

PART ONE
CHEMICAL AGENT CASUALTIES
CHAPTER 1
INTRODUCTION

1-1. The Threat of Chemical Warfare Agents to U.S. Forces

a. Chemical warfare (CW) agents (also referred to as chemical agents) remain a continuing threat to U.S. forces through the 1990s. Delivery may be accomplished by multiple means, causing extensive injury and contamination. Traditionally, threat commanders have regarded chemical weapons as a part of their conventional arsenal. The Chemical Weapons Convention (CWC), signed by 130 countries in January 1993, will take many years to fully implement and to verify the destruction of known chemical weapons stockpiles. Some countries with offensive chemical warfare programs, like North Korea and Iraq, have not signed the CWC. In spite of the CWC and other diplomatic efforts, chemical weapons will be available to threat forces in regions where U.S. forces may be deployed.

b. In addition to established threat areas, many countries have shown that chemical weapons are readily obtainable. The ease of obtaining these weapons greatly increases the complexity and extent of the total threat. For example, nonmilitary organophosphate insecticide factories may also be used to produce nerve agents.

c. Some threat forces are well prepared to conduct military operations in a chemically contaminated environment. Many threat combat vehicles (including tanks, reconnaissance vehicles, and aircraft) have organic NBC protective systems. These systems provide personnel protection from the effects of NBC contamination on the battlefield.

d. Chemical weapons are most effectively employed against untrained or unprotected targets. Civilian fixed sites (airfields, depots, cities, and ports) are especially vulnerable. These sites may be targeted as part of the plan to defeat U.S. force projection.

1-2. Military Employment of Chemical Warfare Agents

a. Chemical agents dispersed by modern weapons can be tactically used anywhere within the range of current delivery systems.

b. Chemical agents can be used in conjunction with other weapons systems or by themselves.

Chemical agents may produce temporary incapacitating effects, serious injury, or death. Chemical agents also have the potential for use by saboteurs and terrorists in rear areas against key targets and civilian populations. The scope of CW is broad since it aims at groups rather than individuals and could be directed against civilian populations. Vapors of chemical agents may penetrate vehicles, ships, aircraft, fortifications, and buildings. Special design of such equipment and/or structures can prevent chemical agent penetration.

c. The presence or threat of CW operations can create psychological or physiological problems, adversely affect morale, and reduce military or civilian efficiency.

d. Chemical fires may be employed with smoke. Therefore, friendly forces must be prepared for chemical attacks when the enemy is employing smoke munitions or production equipment.

e. All service members must take every precaution against becoming chemical casualties. Each service member must apply the principles of first aid and decontamination contained in this manual to increase their chances for survival and recovery. Medical personnel must apply the principles of first aid, treatment, and decontamination contained in this manual to increase their and their patients' chances of survival.

1-3. Routes of Entry

Chemical agents may enter the body by several routes. When inhaled, gases, vapors, and aerosols may be absorbed by any part of the respiratory tract. Absorption may occur through the mucosa of the nose and the mouth and/or the alveoli of the lungs. Liquid droplets and solid particles can be absorbed by the surface of the skin, eyes, and mucous membranes. Chemical agents that contaminate food and drink can be absorbed through the gastrointestinal tract. Finally, wounds or abrasions are presumed to be more susceptible to absorption than the intact skin.

1-4. Classification of Chemical Agents

Chemical agents are classified by either their physiological action or their military use.

a. *Physiological Action.*

(1) Nerve agents (anticholinesterase) (such as Tabun (GA), Sarin (GB), Soman (GD), GF, and V-agent (VX)) inhibit the cholinesterase enzymes. The cholinesterase enzymes are responsible for the hydrolysis of acetylcholine, a chemical neurotransmitter. This inhibition creates an accumulation of acetylcholine at a cholinergic synapse that disrupts the normal transmission of nerve impulses. Cholinergic synapses are located—

- In the central nervous system (CNS).
- In the neuromuscular endplates of the peripheral voluntary nervous system.
- At the parasympathetic endings and sympathetic presynaptic ganglia of the autonomic nervous system.

(2) Blister agents (vesicants) include sulfur mustard (H/HD) and nitrogen mustard (HN), arsenical (lewisite (L)), and phosgene oxime (CX). Blister agents produce pain and injury to the eyes, reddening and blistering of the skin, and when inhaled, damage to the mucous membranes and respiratory tract. Mustard may produce major destruction of the epidermal layer of the skin.

(3) Lung-damaging agents (choking agents) include phosgene (CG), diphosgene (DP), chlorine, and chloropicrin (PS). These agents produce injury to the lungs and irritation of the eyes and the respiratory tract. They may also cause intractable pulmonary edema and predispose to secondary pneumonia.

(4) Blood agents (cyanogens) include hydrogen cyanide (AC) and cyanogen chloride (CK). These agents are transported by the blood to all body tissues where the agent blocks the oxidative processes, preventing tissue cells from utilizing oxygen. The CNS is especially affected and leads to cessation of respiration followed by cardiovascular collapse.

b. *Military Use.*

(1) Toxic chemical agents produce serious injury or death. They include nerve agents, blister agents, lung-damaging agents (choking agents), and blood agents.

(2) Incapacitating agents produce temporary physical or mental effects, or both.

1-5. Means of Delivery of Chemical Agents

Chemical agents can be dispersed by explosive shells, rockets, missiles, aircraft bombs, mines, and spray devices. Also, water supplies have the potential for contamination by either water-soluble or miscible liquids or solids. The means of delivery does not in itself help in identifying chemical agents. A spray or cloud delivered from an aircraft or by shells and bombs indicates a chemical attack maybe taking place. It must be remembered that vapors delivered from

aircraft may not be visible; also, vapors and sprays may be hidden by atmospheric conditions.

1-6. Diagnosis of Injury from Chemical Agents

a. *Odor.* Some agents have odors which may aid in their detection and identification (table 1-1), but many are essentially odorless. (Table 1-1 is located in the back of this manual.) The odor of a chemical agent delivered by an explosive shell may be concealed by the odor of the burning explosive. Vomiting agents may be mixed with more lethal agents to induce vomiting and irritation of the respiratory tract. This mixture forces the affected individuals to break the seal of their masks in order to vomit, exposing them to the more toxic agents in the environment. Detection of a chemical agent odor is one indication for immediately putting on the mask and wearing it until the "all clear" signal is given. However, odor alone must not be relied on for detection or identification of a chemical agent. Some chemical agents are not perceptible by smell even on initial exposure. Continued exposure dulls the sense of smell. Even harmful concentrations of an odor-producing chemical agent may become imperceptible. Standard detection devices are the most reliable means of identifying a chemical agent, but users should remember that detection devices indicate concentrations in their immediate area only. They may not cover large areas and should not be the sole means on which to base conclusions on the presence or absence of chemical agents.

b. *Signs and Symptoms.* A chemical agent that has produced signs and symptoms in exposed personnel can usually be identified from all of the following.

(1) A brief history bringing out the symptoms that have occurred and their progression.

(2) Physical examination of the eyes (pupils, conjunctival, lids) and skin.

(3) Observation of respiration, color of mucous membranes, and general behavior. However, if a mixture of agents has been used, identification of the agents may not be possible. Signs and symptoms are summarized in table 1-1. Full descriptions of the signs and symptoms produced by specific chemical agents are given in the chapters that follow.

1-7. Protective Measures and Handling of Casualties

a. Depending on the theater of operations, guidance issued may dictate the assumption of a minimum mission-oriented protective posture (MOPP) level. However, MOPP 4 (consisting of wearing the protective overgarment, mask with hood, gloves, and overboots) will be assumed immediately—

- When the local alarm or command is given.

- When entering an area known to be or suspected of being contaminated with an NBC agent.
- During any motor march, once CW has been initiated.

- When casualties are being received from an area where chemical agents have reportedly been used. Appendix A provides additional information on recognizing chemical agent casualties.

If individuals find themselves alone without adequate guidance, they must mask IMMEDIATELY and assume MOPP 4 under any of the following conditions:

(1) Their position is hit by artillery, mortar fire, rocket fire, or by aircraft bombs, and chemical agents have been used or the threat of their use is significant.

(2) Their position is under attack by aircraft spray.

(3) Smoke or mist of an unknown source is present or approaching.

(4) A suspicious odor, liquid, or solid is present.

(5) A chemical or biological attack is suspected.

(6) They have one or more of the following signs/symptoms:

(a) An unexplained sudden runny nose.

(b) A feeling of choking or tightness in the chest or throat.

(c) Blurring of vision and difficulty in focusing the eyes on close objects.

(d) Irritation of the eyes (could be caused by the presence of several chemical agents).

(e) Unexplained difficulty in breathing or increased rate of breathing.

(f) Sudden feeling of depression.

(g) Anxiety or restlessness.

(h) Dizziness or light-headedness.

(i) Slurred speech.

(7) Unexplained laughter or unusual behavior noted in others.

(8) Buddies suddenly collapsing without evident cause.

(9) Animals or birds exhibiting unusual behavior and/or sudden unexplained death.

b. The mask should be worn until unmasking procedures indicate the air is free of chemical agent and the "all clear" signal is given (see FM 3-4 for unmasking procedures). If vomiting occurs, lift the mask momentarily and drain it (keep your eyes closed and hold your breath), then replace, clear, and seal the mask.

c. Chemically contaminated casualties present a hazard to unprotected personnel. Handlers must wear their individual protective equipment (IPE) while decontaminating these casualties. Casualty decontamination is conducted in an area equipped for

casualty decontamination purposes (see para 1-11). The decontamination area is located downwind (prevailing winds) of the medical treatment facility (MTF). Contaminated clothing and equipment are placed in plastic bags and removed to a designated dump site downwind from the MTF (see apps B and C).

d. When an MTF is expected to operate in a contaminated area, collective protective shelters (CPS) must be used (see app C).

e. Most chemical agents can poison food and water. Chemical contamination will make supplies and equipment dangerous to handle without protective equipment. Food and water packaged in sealed, airtight cans, bottles, or other impermeable containers can be decontaminated as described in FM 3-5 and FM 8-10-7. (Some plastics are permeable to chemical agents.) Exposed foods that are known to be contaminated or suspected of being contaminated should NOT be consumed unless approved by veterinary personnel. In the U.S. Army water purification is performed by quartermaster water purification units. Certification of water potability is the responsibility of medical personnel (preventive medicine personnel in the U.S. Army).

f. Military commanders, leaders, and medical personnel should be on the alert for the possibility of anxiety reactions (combat stress reactions (CSR)) among personnel during chemical agent attacks. All possible steps must be taken to prevent or control anxiety situations. Personnel in protective clothing are particularly susceptible to heat injury. Ambient temperature is considered when determining the degree of physical activity feasible in protective clothing. Wet bulb globe temperature (WBGT) index determinations (which indicate heat stress conditions in the environment) should be used with caution since the humidity within the protective ensemble will generally be higher than ambient humidity. At MOPP 4 add 10°F to the WBGT index. (See FM 3-4 for additional guidance on the degradation effects of the protective clothing.)

1-8. Chemical Agent Contamination Detection and Identification

Identification of chemical agents will greatly assist in the diagnosis and treatment of chemical injuries. The following are means of detecting and identifying chemical agent contamination:

a. Chemical agent detector paper or tape can be used to detect/identify liquid chemical agents.

(1) The VGH ABC-M8 Chemical Agent Detector Paper can be used to detect and identify liquid V- and G-type nerve agents and H-type blister agents. It does not detect chemical agent vapors. Some solvents and standard decontaminating (including the M258A1 kit) solutions cause false-positive reactions by the M8 paper.

(2) The M9E1 Chemical Agent Detector Paper (tape) (which can be worn on the uniform) detects the presence of liquid nerve agents (V and G) and blister agents (H/HD, HN, and L). The M9 paper does not distinguish between the types of agent involved—only that an agent or agents maybe present. Neither will it detect chemical agent vapors. Extremely high temperatures, scuffs, or certain types of organic liquids and decontaminating solution number 2 (DS2) cause false-positive reactions by the M9 paper.

b. Automatic chemical agent alarm systems and the chemical agent monitor (CAM) detect agent aerosol and vapor contamination consistent with their designed specifications and operational limitations.

c. Detector kits (such as the M256 Chemical Agent Detector Kit) detect and identify vapor concentrations of nerve, blister, and blood agents.

1-9. Medical Management

Medical management consists of those procedures for optimizing medical care to ensure the maximum return to duty (RTD) on the battlefield. This includes triage, basic survival treatment, decontamination, emergency forward treatment, evacuation, and continuing protection of chemical agent casualties. Although casualty decontamination is part of medical management, the physical decontamination of these personnel is the responsibility of the supported unit (app C).

1-10. Personal Decontamination

a. *Eyes and Skin.* Following contamination of the eyes or skin with vesicants or nerve agents, personal decontamination must be carried out IMMEDIATELY. These chemical agents are effective at very small concentrations. Within a very few minutes after exposure, decontamination is marginally effective for vesicants or nerve agents. Decontamination consists of either agent removal and/or neutralization. Decontamination after agent absorption occurs may serve little or no purpose. Service members will decontaminate themselves unless they are incapacitated. For those individuals who cannot decontaminate themselves, the nearest able person should assist them as the situation permits. Refer to appendix D for eye and skin decontamination procedures.

NOTE

In a cyanide or phosgene only environment, decontamination is not required.

(1) Decontaminate the eyes with copious amounts of water (see app D).

(2) Decontaminate the skin with the M291 or M258A 1 Skin Decontaminating Kit (see app C and

app D (figs D-1 and D-2)).

(a) The M291 kit measures 4.4 by 9.3 by 0.7 inches and weighs 1.6 ounces. The kit can be folded to a measurement of 4.4 by 4.7 by 1.4 inches. Each kit contains six packets; enough to do three complete skin decontamination. Each packet contains an applicator bag filled with decontamination powder. The decontamination powder consists of 2.8 grams (gm) Ambergard™ XE-555 decontaminant resin. The pouch is discarded when all packets have been used. The kit will fit into the pocket on the outside rear of the M17 or M40 protective mask carrier or in the inside pocket of the carrier for the M24 and M25 series protective mask. The pouch can also be carried in a pocket of the battle dress uniform (BDU) or chemical protective overgarment.

WARNING

The M291 is for external use only. It may be irritating to the eyes. Keep the decontaminating powder out of the eyes. Use water to wash toxic agent out of eyes. You may also use a 0.5 percent chlorine solution to wash toxic agent out of cuts or wounds.

(b) The M258A1 kit measures 1¾ by 2% by 4 inches and weighs 3.2 ounces. Each kit contains six packets: three DECON-1 packets and three DECON-2 packets. The DECON-1 packet contains a wipe pre-wetted with hydroxyethane 72 percent, phenol 10 percent, sodium hydroxide 5 percent, and ammonia 0.2 percent, and the remainder water. The DECON-2 packet contains a wipe impregnated with chloramine B and sealed glass ampules filled with hydroxyethane 45 percent, zinc chloride 5 percent, and the remainder water. The case fits into the pocket on the outside rear of the M17 or M40 protective mask carrier or in an inside pocket of the carrier for the M24 and M25 series protective mask. The case can also be attached to the web belt or on the D-ring of the protective mask carrier.

WARNING

The ingredients of the DECON-1 and DECON-2 packets of the M258A1 kit are poisonous and caustic and can permanently damage the eyes. The wipes must be kept out of the eyes, mouth, and open wounds.

b. *Clothing and Equipment.* When the M258A1 kit has been replaced with the M291 kit, the M258A1 will be used for decontamination of selected items of

individual clothing and equipment (there is insufficient capability to do more than emergency spot decontamination). The M258A1 kit is not used to decontaminate the protective overgarment. The protective overgarment does not require immediate decontamination since the charcoal layer is a chemical agent barrier; however, to enhance its protective capability, gross contamination should be removed. Exchange the protective overgarment as soon as the mission permits, using the procedures outlined in FM 3-5. The Decontamination Packet, Individual Equipment (DPIE), M295, is used to decontaminate individual equipment such as the weapon, helmet, and other individual gear. The M295 contains the same ingredients as the M291, except that the pads are much larger. However, the M295 is not Food and Drug Administration (FDA) approved for use on the skin.

1-11. Casualty Decontamination

Contaminated casualties entering the medical treatment system are decontaminated through a decentralized process. This is initially started through self-aid and buddy aid procedures. Later, units should further decontaminate the casualty before evacuation. Patient decontamination stations are established at the field MTF to decontaminate individuals as required (clothing removal and spot skin decontamination) prior to treatment and further evacuation. These stations are manned by nonmedical members of the supported units under medical supervision. Medical supervision is required to prevent further injury to the patient and to provide emergency medical treatment (EMT) during the decontamination process. There are insufficient medical personnel to both decontaminate and treat patients. Medical personnel will be fully employed providing treatment for the patients during and after decontamination by nonmedical personnel. Decontamination is accomplished as quickly as possible to facilitate medical treatment, prevent the patient from absorbing additional agent, and reduce the spread of chemical contamination. (For details on

patient decontamination, see app C of FM 8-10-7 and chap 9 of FM 3-5.)

1-12. First Aid

First aid comprises either self-aid, buddy aid, or CLS.

a. Self-Aid. Self-aid consists of first-aid measures that service members can apply in helping themselves. These include individual decontamination and administration of chemical agent antidotes.

b. Buddy Aid. Buddy aid consists of emergency actions undertaken by individuals to restore or maintain vital body functions in a casualty. Exposure to chemical agents may produce effects which require immediate self-aid. However, mental confusion, muscular incoordination, physical collapse, unconsciousness, and cessation of breathing may occur so rapidly that the individual is incapable of providing self-aid. Therefore, the nearest individual may need to—

- (1) Mask the casualty.
- (2) Administer antidotes.
- (3) Administer assisted ventilation, if required and if equipment is available.
- (4) Decontaminate the casualty.
- (5) Put selected items of protective clothing on the casualty to preclude further absorption of contamination through any exposed skin.
- (6) Evacuate the casualty as soon as possible.

c. Combat Lifesaver. In addition to those actions taken as buddy aid, CLS aid also includes—

- (1) Administering additional atropine.
- (2) Administering additional CANA.
- (3) Establishing an oropharyngeal airway.
- (4) Starting intravenous infusions.

1-13. Medical Treatment

Medical treatment consists of those procedures undertaken to return soldiers to duty, to save life and limb, and to stabilize the patient for evacuation to the next level of medical care. Table 1-1 summarizes the treatment of chemical agent casualties. Specific chemical agent treatment procedures are described in the succeeding chapters.

									surrounded by erythema. Swollen within 1 hour, blisters after 24 hours, necrosis of skin. Long recovery (1 to 3 months)						bicarbonate			
Phosgene	CG	Green corn, grass, or new-mown hay	Lung-damaging agent		Irritation	Lacrimation (after respiratory symptoms)	Irritation		Coughing, choking, chest tightness on exposure. Latent period, then pulmonary edema, dyspnea, frothy sputum, rales, pneumonia, and fever	Possible cyanosis following pulmonary edema	Nausea, occasional vomiting (after respiratory symptoms)	Shock after severe exposure, hypertension and tachycardia		Anxiety, depression			Corticosteroids IV and by inhalation promptly may be lifesaving. Rest, oxygen, antibiotics	CG
Hydrogen cyanide	AC	Faint, bitter almonds	Interferes with oxygen utilization at cellular level						Deep respiration followed rapidly by dyspnea, gasping, then cessation of respiration	Initially pinker than usual; may change to cyanosis	Nausea	Profound hypertension		May have initial excitation; then depression, giddiness, headache, irrational behavior, ataxia, convulsions or coma			A. Drugs binding cyanide: 1) Methemoglobin formers; nitrites or DMAP 2) Scavengers; dicobalt edetate and hydroxocobalamin B. Provision of s-groups; thiosulfate C. Assisted ventilation D. Oxygen	AC
Cyanogen chloride	CK	Very irritating	Like hydrogen cyanide, lung irritant		Irritation	Lacrimation	Irritation		Irritation, cough, choking, dyspnea: pulmonary can be rapid	Like hydrogen cyanide (AC)						Like hydrogen cyanide and phosgene	CK	
Vomiting agents	DM DA DC	Burning fireworks, very irritating	Local irritant, induces vomiting		Irritation	Lacrimation	Pain, rhinorrhea, tightness, sneezing	Tightness	Tightness and pain, uncontrollable coughing	Stinging (especially of face), occasional dermatitis	Salivation, nausea, vomiting			Severe headache, mental depression	May cause desire to remove protective mask		Wear mask in spite of symptoms. Spontaneous improvement	DM DA DC
Irritant agents	CN CA	Irritating	Local irritant		Redness, irritation	Pain, blepharospasm, profuse lacrimation, photophobia	Irritation, burning	Tightness, burning	Tightness and irritation if concentration is high	Stinging (especially of face), occasional dermatitis, may blister	Occasional vomiting			Headache	Wash eyes with copious amounts of water	Spontaneous improvement. Analgesic eye and nose drops if necessary	CN CA	
	CS CR	Very irritating, pungent, pepper-like	Local irritant		Intense irritation	Pain, blepharospasm, profuse lacrimation, photophobia	Irritation, burning, tightness	Tightness, burning	Tightness in chest and difficulty breathing	Stinging, occasional dermatitis, may blister	Nausea and vomiting			Headache	Wash eyes with copious amounts of water	Symptoms disappear rapidly in fresh air	CS CR	
Incapacitating agents	BZ	None	Anticholinergic	Mydriasis		Blurred vision	Extreme dryness	Extreme dryness		Dry, flushed	Constipation	Tachycardia, elevated blood pressure	Urgency, urinary retention	Headache, giddiness, drowsiness, disorientation, hallucinations and occasional maniacal behavior. Ataxia and/or lack of coordination	For contamination of skin, wash with soap and water	Restraint, cool environment. Physostigmine. Treatment may be required over several days	BZ	
	LSD	None	Psychotomimetic	Mydriasis						Sweaty palms, cold extremities		Tachycardia		Mental excitation, poor concentration, tremor, indecisiveness, inability to act in a sustained or purposeful manner. Hallucinations	Pyrexia	Reassurance, restraint, prompt evacuation, diazepam	LSD	