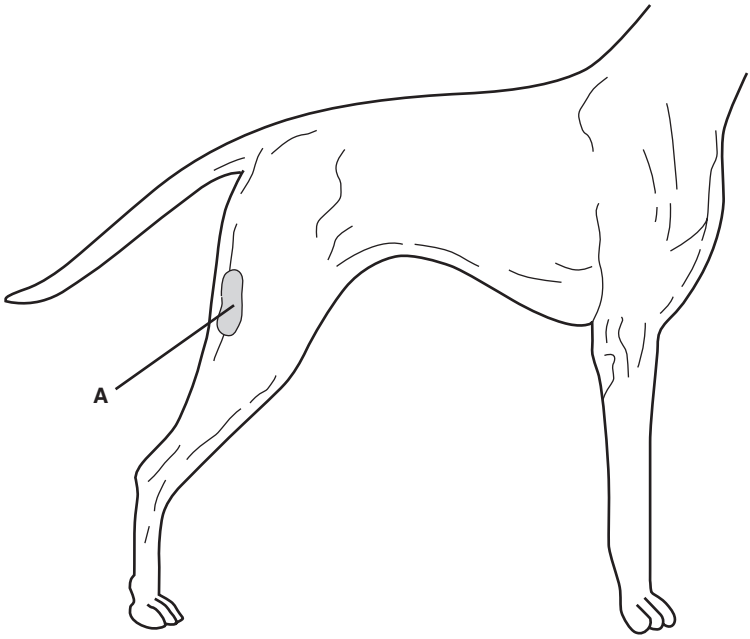

Figure 12-1. Location (A) for administering emergency treatment for severe nerve agent exposure in military working dogs.

atropine toxicity may include vomiting, thirst, difficulty eating, constipation, difficulty urinating, altered mental status (either depression or excessive stimulation), ataxia, seizures, decreased respiration rate, increased heart rate with possible arrhythmias, and abnormal blood pressure (decreased, with shock and circulatory collapse, or increased).

Atropine administered systemically may not overcome local ocular effects, so the absence of pupillary dilation does not necessarily indicate the need for further atropine administration.

Canine nerve agent casualties can tolerate much greater doses of atropine than would a normal (unexposed) dog. However, repeated doses of atropine will markedly increase its effects, especially in animals that have received only a

minimal exposure. The MWD must be monitored for heat stress because atropine dries the mucous membranes, thus preventing the dog from expelling body heat.

2. If the dog is still showing signs of seizures after initial treatment, it may be given up to three additional CANA autoinjections at 5 to 10 minute intervals until seizures stop.
3. Maintain a clear airway by removing respiratory secretions and saliva that may obstruct the airway. Loosen or remove the muzzle. **CAUTION:** When clearing the MWD's airway, be careful to avoid being bitten. Even a minor MWD bite could compromise mission-oriented protective posture (MOPP) equipment, resulting in human nerve agent exposure.
4. In severe nerve agent exposure, the animal's respiration is markedly depressed, and extreme muscular weakness or paralysis is present. In such cases, assisted ventilation is required to effectively resuscitate the animal.
5. Adequate atropine and 2-PAM Cl should bring about an improvement or restoration of spontaneous respiration and also improve blood circulation. If signs of nerve agent exposure persist or recur, veterinary personnel may need to administer additional 2-PAM Cl autoinjectors every 8 to 12 hours for up to 3 days.

   NOTE: Atropine is usually sufficient to control central nervous system (CNS) signs. If convulsions persist or occur intermittently and further interfere with respiration, they may be controlled by the administration of CANA.

Vesicants (Blister Agents)

- Vesicants include sulfur mustard (H/HD), nitrogen mustard (HN), lewisite (L), and a mixture of mustard and lewisite (HL).
- Clinical signs (HD and HN) exposure include an asymptomatic latent period (hours), after which the following signs may appear:
  - skin: redness, blisters, ulcerations
  - eyes: irritation, conjunctivitis, swollen eyelids, corneal opacity, corneal ulcerations
  - respiratory: cough, nasal discharge, difficulty breathing, fever, tracheal and pulmonary rales

  - gastrointestinal: oral ulceration, abdominal pain, vomiting, bloody diarrhea
  - systemic: excitation, salivation, slowed heart rate, decreased white blood cell and platelet counts, shock
- Fever is not typically associated with these agents.
- Signs of lewisite exposure include immediate pain, restlessness, vomiting, bloody diarrhea, shock, weakness, anemia, and pulmonary edema.
- Decontamination of MWDs: use large amounts of soap and water. RSDL should be used for HD only. For MWD equipment, use an M295 IEDK and 5% hypochlorite (bleach).
- Immediate management: symptomatic and supportive care.

When applied to MWDs, the terms "blister agent" and "vesicant" are misnomers because vesiculation (blistering) generally does not occur in dogs or most other animal species. Despite the lack of blistering, these agents cause injury to any part of the dog's body they contact. If the MWD must transit a contaminated area, MWD CBRN protection recommendations should be followed.

Distilled Mustard Absorption

Distilled mustard (HD) is used as a delayed-action casualty agent. Its persistency depends upon the munitions used and the weather. With an increase in temperature (over 90°F) and humidity, there is a marked decrease in the effective dosage. Although HD is not persistent at high temperatures (100°F –120°F), mustard vapor becomes a major hazard. In addition, wet skin absorbs more mustard agent than does dry skin.

Clinical Signs

Liquid mustard or mustard vapors produce delayed effects on the skin and eyes following exposure. The long hair of dogs does not prevent injury to the skin, but it does impede the penetration of liquids and vapors.

Skin. Contamination of the skin is followed by a latent period, which varies in length with the degree of exposure. Within 1 hour after exposure, piloerection (erection of the hair) occurs at

the site of exposure and may last for an hour or more. Two to three hours after that, redness and edema of the skin develop, increasing in intensity for 24 hours and then subsiding. In mild exposures, edema is followed by exfoliation of the epidermis of the skin. Severe exposures cause ulcerated lesions. The lesions heal if secondary infection can be prevented or treated adequately. **NOTE:** The skin of the abdomen, axilla, face, and feet are more susceptible to damage from HD than other parts of the skin, and this sensitivity is not directly related to the length of hair protecting the rest of the dog's body.

Eyes. The eye is the body part most sensitive to mustard's corrosive effects. Liquid mustard or heavy vapor exposures can be extremely damaging to the eye. Mild ocular exposures are followed by conjunctivitis and conjunctival edema, usually appearing within 1 or 2 hours; edema of the eyelids; corneal opacity and inflammation of the cornea; corneal roughening; and pain. More severe exposures can produce more serious lesions, resulting in necrotic conjunctivitis, corneal erosions or deep ulcerations, deep ophthalmic inflammation, and permanent corneal opacification due to scarring. These lesions predispose the eye to secondary bacterial infections.

Respiratory tract. Mild to severe exposures to mustard vapor may damage the respiratory tract. Inhalation of blister agent vapors will initially produce sloughing and ulceration of the tracheobronchial mucosa. Profuse inflammatory exudation and edema may cause respiratory distress. Severe exposures affect the lung tissue, causing pulmonary edema and acute pulmonary alveolar emphysema, which may become complicated by secondary purulent bronchopneumonia. The effects of respiratory exposures tend to develop over several days. The signs of respiratory involvement include cough, nasal discharge, respiratory difficulty, fever, and tracheal and pulmonary rales.

Gastrointestinal tract. Ingesting contaminated food and water or licking contaminated body areas may produce ulceration of the mucous membranes, resulting in oral ulceration, abdominal pain, vomiting, bloody diarrhea, and prostration.

Systemic. Systemic absorption of mustard can result from extremely high skin or respiratory exposures, or absorption of the agent in the intestines. It may produce systemic effects

involving the CNS, cardiovascular system, and hematopoietic system. The possibility of severe leukopenia and susceptibility to infection also exists. These effects are manifested by excitation, salivation, slowed heart rate, decreased count of white blood cells and platelets, bloody diarrhea, and shock.

Decontamination

MWD decontamination for distilled mustards involves large amounts of soap and warm water and RSDL (for HD only); MWD equipment can be decontaminated using an M295 IEDK or 5% hypochlorite (bleach). Keep in mind the following considerations:

- Decontamination should be carried out within 2 minutes after contamination with vesicants to prevent injury. Before redness and edema appear, localized areas can be decontaminated by using the RSDL (for HD only) as described in *Multiservice Tactics, Techniques, and Procedures for Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries* or washing the MWD with soap and warm water.
- Do not use RSDL in or around the eyes as it may cause additional ocular injury. The eyes must be decontaminated with copious water irrigation immediately after exposure. Ophthalmic ointments should not be applied until after thorough decontamination is completed and the eyes have been examined, because ointments may absorb mustard agents and prolong corneal exposure, thus increasing eye injury.

Treatment

Treatment for either local or systemic effects of blister agents is primarily symptomatic and similar to the treatment described in *Multiservice Tactics, Techniques, and Procedures for Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries* for human casualties. Specific systemic or topical antibiotic therapy should be administered when indicated. Supportive therapy may be required to maintain the animal's nutritive and fluid status. With eye injuries, the degree of corneal damage should be determined with fluorescein stain and treated

accordingly with an antibiotic or a combination of antibiotics and steroid ointments. The possibility of leukopenia, lung damage, sepsis, or others injuries may also exist.

Nitrogen Mustards

Nitrogen mustard (HN) is a delayed-action agent; it may be hours or longer before a dog feels skin-damaging symptoms. A dog's eyes are very susceptible to low concentrations of HN. High concentrations are required to significantly damage the skin or respiratory tract. Liquid and vapor exposures to HN are less damaging to the skin of MWDs than are equal concentrations of HD or arsenical blister agents. Exposures of the eye to HN, however, produce more serious lesions than HD exposures. The respiratory, gastrointestinal, and systemic signs and symptoms of HN are similar to those effects caused by HD. Decontamination and treatment for HN are similar to those for HD.

Arsenical Vesicant Agents

Arsenical vesicant agents such as lewisite (L) are more damaging as liquids than as vapors. Exposure to L is immediately painful, and the exposed MWD becomes very restless. Lesions produced by L are more severe and develop faster than those produced by mustard. L on the skin and inhaled L vapors are readily absorbed systemically, producing signs of arsenic poisoning manifested by restlessness, vomiting, bloody diarrhea, shock, weakness, anemia, and pulmonary edema.

British antilewisite (BAL), or dimercaprol, ointment penetrates and neutralizes arsenical blister agents; however, there is no initial MCDM BAL issue for MWDs. The treatment protocol below is based on the availability of BAL ointment and BAL injectable.

- **Local**. The treatment of lesions induced by L is similar to that for other blister agents. To treat localized skin exposures, BAL ointment can be rubbed into the contaminated areas, allowed to remain 5 minutes, and then washed off. Any other protective ointment on the skin must be removed before application of BAL ointment.

- **Systemic**. Systemic treatment for arsenical blister agents is indicated when there is extensive skin exposure that has not been decontaminated within 15 minutes, when a very rapid onset of effects follows exposure, or when systemic signs of arsenic poisoning appear. Systemic therapy consists of the administration of BAL injectable at 2.5 to 5.0 mg per kg by intramuscular (IM) injection. The dosage can be repeated every 4 hours for 2 days, and then two times per day for the next 10 days or until recovery is apparent. Supportive therapy should also be administered, as indicated.

Incapacitating (BZ-Type) Agents

- Clinical signs: increased heart rate, dilated pupils, impaired vision, dry mouth, decreased physical endurance while working, incoordination, behavioral changes, confusion, a lack of normal responses to commands, spontaneous aggressive behavior.
- Decontamination of MWDs: large amounts of soap and water.
- Immediate management: physostigmine salicylate. Provide supportive care; monitor vital signs.

Absorption

Significant absorption of BZ, an incapacitating agent, is most likely to occur through the animal's respiratory tract, but percutaneous and gastrointestinal absorption can also occur.

Signs and Symptoms

BZ-type agents are anticholinergic agents with pharmacological effects similar to those of atropine, although they have a greater effect on the CNS than atropine. The onset of signs following a moderate respiratory exposure can be expected to occur within 10 to 20 minutes. In general, the greater the absorbed dose of BZ-type agents, the shorter the time before onset of signs.

In the MWD, early effects of moderate exposures to BZ include increased heart rate, dilated pupils, impaired vision (shown by bumping into objects), dry mouth, and a decrease in physical

endurance while working. Marked increases in body temperature do not usually occur. The agents' predominant effects are on the CNS, resulting in incoordination, behavioral changes, confusion, and a lack of normal responses to commands. Exposures may incapacitate animals and make them unfit for service.

There is a large margin of safety between incapacitating and lethal exposures to BZ-type agents. Overwhelming exposures, however, can result in prostration and convulsions, with death occurring rapidly. Moderate exposures may cause altered mental status, failure of the MWD to follow commands, and spontaneous aggressive behavior.

Decontamination

For MWDs, use large amounts of water warm and soap. For MWD equipment, use an M295 IEDK or 5% hypochlorite (bleach).

Treatment

There is no initial MCDM issue of physostigmine salicylate for MWDs. **NOTE:** Do not use anesthetics, tranquilizers, and sedatives because they tend to potentiate the effects of incapacitating agents.

After a moderate exposure to BZ, effects on the MWD may persist 24 hours or more. Although the MWD's life is not immediately threatened, therapy can be administered to hasten recovery and return the animal to duty as quickly as possible. However, the MWD should be examined and its work performance evaluated before it is returned to duty.

General therapy for BZ exposure should include restricting activity and providing clean drinking water. Physostigmine salicylate (0.02–0.025 mg/kg, for a total of 1–1.5 mg) can be given by slow intravenous (IV) or IM injections.

Repeated doses of physostigmine salicylate at reduced dosage levels can be given at intervals of 1 to 2 hours until effective; if signs of BZ exposure recur, maintenance doses can be given every 2 to 4 hours. The dosage levels are reduced in continuous therapy to avoid an overdose of physostigmine. The signs of physostigmine overdose include pinpoint pupils, muscle weakness, twitching, vomiting, diarrhea, respiratory

distress, slowed heart rate, and convulsions. If toxicity is noted, administration of physostigmine should be discontinued, and one atropine injector, IM, should be given to control severe effects of overdose.

Cyanide Compounds (Blood Agents)

- Clinical signs (with high concentrations): difficulty breathing, coughing, death.
- Decontamination: usually unnecessary because the agents evaporate quickly.
- Immediate management: the antidote is sodium nitrite and sodium thiosulfate, IV; supportive management consists of oxygen.

Cyanide compounds affect bodily functions by inactivating the cytochrome oxidase system; this poisoning prevents cellular respiration and the normal transfer of oxygen from the blood to body tissues. Hydrogen cyanide (AC) and cyanogen chloride (CK) are the important agents in this group. Cyanogen agents are highly volatile and nonpersistent even at very low temperatures. Exposure at high concentrations causes effects within seconds and death within minutes in unprotected personnel and MWDs. The chlorine in CK also produces central and peripheral pulmonary compartment effects.

Absorption

With agent dispersed from munitions or aircraft, inhalation is the usual route of entry.

Clinical Signs

AC causes asphyxiation of the tissues, especially the respiratory center of the CNS, resulting in difficulty breathing, coughing, and death. In addition to cyanide effects, CK causes marked local irritant effects on the respiratory system, leading to pulmonary edema.

Decontamination

MWD decontamination for cyanide compounds is usually not necessary because the agents evaporate quickly. If the MWD's hair is wet, use large amounts of soap and water.

Initial Treatment

Treatment is difficult under field conditions. It should consist of oxygen therapy under positive pressure ventilation and antidote injections, when available (there is no initial MDCM issue of sodium nitrite and sodium thiosulfate, the antidote, for MWDs).

For MWDs under 85 pounds, inject one sodium nitrite 10-mL (3%) ampule containing 300 mg of sodium nitrite, followed by one 50-mL (25%) ampule containing 12.5 g of sodium thiosulfate, IV. For MWDs over 85 pounds, inject two sodium nitrite 10-mL (3%) ampules containing 300 mg each (total 600 mg) of sodium nitrite, followed by two 50-mL (25%) ampules containing 12.5 g (total 25 g) of sodium thiosulfate, IV. The IVs must be administered slowly, over 3 to 5 minutes.

If the dog's exact weight can be obtained, the initial dosage of sodium nitrite should be approximately 1.8 to 3.2 mg/kg (4–7 mg per pound) IV, followed immediately by sodium thiosulfate at approximately 68 to 136 mg/kg (150–300 mg per pound).

Follow-Up Treatment

If signs of intoxication continue, additional medication may be needed. To determine the dosage, visually examine a small amount of venous blood. If the blood is chocolate brown, indicating the presence of methemoglobin, give an additional injection of sodium thiosulfate at one-half the initial dose because there should be sufficient methemoglobin present from the original dose of sodium nitrite. If the venous blood is red, give additional injections of both sodium nitrite and sodium thiosulfate at one-half the initial dose.

Lung-Damaging (Choking) Agents

- Agents include ammonia, chlorine, HC smoke, oxides of nitrogen (NOx), and phosgene (CG).
- The effects of lung-damaging agents in MWDs are similar to their effects in humans: delayed signs of breathing difficulty, coughing, wheezing, sneezing, and collapse. One difference is that cyanosis (prominent in human casualties of phosgene) is masked in MWDs.
- Decontamination for MWDs: large amounts of warm water.

Treatment

For MWDs exposed to lung-damaging agents, rest should be strictly enforced, especially when pulmonary edema develops, and the dog should be observed closely for 24 to 36 hours. An MWD in shock should be kept comfortably warm and given oxygen, if available. If pneumonia develops, treatment with antibiotics is indicated.

Riot-Control (Irritant) Agents

Under field conditions, the irritant agents bromobenzyl cyanide (CA), chloroacetophenone (CN), and *o*-chlorobenzylidene malononitrile (CS) have little effect on MWDs. CS may cause increased respiration and hyperactivity.

Decontamination

For skin decontamination, a 0.25% solution of sodium sulfite is more effective than saline or water for dissolving and neutralizing the irritant agent and should be used if available.

Treatment

Liquid or solid agents in direct contact with the eyes will cause severe irritation; the eyes should be flushed with saline or water.

Smoke and Incendiary Agents

Burning particles of white phosphorus (WP), the main agent of concern, cause deep burns on contact with the skin. The smoke is generally not toxic. NOTE: Because WP burns spontaneously when exposed to air, oxygen must be excluded to stop the burning. This may be done by submerging the burn or wound in water or by covering it with a water-soaked dressing.

At the earliest opportunity, all WP should be removed from the skin as follows:

1. Bathe the affected part in a bicarbonate solution to neutralize phosphoric acid, which then allows removal of visible WP. Remaining fragments will be observed in dark surroundings as luminescent spots.
2. If the MWD's condition permits, debride the burn promptly to remove bits of phosphorus that might be absorbed later and possibly produce systemic poisoning.
3. After it is certain that all phosphorus has been removed, apply petroleum-based ointment.

Further treatment should be carried out as for thermal burns. Treatment with ultraviolet light is both palliative and therapeutic.

If the eyes are affected, initial treatment consists of irrigation using water or saline. The lids must be separated and a local anesthetic instilled to aid in the removal of all embedded particles. If the eyes are severely ulcerated, atropine ophthalmic ointment should be instilled once all particles have been removed.

Other agents of concern include sulfur trioxide-chlorosulfonic acid solution (FS), titanium tetrachloride (FM), and a chemical mixture (HC). Field concentrations of these agents usually are not harmful to MWDs, but the liquid may cause burns on the skin and in the eyes. After the eyes are irrigated, treat them the same way as for thermal burns.

Toxic Industrial Chemicals and Materials

MWDs are likely to come into contact with toxic industrial chemicals (TICs) and toxic industrial materials (TIMs) during an incident as well as during their daily duties. MWDs are at greater

risk than humans of being exposed to TICs and TIMs because they breathe the air closer to the contaminated ground, walk across contaminated areas, and lick or groom their paws or fur.

Common Types of Toxic Industrial Chemicals and Materials

Hydrocarbons include gasoline, diesel fuel, motor oil, transmission fluid, general cleaners and degreasers, and lubricants. Exposure can occur via oral, ocular, inhalation (vapors, aerosols, particles, or dust), or dermal routes. Clinical signs can be gastrointestinal (vomiting, diarrhea, abdominal pain), ocular (conjunctivitis, corneal irritation or necrosis), respiratory (nasal discharge, nasal bleeding, respiratory distress), dermal (burns, skin eruptions, dermatitis), or associated with the CNS (ataxia, seizures, coma). Hydrocarbon exposure may lead to liver and kidney damage.

Polychlorinated biphenyls (PCBs) have been banned in the United States since 1979. However, older buildings and equipment may still contain PCBs, which could be released during a disaster or fire. PCBs can be aerosols, vapors, oily liquids, or solids. Exposure can occur via oral, inhalation, or dermal routes, and can lead to liver and kidney damage. Additional effects including gastric injury, thyroid suppression, anemia, skin lesions, and reproductive effects; neurobehavioral abnormalities are also possible.

Hazardous metals are of concern when buildings or equipment are damaged or destroyed. Explosions and fires may increase the risk for release of particles or fumes such as lead fumes from lead piping or arsenic from pressure-treated lumber. Some of the more likely hazardous metals MWDs may encounter are arsenic, lead, zinc, cadmium, chromium, thallium, mercury, nickel, cobalt, and beryllium. Exposure is mainly via inhalation but can also be oral. Clinical signs include nonspecific respiratory problems (coughing, respiratory distress, pneumonitis) and gastrointestinal abnormalities (vomiting, diarrhea, abdominal pain).

Asbestos is still used in insulation and concrete and is only a concern when buildings are damaged from explosions or compressive forces. Exposure is mainly due to inhalation, with initial clinical signs of coughing and bronchitis.

Soaps and detergents are only mildly irritating to gastrointestinal and mucous membranes. More alkaline detergents cause ocular, dermal, and gastrointestinal irritation, and potentially corrosive burns and ulcerations to these systems as well. Decontamination for soaps and detergents is large amounts of water.

Acids and alkalis are common in cleaning products. Exposure can occur via oral, ocular, inhalation (acid aerosols, mists, or vapors), and dermal routes. Clinical signs include mild to moderately severe burns for oral, ocular, and dermal exposure and dyspnea and pulmonary edema for inhalation exposure. Decontamination is large amounts of water.

Ethylene glycol and propylene glycol are found in various household and industrial compounds. Exposure is mainly oral with CNS clinical signs of ataxia, weakness, and depression that can progress to renal failure, seizures, and liver damage. Within 1 to 2 hours of ethylene glycol ingestion, induce vomiting or gastric lavage (or both), followed by administration of activated charcoal and sodium sulfate. After 1 to 2 hours, administer 4-methylpyrazole (5% solution [50 mg/mL]) at 20 mg/kg IV initially, followed by 15 mg/kg IV at 12 and 24 hours after ingestion, and 5 mg/kg IV at 36 hours after ingestion. Supportive treatment consists of correcting fluid, electrolyte, and acid-base disorders. Propylene glycol treatment is supportive.

Phenols may be present in large quantities in industrial settings. At low concentrations (< 4.5%), phenols are irritants; at concentrations over 5%, phenols are caustic. Exposure can occur via oral and dermal routes. Clinical signs include oral and esophageal burns, panting, profuse vomiting and diarrhea, salivation, muscle tremors, convulsions, coma, and death. Exposure can also lead to liver and kidney damage. Initial decontamination for phenols consists of large amounts of water under pressure until the phenol odor is gone. Rapid skin decontamination is critical. Flush eyes with copious amounts of water or saline. After the smell of phenol is gone, decontaminate with large amounts of water and soap. In cases of ingestion, do not induce emesis. Administer activated charcoal.

Alcohols, unless ingested in large quantities, do not generally cause severe problems. Exposure occurs via oral, inhalation, and dermal routes. Clinical signs include ataxia, CNS depression, dyspnea, and gastritis.

Common harmful gases are bromine, chlorine, fluorine, hydrogen sulfide, and carbon monoxide. Bromine gas, used in agriculture, sanitation, and petrochemical industries, causes coughing, nosebleeds, and pulmonary edema. Chlorine gas is used in many industries and for sewage treatment. Chlorine causes ocular and respiratory irritation and may cause pulmonary edema. Fluorine gas is used in aluminum and petrochemical industries as well as in dyes, agricultural chemicals, and ceramics. It causes severe ocular and respiratory irritation.

Hydrogen sulfide is produced by various industries such as paper mills, food processing plants, and petroleum refineries. Because hydrogen sulfide is heavier than air, it accumulates in low-lying areas, and it smells like rotten eggs. Clinical signs of hydrogen sulfide exposure are conjunctivitis and pulmonary edema, but large exposures can rapidly induce unconsciousness, seizures, and death. Carbon monoxide is slightly lighter than air and usually poses a risk only when entering poorly ventilated, confined spaces containing motor vehicle smoke or exhaust. Mild clinical signs of carbon monoxide exposure are vomiting and lethargy; moderate clinical signs are dyspnea, weakness, ataxia, tachypnea, and tachycardia; and severe clinical signs are disorientation, severe lethargy, hypotension, syncope, seizures, pulmonary edema, and coma.

Decontamination and Treatment

MWD decontamination for most TICs and TIMs is large amounts of soap and water. Eyes should be irrigated with copious amounts of water, saline, or ophthalmic solution until all contaminants have been removed. Prior to decontamination, check to ensure that the agent involved will not react with water, thus causing further injury. Treatment for TICs and TIMs not listed above is supportive.

Biological Warfare Agents

The initial MCDM issue of doxycycline for MWDs is two bottles of doxycycline, 100-mg tablets (30 tablets per bottle). An alternative is one bottle (30 tablets) of ciprofloxacin, 500-mg tablets. Additional medication may be needed to complete

this treatment. **WARNING:** Do not give doxycycline (or other tetracycline antibiotics) or ciprofloxacin (or other quinolone antibiotics) to an MWD with a known allergy. Contact veterinary personnel for a substitute. Also, doxycycline and ciprofloxacin increase sensitivity to sunlight. Keep the MWD in the shade when possible. Notify veterinary personnel if the MWD develops a rash, hives, vomiting, or diarrhea, or has difficulty breathing.

Diseases produced by offensive use of biological agents could infect animals within the contaminated area; however, most of the diseases likely to be used in biowarfare are unlikely to cause illness in MWDs. This is primarily due to varied species susceptibility between dogs and humans for most biowarfare agents. For definitive information on biowarfare agents, see *Treatment of Biological Warfare Agent Casualties* (Washington, DC: US Army, Marine Corps, Navy, Air Force; 17 July 2000; ATP 4-02.84 (FM 8-284)/MCRP 4-11.1C/NTRP 4-02.23 [NAVMED P-5042]/AFMAN 44-156_IP (AFMAN [I] 44-156).

The response to the threat or use of biowarfare agents may vary depending on whether veterinary medical measures are employed before exposure, or after exposure in the presence of clinical signs. Prior antibiotic prophylaxis may prevent illness in exposed MWDs. Active immunization may be effective against biowarfare in humans, but there are no approved canine immunizations for these agents. The best protective modality for MWDs against a wide variety of biological threats is the use of prophylactic antibiotics and decontamination procedures. Among likely biowarfare agents, MWDs may be susceptible to plague (*Yersinia pestis*), tularemia, brucellosis, Q-fever, and anthrax. Dogs are believed to be less susceptible than humans to all of these diseases. The Department of Defense MWD Veterinary Service currently recommends that all MWDs deployed to areas with high risk of natural tick-borne rickettsial disease be placed on prophylactic doxycycline (6 mg/kg/day). Doxycycline is generally considered efficacious against all biowarfare agents of concern, and the prophylactic dose may provide additional protection for MWDs. Ciprofloxacin may also be used.

Decontamination should be performed with soap and water. MWD equipment should be decontaminated with 5% hypochlorite solution, according to *Multiservice Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Decontamination*.

Nuclear and Radiological Weapons

MWDs exposed to nuclear weapons or radioactive material will present with the same types of medical problems as human patients, including blast, thermal, and radiation injuries and radiation sickness, depending on the amount of radiation received. Veterinary care will be based on the dog's clinical condition and its prognosis for recovery. MWD equipment should be decontaminated according to *Multiservice Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Decontamination*.

For radioactive iodine exposure, potassium iodide (KI) should be administered within 4 hours before or after exposure. The initial MCDM issue of KI for MWDs is one package containing fourteen 130-mg tablets. Administer half a tablet (65 mg) once a day by mouth until instructed by a veterinarian to stop. **WARNING:** Do not start administration of KI if more than 12 hours has passed since exposure.

Notify veterinary personnel if the MWD develops wheezing, difficulty breathing, or swelling of the mouth or throat. In cases of MWDs exposed to other radioactive isotopes, consult the Department of Defense MWD Dog Veterinary Service (210-671-3991/3992, DSN: 312-473-3991/3992) prior to administering any radiotherapy.

Decontamination

Decontamination should occur as quickly as possible after exposure to prevent or reduce any further absorption of the agent and to prevent contamination of other personnel, equipment, and the surrounding area. **NOTE:** All personnel who handle CBRN-contaminated animals must be in MOPP 4 or proper civilian personal protective equipment as determined by the incident commander.

Soap (Castile liquid soap [NSN 8520015190776] or any nonmedicated veterinary shampoo) and warm water are safe for the majority of CBRN agents an MWD could encounter. Using warm water will help prevent hypothermia and assist with removal of contaminants during decontamination.

The initial MCDM issue of RSDL for MWDs is one pouch (contains 3 packets). The MWD handler should carry an extra M295 IEDK for decontamination of MWD equipment.

Eyes. Any amount of agent getting into the eyes of an animal requires prompt action to prevent conjunctival absorption, which can occur very rapidly. The eyes should be decontaminated by irrigation with copious amounts of water, saline, or ophthalmic solution until all contaminants have been removed. After decontamination is complete, the eyes should be thoroughly evaluated and treated with appropriate ointments. **CAUTION:** Do not use RSDL in or around eyes. RSDL and soap can cause further injury and both must be kept out of an MWD's eyes. Likewise, eye ointments can absorb and concentrate agents, causing additional damage and toxicity, so they must not be used until the eyes have been thoroughly decontaminated and examined.

Hair and skin. Because the dog's coat delays penetration of agents to the skin and cutaneous absorption requires several minutes, effective decontamination of the hair and skin may be carried out before any significant absorption has occurred. However, decontamination is not a substitute for treatment. When the animal shows signs of exposure to a CBRN agent, specific therapy should be initiated.

Immediate Decontamination

The MWD's entire body should be wiped down using the RSDL, except for eyes and the periocular area, as soon after nerve agent or HD exposure as possible. For other contaminants, soap and warm water can be used for MWD decontamination. The eyes should be flushed with large amounts of water, ophthalmic solution, or saline. If soap is not available, rinsing with large amounts of water is the next best method of decontamination. Allow the MWD to shake off excess water and dry it with a clean towel or other absorbent cloth.

Thorough Decontamination

The preferred method of decontaminating the MWD is by first using RSDL (for nerve agents and HD), then thoroughly washing and rinsing the MWD to ensure all contaminants are removed. Thorough MWD decontamination should be completed by

washing the hair down to the skin with soap and warm water. It is important that all body surface areas are saturated with soap and water and gently scrubbed. After the washing is completed, the hair and skin should be rinsed until the soap residue is completely removed. If soap is not available, rinsing with large amounts of water is the next best method of decontamination. Step-by-step decontamination instructions are as follows:

1. Rinse the MWD thoroughly with plain water beginning at the head, then moving along the back to the tail. Then rinse down the MWD's sides, chest, stomach, legs, and paws.
2. Work the soap into the hair starting the head, then moving along the back and to the tip of the tail, then work down the MWD's sides, chest, abdomen, legs, and paws. Make sure the soap reaches the MWD's skin. If the MWD has erect ears, flush the ears with otic solution or water.
   NOTE: Special attention should be paid to the MWD's stomach, face, ears, eyes, under tail, paws, and between the legs to ensure all contamination is removed.
3. Flush the eyes with copious amounts of water, ophthalmic solution, or saline.
4. Rinse the dog with plain water using the same pattern as the initial rinse (head to back to tail, then down sides, chest, stomach, legs, and paws).
5. Allow the MWD to shake off excess water. A tarp or other impervious material may be placed around the dog while it shakes off excess water to prevent contamination of other people, MWDs, or equipment.
   NOTE: Steps 1 through 5 may need to be repeated until all contaminants are removed.
6. Dry the MWD with clean towels or other absorbent cloth.

MWD Equipment

The leash, collar, and muzzle should be removed from the MWD and decontaminated as soon as possible. These items may be decontaminated using an M295 IEDK, soap and water, 5% hypochlorite (bleach) solution. Additional guidance for decontamination of equipment is contained in *Multiservice Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Decontamination*.