

**U.S. Army Medical Research Institute of
Chemical Defense (USAMRICD)**

**FIELD MANAGEMENT
OF CHEMICAL
CASUALTIES
HANDBOOK**



**Chemical Casualty Care Division
USAMRICD
3100 Ricketts Point Rd
Aberdeen Proving Ground, MD 21010-5400**

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Chemical Casualty Care Division's
FIELD MANAGEMENT OF CHEMICAL
CASUALTIES
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**Third Edition
2007**

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Disclaimer

The purpose of this Handbook is to provide concise, supplemental reading material for attendees of the Field Management of Chemical Casualties Course.

Every effort has been made to make the information contained in this Handbook consistent with official policy and doctrine.

This Handbook, however, is not an official Department of the Army publication, nor is it official doctrine. It should not be construed as such unless it is supported by other documents.

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INTRODUCTION

With the end of the Soviet Union as a global superpower, the world as we knew it ended, and a turning point in world history began. We first witnessed this moment in 1990 with the formal reunion of East and West Germany, through Operations Desert Shield and Desert Storm, Operations Restore Hope in Somalia, and the United States' (U.S.) involvement in the Balkans Conflict, September 11, 2001, Afghanistan, and Operation Iraqi Freedom. This historic shift and the War on Terrorism will persist well into the next century.

The ability and will to wage war on a large scale have not diminished, only shifted to new players. Former Soviet subjects have taken new and unpredictable directions. Strident nationalism and long suppressed ethnic rivalries have emerged with vicious, bloody warfare the end result. The disarray and economic upheaval inside Russia have allowed the sale of Russian weaponry and technology to perpetuate.

The so-called third world nations and terrorists have also taken advantage of the new world order to challenge what was once thought unchallengeable. Economic investment and economic power have given military muscle to

nations who, even 10 years ago, were struggling just to feed their people. In some cases, this newfound power has also taken on nationalistic fervor.

As a consequence of the unprecedented world challenges, the threat spectrum faced by the U.S. into the next century has broadened. It now includes formerly democratic governments, members of regional cooperation alliances, and terrorists of all persuasions. Let's narrow our gaze somewhat and look at examples of threats within the chemical and biological (C/B) threat spectrum.

THE C/B THREAT SPECTRUM

The threat of C/B weapons' use against coalition forces in Operation Desert Storm must be seen as the first of many C/B threats the U.S. military will face. Throughout the world, nations and terrorists are still attempting to, or have in fact, produced C/B agents and means to employ them. This handbook will provide some answers and suggestions, but you, the medical NCO, must read and research to ensure that the mission of providing health service support to chemical casualties will be successful.

NERVE AGENTS

GA, GB, GD, GF, VX

SUMMARY

Signs and Symptoms:

Vapor

Small exposure—small pupils, runny nose, mild difficulty breathing.

Large exposure—sudden loss of consciousness, convulsions, no breathing, flaccid paralysis, copious secretions from nose, mouth and lungs, small pupils.

Liquid on skin:

Small to moderate amount—localized sweating, nausea, vomiting, feeling of weakness.

Large amount—sudden loss of consciousness, convulsions, no breathing, flaccid paralysis, copious secretions from nose, mouth, and lungs.

Detection: M256A1; Improved Chemical Agent Monitor (ICAM); M8 paper; M9 paper; M22 (ACADA).

Decontamination: M291; large amounts of water and soap; RSDL, 0.5% hypochlorite bleach, M295. [Note: Never use full-strength or 5% bleach on skin!]

Immediate management: administration of MARK I kits or ATNAA; diazepam (Convulsive Antidote Nerve Agent-CANA). In addition, if casualty's symptoms are severe, ventilation and suction of airways for respiratory distress.

NERVE AGENTS

Nerve agents are considered the primary chemical agent threat to the U.S. military because of their high toxicity and effectiveness through multiple routes of entry. They are absorbed through the eyes, respiratory tract, and skin.

TOXICITY

The classical nerve agents are Tabun (GA), Sarin (GB), Soman (GD), GF, and VX. Tables I and II show the toxicities of the nerve agents by inhalation and skin exposure.

The Ct product, or $C \times t$, is a marker of a dose of a **vapor or aerosol** to which someone has been exposed. The units are usually mg/m^3 for C and minutes for t. One can be exposed to the same Ct of $100 \text{ mg}\cdot\text{min}/\text{m}^3$ by staying in a concentration of $10 \text{ mg}/\text{m}^3$ for 10 minutes ($10 \times 10 = 100$), $20 \text{ mg}/\text{m}^3$ for 5 minutes ($20 \times 5 = 100$), or $5 \text{ mg}/\text{m}^3$ for 20 minutes ($5 \times 20 = 100$). The Ct that will cause a biological effect is constant over a range of C and t. Thus, if a Ct of $100 \text{ mg}\cdot\text{min}/\text{m}^3$ of nerve agent causes shortness of breath, it would be a result of any combination of C and t that produces a product of $100 \text{ mg}\cdot\text{min}/\text{m}^3$.

The LC_{50} is the Ct of agent vapor that will be lethal (L) to half of the population exposed to it. The IC_{50} is the Ct that will incapacitate (I) half of those exposed to it. The word “incapacitate” must be defined when using this term. For example, dim vision might incapacitate a Soldier for some jobs, in which case the IC_{50} will be the Ct needed to cause dim vision. On the other hand, incapacitation might be defined as loss of consciousness and twitching, in which case the IC_{50} will be the Ct needed to produce these effects. The IC_{50} shown in Table I causes severe effects, including convulsions.

Table I shows the estimated LC_{50} , estimated IC_{50} , and Ct that will cause pinpoint pupils (miosis) in half of the exposed population (MC_{50}).

Table II shows the estimated amounts that will cause lethality in half of the population when placed on the skin.

The LD_{50} is the dose (D) of agent **liquid or solid** that is lethal (L) to half of the population exposed to it. The LD_{50} of VX, when placed on human skin, is the size of a droplet that will cover the width of two columns of the Lincoln Memorial on a Lincoln penny.

TABLE I. Vapor Toxicity
mg-min/m³

Agent	LC₅₀	IC₅₀	MC₅₀
GA	400	300	2-3
GB	100	75	3.0
GD	70	Unknown	<1.0
GF	Unknown	Unknown	<1.0
VX	50	35	0.04

TABLE II. LD₅₀ on Skin

Agent	Amount
GA	1000 mg
GB	1700 mg
GD	50 mg
GF	30 mg
VX	10 mg

MECHANISM OF ACTION

When a nerve agent poisons a Soldier, the action of the enzyme **acetylcholinesterase** (AChE) is blocked. The normal function of acetylcholinesterase is to break down (hydrolyze) the chemical messenger, or neurotransmitter, **acetylcholine** (ACh).

The nervous system is made up of electrically conducting cells called neurons. Neurons convey information by electrical signals, called action potentials. When an electrical signal reaches the end of the neuron, the information must be conveyed to the next cell by means of a chemical messenger or neurotransmitter. Cholinergic neurons are neurons, which use ACh as the neurotransmitter to communicate with other cells. When an electrical signal reaches the end of a cholinergic neuron, the neuron releases packets of ACh. These cross a space, called a synaptic cleft, to the next cell in the series, another neuron, gland cell, or muscle cell. There they interact with specialized proteins called synaptic receptors. The interaction of enough molecules of ACh with post-synaptic receptors, or receptors on the second cell, causes a new electrical signal to arise and continue the communication into the second cell.

Acetylcholinesterase (AChE), an enzyme present on post-synaptic membranes, serves as the turn-off switch or governor of this process. AChE breaks down or hydrolyzes ACh, stopping the reaction from getting out of hand.

Nerve agents act directly upon AChE. When a nerve agent inhibits AChE, it cannot perform its normal function of hydrolyzing ACh. ACh then accumulates, and the target cell's action continues uncontrolled, producing a clinical syndrome called **cholinergic crisis**.

EFFECTS

The primary concern of the Soldier medic or combat lifesaver when treating the nerve agent poisoned Soldier is to provide correct, timely, and lifesaving care. The first step in providing this care is to understand the effects that vapor or liquid nerve agent exposure has on the Soldier.

Nerve agent produces cholinergic crisis by inhibiting AChE and thus prolonging the action of ACh. The parts of the body that are affected by excessive acetylcholine accumulation are:

- Eyes
- Nose (glands)
- Mouth (glands)

- Respiratory tract
- Gastrointestinal tract
- Cardiac muscle
- Sweat glands
- Skeletal muscle
- Central nervous system (CNS)

Eyes. Direct contact with a nerve agent vapor or aerosol produces effects on the eyes. When the route of entry of the agent is through the skin or by ingestion, the effect on the eyes is delayed or may not occur. The main effect of the agent is to cause miosis, or pinpointing, of the pupils. One or both pupils may be pinpointed and unresponsive to light or darkness. Pinpoint pupils cause a complaint of dim vision that is more pronounced in low light conditions; Soldiers may complain that everything looks “black,” even in the middle of the day. Frontal headache, mild aching around the eye, or severe eye pains are common complaints in a Soldier exposed to a moderate concentration of agent. About one patient in ten may complain of nausea. Twitching of the eyelids may be observed through the protective mask, and the eyes may be reddened. When a light source is used to test for pupillary response, the Soldier may complain of an ache behind the eyes due to light sensitivity.

Nose and Mouth. The secretory glands of the nose and mouth are as or more sensitive to

nerve agent vapor or aerosol than the eyes. If the Soldier is poisoned by nerve agent liquid on the skin or by ingestion, the nose will become affected, but only in response to the whole body (systemic) involvement. But if exposed to a nerve agent vapor or aerosol, the nose will begin to run immediately. This effect has been described by patients recovering from accidental nerve agent vapor exposure as “worse than a cold or hay fever” and “like a leaking faucet.” Even after low concentrations of agent, runny nose (rhinorrhea) may be severe. The mouth will secrete saliva so copious that watery secretions run out the corners of the mouth.

Respiratory Tract. Inhalation of a small amount of nerve agent vapor will cause the Soldier to complain of tightness in the chest or shortness of breath (dyspnea). This occurs because the excessive ACh stimulates the muscles in the airways to contract and constrict the airways (bronchoconstriction). As the concentration increases, breathing difficulty will become severe. One or two breaths of a high concentration of nerve agent vapor will cause gasping and irregular respirations within seconds to a minute or two. Cessation of breathing (apnea) can occur within minutes after exposure to a large amount of nerve agent, either by liquid on the skin or vapor.

Excessive bronchial and upper airway secretions (bronchorrhea) caused by stimulation of the airway glands by the excessive ACh will compound breathing difficulty. These secretions can obstruct the airway and cause difficulty in moving air into and out of the lungs.

Gastrointestinal (GI) Tract. After exposure to a large but sublethal concentration of vapor, the Soldier will complain of nausea and may vomit. Nausea and vomiting may be the first effects from liquid nerve agent exposure on the skin. The Soldier may complain of nausea followed by vomiting, “heartburn,” and pain in his abdomen. In addition, the Soldier may belch frequently and have diarrhea or involuntary defecation and urination. These effects usually occur within several minutes after vapor exposure. However, after liquid agent exposure on the skin, these effects may lag in onset for as long as 18 hours after exposure.

Cardiac. The heart rate can either increase or decrease after nerve agent exposure. Generally, blood pressure will increase, but the blood pressure can rarely be determined in a contaminated area because the casualty and the examiner are in protective gear. Although it is important in assessing the patient’s cardiovascular status, the heart rate will not aid the Soldier medic/combat lifesaver in choosing the care needed to treat nerve agent poisoning.

Sweat Glands. The skin is very permeable to nerve agent. When penetration occurs after either liquid or vapor exposure, localized sweating occurs and progressively spreads over the surrounding skin area as nerve agent is absorbed. The likelihood that the Soldier medic/combat lifesaver will be able to observe this localized sweating is minimal.

Skeletal Muscles. After exposure to a moderate or large amount of nerve agent, the Soldier will complain of weakness and twitching of muscle groups. The twitching can first be noticed at the site of a liquid droplet on the skin. The muscles may show a rippling effect (fasciculation). As the nerve agent effect progresses, muscles can go into a prolonged contraction. However, instead of a prolonged contraction, the large muscle groups may begin unsynchronized contractions that cause the arms and legs to flail about. The hyperactivity of the muscles in these instances leads to muscle fatigue and flaccid paralysis (limp, unable to move). Unless the Soldier medic/combat lifesaver aggressively cares for this casualty, he/she will not survive.

The twitching caused by the direct effect of nerve agents on skeletal muscle may be difficult to distinguish from the tonic-clonic movements of convulsive seizures, but they are not seizures.

Seizures are caused by electrical discharges in the brain. A nerve agent poisoned patient who has been treated, has normal mental status, and is talking appropriately, but still has twitching, is most likely not seizing, but suffering the skeletal muscle effects only.

Because certain muscles, especially the diaphragm, play a major role in breathing, the skeletal muscle effects of nerve agents can worsen the patient's respiratory status by weakening or paralyzing these muscles of respiration.

Central Nervous System (CNS) (brain and spinal cord). In the case of a large inhalation or liquid dose, the effects are rapid and usually fatal under battlefield conditions. The Soldier almost immediately loses consciousness, followed seconds later by seizure activity. Several minutes later, respiration ceases. Without immediate care, this Soldier will not survive to reach Level 1 treatment. Seizures may be present without motor activity, especially in a patient who has been either twitching or seizing for long enough that he/she has depleted the muscles of energy in the form of adenosine triphosphate (ATP).

When exposed systemically to low amounts of nerve agent, the Soldier may complain of generalized weakness. Some people who have

survived low dose exposures have complained of nonspecific symptoms for weeks. These symptoms have included change in sleep pattern, mild memory losses, and new headaches. Some of these symptoms may reflect post-traumatic stress disorder.

Understanding when these effects can most occur is critical for the Soldier medic/combat lifesaver. The length of time a casualty may be in your care is unknown. It is best to understand what may occur and when, because being surprised by and unprepared for the reactions of a nerve agent poisoned Soldier lessens his chances for survival. Tables III and IV show nerve agent effects, the onset time of these effects, and the required self- and buddy-aid.

These tables show the typical time course for mild, moderate, and severe exposures to nerve agent. When a lethal or near lethal exposure occurs, the time to onset of symptoms and maximal severity of symptoms may be extremely brief. If aggressive care is not given to the Soldier exposed to a lethal concentration, death can result within five minutes after the appearance of symptoms.

TABLE III. Nerve Agent Effects ***Vapor Exposure***

Mild

Eyes	Small pupils (miosis) Dim vision Headache
Nose	Runny nose (rhinorrhea)
Mouth	Salivation
Lungs	Tightness in the chest (dyspnea, bronchoconstriction)

Time of onset: seconds to minutes after exposure.

Self-aid: 1 MARK I Kit or ATNAA

Buddy-aid: stand by

Severe

All of the above, plus
Severe breathing difficulty or cessation of respiration
Generalized muscular twitching, weakness, or paralysis
Loss of consciousness
Loss of bladder, bowel control
Convulsions
Seizures

Time of onset: seconds to minutes after exposure

Self-aid: none; Soldier will be unable to help himself

Buddy-aid: 3 MARK I Kits or 3 ATNAAs and diazepam (CANA) **immediately**

Treat the casualty using his own MARK I and diazepam to start. Do not use your own.

TABLE IV. Liquid on Skin

Mild/Moderate

Muscle twitching at site of exposure

Sweating at site of exposure

Nausea, vomiting

Feeling of weakness

Time of onset: 10 minutes to 18 hours after exposure

Self-aid: 1 to 2 MARK I Kits or ATNAAs, depending on severity of symptoms

Buddy-aid: stand-by

Severe

All of the above, plus

Breathing difficulty or cessation of breathing

Generalized muscular twitching, weakness, or paralysis

Loss of consciousness

Loss of bladder and bowel control

Convulsions
Seizures

Time of onset: minutes to an hour after exposure

Self-aid: none; Soldier will be unable to help himself

Buddy-aid: 3 MARK I Kits or ATNAAs and diazepam (CANA) **immediately**

Treat the casualty using his own MARK I and diazepam to start. Do not use your own.

TREATMENT

The most important care the casualty receives is the care given within the first several minutes after exposure (self-aid, buddy-aid).

Immediate care, including administration of antidotes, can mean the difference between survival and death in a Soldier exposed to a nerve agent. It is imperative that every medic/combat lifesaver understands the effects of nerve agents, the time in which effects occur, and the correct steps to take to save the exposed Soldier.

Every Soldier must know the signs and symptoms of mild and severe nerve agent poisoning and the correct first aid in order to

evaluate and provide the appropriate self- and buddy-aid.

SELF-AID AND BUDDY-AID

Timely and correct determination of the type of agent and route of entry causing the signs or symptoms is critical if the poisoned Soldier is to survive to reach definitive medical care. Nerve agents will, under most field conditions, be encountered in both the vapor and liquid forms. When nerve agents are encountered and Soldiers have donned protective equipment, a hasty self-evaluation for signs or symptoms of poisoning must be conducted. This self-evaluation implies that Soldiers know the signs and symptoms of mild and severe nerve agent poisoning, as well as the correct first aid.

Tables III and IV show methods of exposure, resulting signs or symptoms, and self-aid or buddy-aid to be rendered. **Timely and correct first-aid actions are critical to enhance the casualty's chances for survival.**

When the effects progress to more than one organ system, the situation has changed from a mild to a severe exposure. The buddy's aid in determining this change becomes critical. As the change occurs, the remaining MARK I Kits and one CANA autoinjector must be administered.

Always follow self- or buddy-aid promptly with Level 1 medical care.

SOLDIER MEDIC/COMBAT LIFESAVER TREATMENT OF NERVE AGENT POISONING

The Level 1 care provider (medic, combat lifesaver) must rapidly determine the following:

- extent of the poisoning
- what medications have been administered
- complications induced by the poisoning and/or resulting from conventional wounds
- if possible, route of exposure, liquid or vapor; liquid poisoning can delay onset of effects

PROTECTIVE POSTURE DURING TREATMENT

First, protect yourself by donning Mission-Oriented Protective Posture (MOPP) Level IV.

CASUALTY DECONTAMINATION

Next, assist the casualty in performing decontamination of exposed skin in the following order:

- face
- neck area
- chest area

- abdomen
- arms and hands
- other exposed skin areas

Performing this decontamination eliminates nerve agents on the skin surface that could continue to absorb into the skin causing a “time release” effect of symptoms.

TREATMENT GUIDELINES

The treatment guidelines provided below assume that the Soldier medic or combat lifesaver is certain that nerve agent poisoning has occurred. Use of atropine in the absence of nerve agent will cause the casualty to experience inhibition of sweating and heat storage problems in a warm climate.

DRUG THERAPY

Atropine is the drug of choice for treating nerve agent poisoning. It will dry secretions, (including those in the airways), reduce bronchoconstriction, and decrease gastrointestinal motility.

Atropine **will not relieve miosis and will not relieve muscle twitching or spasms or increase diaphragm effort.**

Mild and Improving Symptoms (Especially Vapor-only Exposure).

Observation is all that is needed for the casualty with mild symptoms, such as rhinorrhea, slight or recovering breathing difficulty, or excessive salivation that is decreasing. In the casualty with mild symptoms that appear to be clearing, the one MARK I Kit administered during self-aid, followed by observation for several hours, will normally be all that is needed.

In general, if there is suspicion that the patient may have had a liquid exposure, the patient should be observed for at least several hours and not returned to duty. Liquid exposures can cause symptoms with onset delayed by many hours.

Pain in the eyes, twitching of the eyelids, redness, and miosis cannot be treated in the field setting by the Soldier medic/combat lifesaver. At the battalion aid station (BAS), eye pain can be controlled with atropine eye drops. These conditions, although annoying, are not life-threatening.

Severe Symptoms.

If the casualty has severe symptoms involving two or more major organ systems

(systemic) (gastrointestinal, skeletal muscle, respiratory, etc.), the first step is to administer all three MARK I Kits and diazepam.

MARK I kits include autoinjectors of 2 mg atropine and 300 mg 2-PAM Cl. Giving one MARK I means injecting both into the patient.

Diazepam (CANA) should always be administered when the three MARK I Kits are given together. Additionally, more atropine (2 mg) should be given every five minutes until the patient breathes easily without excess secretions complicating breathing. A total of 15 to 20 mg of atropine may be required in the first 3 hours after the onset of symptoms.

Atropine. If the casualty is unconscious and in respiratory distress, **three MARK I Kits and diazepam should be given immediately**, followed by additional atropine as described above. Over the next 5 to 15 minutes, 10 to 15 mg of atropine may be needed. Atropine administered with the autoinjector will show some effectiveness in three to five minutes. During the time the atropine takes to reach maximum effect, the constriction and secretions in the airway and feeling of “tightness in the chest” will begin to decrease. Atropine will have a drying effect on salivation and rhinorrhea. Atropine (2 mg) should be administered at 3 to 5-minute intervals until the casualty can tell the

Soldier medic/combat lifesaver that it is easier to breathe or manual ventilation becomes easier.

Observe the casualty for indications that the atropine can be discontinued.

At Level 2 and higher, IV access will allow more precise administration of additional doses of atropine through the IV route.

There is no upper bound to atropine use.

Discontinue atropine when:

- Secretions of the mouth, nose, and lungs are minimized.
- The casualty tells you that breathing is easier, or it is easier to administer assisted ventilation.

Pralidoxime Chloride (2-PAM Cl) in the autoinjector (600 mg, 2 ml) is the second drug for use in nerve agent poisoning cases. The 2-PAM Cl removes nerve agent (except Soman) from the enzyme acetylcholinesterase. The 2-PAM Cl (included in the MARK I Kit) must be used as early as possible. If symptoms are severe, involving two or more organ systems (for example, the lungs and gastrointestinal tract), all three MARK I Kits **and diazepam (CANA)** should be given immediately. Additional autoinjectors are not administered until an hour

later. If severe signs or symptoms still persist **one hour** after using the three MARK I Kits, three additional 2-PAM CI autoinjectors should be administered. More than two sets of three 2-PAM CI (six total) must not be used.

Once the patient reaches Level 2 care, IV 2-PAM CI may be administered.

Excess 2-PAM CI may harm the casualty by dangerously raising blood pressure and causing laryngospasm. **Never give more than 3 autoinjectors (or 2000 mg IV) of 2-PAM CI per hour.**

Discontinue the use of 2-PAM CI after symptoms of respiratory distress have eased.

Diazepam (CANA) in the 10-mg autoinjector is the drug adopted by the U.S. military for use in controlling convulsing patients. The doctrine for its use instructs the Soldier to administer one diazepam autoinjector to his buddy immediately after using the third MARK I Kit in severe poisoning cases. **Diazepam is not for self-use.** It should be given only to severe casualties by the medic. The key to increasing the effectiveness of the diazepam is administering it before convulsions begin. Again, when two or more organ systems become involved, one diazepam autoinjector should be administered

along with the three MARK I Kits to lessen the convulsive activity the Soldier may experience.

The Soldier medic or combat lifesaver may administer a second and third diazepam autoinjector using the guidelines below.

After the first injection (buddy-aid):

- Observe the casualty for about 10 minutes.
- Ventilate if necessary.
- Turn the casualty on his/her side to facilitate breathing.
- Pad areas to prevent other injuries.
- Restrain if necessary.
- If still convulsing after 10 minutes, give the second diazepam autoinjector.

Following the second injection (medical aid):

- Observe the casualty for 5 to 10 minutes.
- If still convulsing after 5 to 10 minutes, give a third diazepam autoinjector.

Medical officers and PAs may choose to give more diazepam, either IM or IV, if they deem it necessary.

ATNAA (Autoinjector Treatment, Nerve Agent Antidote): This is a new autoinjector that will

replace the MARK I in the military inventory. It contains dual chambers, which administer 2.1 mg atropine and 600 mg 2-PAM Cl sequentially through one needle. When it is fielded, it will require only half the time to treat a casualty as does the present MARK I. Doctrine for its use will be identical to the present MARK I.

SERPACWA (Skin Exposure Reduction Paste Against Chemical Weapon Agents): This lotion is applied to the skin prior to possible chemical situations, to prevent direct contact with the agent. It is applied like a lotion/cream, and replenished as needed. It is not intended for use on broken skin. It protects against nerve agent liquid.

VENTILATION

Although the use of pyridostigmine pretreatment will decrease the need for assisted ventilation in nerve agent casualties, the need will arise, on occasion, for assisted ventilation in some severe nerve agent casualties. Aggressive airway maintenance and the use of assisted ventilation will greatly increase the casualty's chances for survival.

Providing assisted ventilation in a potentially contaminated environment is possible using the **Resuscitation Device, Individual, Chemical (RDIC)** (see chapter on equipment). By using

this device, the Soldier can survive to reach the Level 1 care facility where mechanical ventilation can take over. Without this aggressive, far-forward resuscitation, the Soldier will not survive.

PRETREATMENT

The U.S. military has adopted the policy of pretreating Soldiers against the nerve agent's effect on AChE with pyridostigmine. Each Soldier in the combat theater of operations is issued one package of pyridostigmine tablets. Each blister pack contains 21 tablets, and each tablet contains 30 mg of pyridostigmine. The Soldier takes the pretreatment only on order from the unit commander. When ordered, one tablet is taken orally every eight hours. If a scheduled dose is missed, **it will not be made up**; the Soldier will take one tablet at the earliest opportunity to begin the next eight-hour interval. The Soldier will discontinue taking the tablets on order from the unit commander. The pretreatment is dispensed in a 14-day blister pack. Doctrine allows commanders to renew the order once, for a total of 28 days.

Pyridostigmine bromide shields the AChE enzyme from the full effects of GD. It prevents GD from permanently and irreversibly binding the enzyme, which it would otherwise do in two minutes. Pyridostigmine enhances the efficacy

of 2-PAM Cl in GD casualties. The pretreatment does not increase the effectiveness of treatment for GB, GF, or VX. These nerve agents also become irreversibly bound to AChE but require many hours to do so, and the binding does not affect therapy. **The effect of pyridostigmine bromide is to convert what would have been a lethal dose of GD into a dose that is survivable, but only if antidotes are promptly and correctly given.** Instead of a dead Soldier, we have a sick one who requires treatment.

Pretreatment is not an antidote.
Pretreatment alone will not protect the Soldier and does not reduce the effects from the nerve agent. When used in conjunction with the MARK I Kit, pyridostigmine enhances the effectiveness of the MARK I Kit against GD **only**. It is critical that the Soldier medic understand that the effect of the pretreatment will have no effect on the severity of nerve agent poisoning symptoms. Therefore, an aggressive approach to care with antidotes is still warranted.

The Food and Drug Administration (FDA) approved the use of pyridostigmine bromide as pretreatment against GD in early 2003. This use of pyridostigmine bromide is therefore not experimental, and commanders are legally permitted to order it.

Soldiers should be told that common side-effects of pyridostigmine bromide are increased bowel movements and abdominal cramping. In most cases these side effects decrease or go away completely after a few days. If these or other symptoms persist, Soldiers should see their combat medic or medical officers before going off the medication if command has ordered that it be taken.

MUSTARD

H, HD, L, HL

SUMMARY

Signs and Symptoms: asymptomatic latent period (hours). Erythema and blisters on the **skin**; irritation, conjunctivitis and corneal opacity and damage in the **eyes**; mild upper **respiratory** signs to marked **airway** damage; also gastrointestinal effects and bone marrow stem cell suppression. Fever is not typically associated with the agents.

Detection: M256A1; ICAM; M8 paper; M9 paper.

Decontamination: M291; water/soap in large amounts. M295 for equipment.

Management: Decontamination immediately after exposure is the only way to prevent damage. Symptomatic management of lesions.

VESICANTS

The blister agents are second only to nerve agents as a concern to the U.S. military. The primary threat blister agents are sulfur mustard (H/HD), Lewisite (L), and a mixture of mustard and Lewisite (HL).

Mustard is a concern because there are large stockpiles of it, it is easily manufactured, and because it is both incapacitating and lethal. Mustard was the largest cause of chemical casualties in World War I. It was also used extensively by Iraq in the war with Iran. Although there were many casualties from mustard in World War I, only about 3% of the casualties died as a result. This low death rate occurred despite the relatively poor protection and level of medical care available at that time (e.g., no antibiotics).

Mustard rapidly penetrates the skin, causing both localized cellular damage and systemic damage. The true deadly nature of the agent's effect is that the Soldier exposed to a large amount of liquid or vapor mustard faces total systemic assault. The reasons for this are (1) failure of the body's immune system, with sepsis and infection as the major contributing causes of death, and (2) pulmonary damage, which is also a major contributory factor in death.

PHYSICAL CHARACTERISTICS

The severity of blister agent effects will, in part, be affected by the environmental conditions at the time of exposure. Warm, humid conditions increase the severity of blister agent damage and shorten the time of symptom onset. Cold weather retards the time of symptom onset, and providing the exposed skin remains cold, lessens the severity of blister agent damage.

Mustard (H/HD) has a fairly high freezing point of 58°F agent, while the mixture HL, containing 37% HD to 63% Lewisite, has a freezing point of -3°F. The lower freezing point of the mixture will cause the agents to have a significant impact on combat operations in a cold northern environment, as well as in a warm desert environment.

Blister agents also have a relatively high vapor density when compared to air. Mustard has a vapor density 5.4 times greater than air, Lewisite a density 7.1 times greater, and HL is 6.5 times heavier than air. The more dense a vapor is, the more likely it is to flow to low spots such as valleys, closed spaces, or the floor.

The Soldier medic/combat lifesaver can use the current intelligence on threat chemical capabilities and the physical characteristics of

blister agents to determine likely exposure mechanisms (liquid and/or vapor) based on temperature. Utilizing all of these data elements, the combat lifesaver and combat medic can then be proactive to the predicted chemical threat; that is, take active steps to prevent or lessen the impact of chemical agent employment on individuals. This information, coupled with understanding the medical implications of an exposure, will allow the combat lifesaver/Soldier medic to “war game” scenarios and anticipate, ahead of time, the required, correct response needed to optimize casualty care.

When operating in cold northern climates or desert regions, particularly at night, care must be exercised to prevent getting contamination into warm-up tents, operations areas, or sleeping areas. An agent at its freezing temperature brought in on clothing or skin will liquefy as it warms and slowly produce vapors. Unless this situation is detected early, Soldiers will be exposed within these confined spaces. In the temperature ranges mentioned earlier, provisions must be made for monitoring personnel and their equipment in a warm-up tent before the individuals occupy work or rest areas. All personnel in the monitoring tent must wear protective masks during monitoring.

If the unit fails to conduct monitoring of personnel and equipment before entering sleep

or work areas, the potential exists for intoxication by multiple routes of exposure. Soldiers could absorb agent through the skin by handling equipment contaminated with a liquid agent, or vapors desorbing from equipment contaminated by liquid agent could affect the eyes and respiratory tract.

DETECTION

Mustard received its name because of its garlic, horseradish, or mustard odor and can be detected by smell, visual observation (oily), M8 and M9 Chemical Detection Papers, the M256A1 Chemical Detection Kit, and the IICAM.

The human nose can detect mustard (H/HD) in concentrations of 0.6 to 1.0 mg/m³. While this seems an undesirable way to detect blister agent, it must be understood that the U.S. military has no automatic vapor/liquid detection capability. Alert Soldiers will most likely smell the agent vapor before encountering the liquid.

After release, H/HD appears as a thick, colorless or pale yellow liquid, and HL appears as a dark oily liquid.

The M8 Chemical Detection Paper will turn **red** in the presence of liquid mustard. The detector ticket from the M256A1 will detect mustard vapor in concentrations of 2 mg/m³ to

12 mg/m³ within 10 minutes. The IICAM will detect mustard in concentrations of 0.03 mg/m³ to 30 mg/m³.

EFFECTS

H/HD. Clinical signs and symptoms from mustard exposure are not apparent until hours later (see Table); however, tissue damage occurs within two minutes. If decontamination is not done within the first two minutes after exposure, nothing can be done to prevent a mustard injury.

Clinical effects occur on the skin, in the eyes, and in the airways. In the event of severe exposure, effects occur days later in the bone marrow and gastrointestinal tract.

The effects on the skin are redness (erythema) that resembles sunburn, and later, blisters. The eyes initially are irritated and later may become swollen shut. The first effects in the airways are the upper airways, with a hacking cough, hoarseness, and throat and nasal irritation. If the exposure is severe, the agent later damages the lower airways.

The major effects and the times at which the first effects begin are shown in the table.

HL. The effect of HL liquid on the eyes and skin, or vapor in the eyes or respiratory tract, is immediate. HL causes intense pain and lid twitching in the eyes. Within an hour, edema of the conjunctivae and lids begins and rapidly results in eye closure.

The casualty feels stinging pain within seconds after contact with liquid HL. The pain causes the casualty to decontaminate rapidly. **Rapid decontamination is the only way to avoid severe burns.** After five minutes of contact with HL, the upper layer of skin (epithelium) will die and appear gray. Painful erythema will begin shortly afterwards, and painful blisters may appear within 12 hours.

The immediate irritation from HL vapor is so intense that an individual will immediately mask or exit the area. Respiratory casualties will be unable to do either. Pulmonary effects are similar to those caused by mustard alone, except that pulmonary edema (fluid in the lungs) is more likely after Lewisite.

SELF-AID AND BUDDY-AID

The actions needed for self-aid or buddy-aid are essentially non-medical in nature. Reacting as quickly as possible to warnings of an attack by donning the protective mask and going to MOPP IV, detecting the agent as early as

possible, and removing any suspect liquid (decontaminating) using the M291 Skin Decontaminating Kit (SDK) are the easiest ways to prevent a blister agent casualty. Reacting quickly to attack indicators will prevent most, if not all, casualty-causing exposures. Some indicators that an attack is in progress or you have come in contact with agent from a previously unknown attack are as follows:

- The out of place smell of mustard, garlic, or onion.
- Color change in M9 detector tape.
- Color change in M8 detector card.
- Overt indications such as enemy helicopters spraying liquid, indirect artillery fire that detonates with dull or muffled explosions.
- An oily feeling of “rain” as it impacts on exposed skin.
- Liquids that appear too thick or oily and appear out of place on equipment, plants, or terrain.

Self-aid or buddy-aid for exposure to blister agents includes decontamination of the eyes. When exposure is suspected, time is critical. Unless the individual was wearing a protective mask at the time of the suspected exposure, the assumption must be that the eyes were exposed. Following the task in STP 21-1-SMCT, Soldier’s Manual of Common Tasks, the individual must decontaminate the eyes and,

although this is not a buddy-aid task, having assistance will increase the effectiveness of the procedure. **Remember that time is critical for effective mustard decontamination as blister agents become “fixed” to tissue components within two minutes after deposition.** Using the M291 SDK as soon as possible to remove agent and flushing the eyes with water will do much to prevent or lessen the physical damage from blister agent exposure.

TABLE. Effects of Mustard Vapor

ORGAN	SEVERITY	EFFECTS	ONSET
Eye	Mild	Tearing Itchy Burning Gritty feeling	4-12 hours
	Moderate	Above, plus Reddening Swelling of lids Moderate pain	3-6 hours
	Severe	Marked swelling of lids Possible cornea damage Severe pain	1-2 hours
Airways	Mild	Runny nose Sneezing Nosebleed Hoarseness Hacking cough	12-24 hours
	Severe	Above, plus Severe productive cough Shortness of breath (mild to severe)	2-4 hours
Skin		Erythema (redness) Blisters	2-24 hours

COMBAT LIFESAVER/MEDIC ACTIONS

The initial medical treatment actions required by the combat lifesaver/Soldier medic at the time of exposure are little more than what the individual himself can do. Self-aid decontamination must be done at the time of exposure. Because of the long time delay until the onset of symptoms under combat conditions, the wounded, exposed individual will have been returned to duty or evacuated by the time symptoms appear.

CASUALTY DECONTAMINATION

The casualty should have performed skin and equipment decontamination with the M291 and the M295, respectively, before being seen by the combat lifesaver/Soldier medic. Because of the persistent nature of blister agents, the decontamination of the patient must be as thorough as possible. As with nerve agent exposure, you must protect yourself by masking and donning MOPP gear. When beginning treatment, attempt to determine what type of decontamination has been done and when. Understanding the potential contamination threat posed by the casualty will allow the combat lifesaver/Soldier medic to avoid cross contamination. Decontamination performed within two minutes reduces the toxic effects by greater than 50%.

FIELD TREATMENT

The actions required at the unit level for blister agent casualties are two-fold. First is triage for evacuation or return to duty, and second is the actual treatment of the casualty. Triage of the Soldier is based on several factors--the severity of observable effects, the opinion of the triaging combat lifesaver/Soldier medic as to whether or not the effects will progress further, and the impairment of normal duty requirements the symptoms cause in the individual.

Casualties with signs or symptoms that appear at the earliest onset time possible (see Table) generally require evacuation with little chance for quick return to duty from the Medical Treatment Facility (MTF) because the initial effects will progress. Faster onset of symptoms can indicate exposure to higher concentrations of agent with more severe lesions, for which the care available at a MTF is required.

Eyes. Individuals with mustard conjunctivitis will require application of a steroid antibiotic eye ointment. FM 8-285, Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries, recommends dexamethasone sodium phosphate-neomycin ophthalmic ointment for application. This drug decreases the inflammation and has antibacterial effects.

Systemic narcotic analgesics are recommended for eye pain. Under no circumstances should the eyes be bandaged as this will allow the eyelids to stick together, and the secretions will not have a means to drain. The resulting accumulation in the conjunctival sac can lead to infection and corneal ulcerations. Individuals presenting with blister agent conjunctivitis will require evacuation to a MTF for treatment by an ophthalmologist as soon as possible. Petroleum jelly or antibiotic ointments should be placed on the eyelashes to prevent abscess formation.

Skin. Individuals presenting with erythema (reddening of the skin), which limits motion in a limb will need to be evacuated. Erythema covering greater than 5% of the body in noncritical areas, using the Rule of 9s to determine the coverage, will require evacuation. Individuals with erythema involving less than 5% of the body may need evacuation, but this usually is determined by the location of the erythema and the duty impairment caused. The treatment for erythema is that needed for the itching and burning sensations that accompany it. Application of a topical steroidal cream or calamine lotion will provide temporary relief.

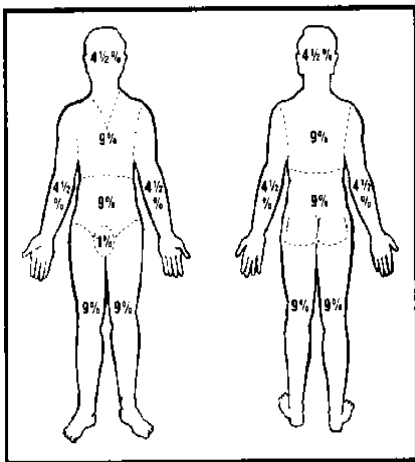
Normally erythema progresses to vesication (blister formation) with the size and number of blisters forming being dependent on the severity of exposure, skin condition (sweaty and moist or

dry) at the time of exposure, and location of the exposure on the individual. Blisters the size of a quarter or smaller should be left intact, if possible. The blister, which is filled with a sterile fluid, will act as a protective cover over the wound providing good protection from infection. These small, unbroken blisters should be covered with a petrolatum gauze bandage. The dressing should be changed every three to four days. The blister fluid does not contain live agent.

Large blisters should be unroofed, and blisters that have broken should have the ragged roof of the blister removed. The area of the open blister should be cleaned with tap water or saline and a petrolatum gauze bandage applied. The primary concern when treating blisters of any size is prevention of infection. The decision to evacuate or return to duty must not be made only on the basis of blister formation. Initial blister formation may be slight, but over time could progress to large blisters unmanageable in the field. If a casualty is not evacuated, the combat lifesaver or Soldier medic must instruct the individual on self-aid care for the blister. The individual should be given a topical antibacterial cream, such as 10% mafenide acetate or silver sulfadiazine burn cream, and instructed to apply a 1/8 inch layer to the blister four times a day. A petrolatum gauze bandage should then cover the area.

Lungs. The Soldier who presents with any sign or symptom of respiratory exposure should be evacuated promptly. The combat lifesaver/Soldier medic cannot determine damage to the larynx or trachea. Any unnecessary delay in diagnosis and required treatment at the MTF must be avoided. If the airway is obstructed by blisters, they may be unroofed.

FIGURE



Estimation of body surface area by the use of the Rule of 9s. (Copied from FM 8-230)

CYANIDE

AC, CK

SUMMARY

Signs and Symptoms: few. After exposure to high Ct, seizures, respiratory and cardiac arrest.

Detection: M256A1 Kit Detector Sampler; **NOT** the M8A1 alarm and IICAM.

Decontamination: Skin decontamination is usually not necessary because the agents evaporate rapidly. Wet, contaminated clothing should be removed and the underlying skin decontaminated with water or other standard decontaminants.

Management: **Antidote:** intravenous **Sodium Nitrite** and **Sodium Thiosulfate.** **Supportive:** oxygen; correct acidosis.

CYANIDE

(CYANOGENS; BLOOD AGENTS)

The two cyanogens of most concern in the category commonly known as blood agents are hydrogen cyanide (AC) and cyanogen chloride (CK). The basic physical action of these agents is to disrupt oxygen utilization at the cellular level.

PHYSICAL CHARACTERISTICS

These agents have a very high vapor pressure, which causes rapid evaporation of the liquid immediately after release. The rapid vaporization significantly reduces the likelihood of a liquid exposure. The AC or CK vapor initially on the ground will quickly expand outward and up. The high volatility will, within a very short time, cause the vapor to lose its lethal concentration near the point of delivery. Within a short period of time, it will pose little threat downwind from the release point. It is because of dissipation <24 hrs that these agents are called non-persistent.

DETECTION

The **only** detection available to the Soldier is the M256A1 Chemical Detection Kit Detector Sampler. The first indication of contact with the

agent AC might be the smell of bitter almonds, or in the case of agent CK, the sudden irritation of the nose and throat. Do not rely on smell to detect the agent since the majority of the population is not able to detect it, and the effective concentration is too low to be noted.

EFFECTS

Cyanide causes very few signs and symptoms in man. Death occurs within minutes after inhalation of a large amount. Inhalation of a lower concentration will produce a slower onset of effects. The major signs and symptoms are shown in the table below.

TABLE. Cyanide (AC and CK)
Effects from Vapor Exposure

Moderate, from low concentration

- Transient increase in rate and depth of breathing
- Dizziness
- Nausea, vomiting
- Headache
- Eye irritation

These may progress to severe effects if exposure continues. The time of onset of these

effects depends on the concentration, but is often within minutes after exposure.

Severe, from high concentration

- Transient increase in rate and depth of breathing--15 seconds
- Convulsions--30 seconds
- Cessation of respiration--2 to 4 minutes
- Cessation of heartbeat--4 to 8 minutes

In addition to the above, CK causes intense irritation of the eyes, nose, and airways. The effects may be similar to those of lung-damaging agents because of the chlorine.

SELF-AID AND BUDDY-AID

The only self-aid for AC and CK is to mask. The only buddy-aid for AC or CK exposure may involve helping a Soldier mask followed by removal from the contaminated site.

COMBAT LIFESAVER/MEDIC ACTIONS

The rapid onset of symptoms may preclude the combat lifesaver/Soldier medic from rendering aid. The symptoms shown in the table may occur within moments and lead rapidly to death.

Rapid evacuation to Level 1 medical care and administration of the cyanide treatment set will improve the casualty's chances for survival.

If the casualty can still talk and walk without difficulty after exposure and presents at the battalion aid station (BAS), chance of survival is good.

LUNG-DAMAGING AGENTS AND TOXIC INDUSTRIAL CHEMICALS

Ammonia, CG, Cl, HC Smoke, NOx

SUMMARY

Signs and Symptoms: sudden laryngospasm and collapse. **Central airway:** breathing difficulty, wheezing; sneezing, coughing, hoarseness when talking. **Peripheral airway:** breathing difficulty, chest tightness.

Detection: Odor of newly mown hay or freshly cut grass or green corn. There are no specific military field detection devices for these compounds; however, the ACADA can detect battlefield agent vapors when deployed as an area surveillance tool.

Decontamination: Vapor - fresh air; liquid - copious water irrigation.

Management: termination of exposure, ABCs of resuscitation, enforced rest and observation, oxygen with or without positive airway pressure for signs of respiratory distress, other supportive therapy as needed.

LUNG-DAMAGING AGENTS AND TOXIC INDUSTRIAL CHEMICALS

Over 1,800 toxic industrial chemicals (TICs) are used in industry, stored at industrial sites, and transported on the world's road and rail systems. Some of these chemicals were deployed as chemical warfare agents during the First World War, killing and injuring thousands, and can have the same deadly consequences today if released during an accident or through terrorist sabotage. Death from exposure to TICs is more frequent when they are inhaled. Inhaling a TIC in the form of a gas, vapor (gas coming from a liquid), or aerosol (liquid or solid particles suspended in a gas) can cause a sudden closure of the larynx (laryngospasm) causing the victim to become and collapse. TICs can also cause damage to the tissues of the upper airways, resulting in swelling, scarring, and airway narrowing, which can restrict breathing. TICs can damage lung tissues, allowing body plasma and other fluids to leak into the lung air sacs (alveoli), causing pulmonary edema and death from asphyxiation.

The military medic/combat lifesaver should know about TIC lung-damaging agents because Soldiers might become exposed to them. Knowing how to identify the signs and symptoms

and provide appropriate support the individual exposed to these agents will save lives.

Understanding the Respiratory System.

The respiratory system can be divided into two parts. Understanding these parts can greatly simplify the treatment problem solving process.

Central Airway. This includes the nasopharynx (nose), oropharynx (mouth), larynx (vocal cords), trachea and bronchi (airway from the throat into the lungs). Tissues in this area are very moist and thin and can be damaged by TICs.

Peripheral Airway. This includes the lung sacs (alveoli) distributed throughout the lung tissue. During normal respiration, inhaled gasses fill the alveoli and then move slowly through their walls. The gasses then move through the thin walls of the blood vessels (capillaries) surrounding the alveoli and into the blood. TICs can damage the walls of alveoli and the capillaries surrounding them; allowing blood plasma and cells to leak into the air space of the alveoli.

TICs are numerous. Those that pose a frequent threat to the Soldier in the field are listed here. Though the list is not complete, casualties from other lung-damaging agents are managed the same way as these examples. In

low doses, highly reactive TICs have a greater effect on the central airway; other TICs act on both airways; and still others that are not as reactive in the central airway, travel deeper in the respiratory tract and destroy the tissues of the alveoli in the peripheral airways. Any TIC inhaled in large doses will cause damage to both central and peripheral airways.

CENTRALLY ACTING TICs:

Ammonia: This highly caustic and reactive gas is used for industrial refrigeration, for cleaning, the processing of some illicit drugs, and for numerous legitimate industrial processes. It is a good example of a TIC that, in low doses, is primarily centrally acting. It rapidly forms a strong base (alkali) when it contacts the moist tissues of the central airway. The alkali burns and destroys the tissues it contacts. The victim may suddenly go in to laryngospasm and collapse. The tissues of the airway will also become swollen. Scar tissue may form along the airway. Frequently, damaged tissue in the airway will die, slough off, and obstruct it.

Sulfur Mustard (HD) is an example of a chemical agent produced solely for warfare that acts on the central airway if inhaled. HD will cause tissue to slough off in large sheets, known as pseudomembranes, which block the airway. The various degrees of airway restriction cause

casualties with central airway restriction/obstruction to be unable to breathe, or to sneeze and cough, have hoarseness when they talk, and make wheezing noises when they breathe.

PERIPHERALLY ACTING TICs:

Phosgene. Today phosgene is a major industrial chemical used in many manufacturing processes. More importantly, it is released from heating or burning many common chemicals or solvents. Carbon tetrachloride, perchloroethylene (a degreasing compound), methylene chloride (used in paint removal), and many other compounds break down to phosgene with flame or heat. Also, common substances, such as foam plastics, release phosgene when they burn. A Soldier presenting with shortness of breath in the absence of a chemical attack or other obvious cause should be questioned very carefully about whether he has been near any burning substances or chemical vapors that were near flame or other hot materials (e.g., a heater with open coils).

Perfluoroisobutylene (PFIB). PFIB is given off when Teflon® burns at high temperatures, such as in a vehicle fire. Teflon® is used to line the interior of many military vehicles, particularly armored vehicles and aircraft. Closed-space fires in these vehicles

release PFIB. Survivors of vehicle fires who are short of breath should be questioned carefully regarding their exposure to the smoke.

Oxides of Nitrogen. Oxides of nitrogen, or NO_x, are components of photochemical smog that can be produced by the burning of gunpowder or the burning of industrial waste. These substances can build up to high concentrations where artillery is fired and there is inadequate ventilation. Soldiers who become short of breath after heavy firing should be suspected of exposure to this lung-damaging agent.

HC Smoke. HC smoke is a mixture of equal amounts of hexachloroethane, zinc oxide, and approximately 7% grained aluminum or aluminum powder used in the military for obscuration. The zinc oxide can cause lung damage if inhaled in toxic amounts. Appropriate precautions, such as the wear of protective masks, must be taken when HC smoke is used.

TICs THAT ACT BOTH CENTRALLY AND PERIPHERALLY:

Chlorine: This is a good example of a combination agent, one that acts on both airway compartments in low doses. It is widely used in industry for the manufacture of plastics, lubricants, and to purify water. It was the first chemical agent used effectively on the First

World War battlefield against unprotected military troops. Its effectiveness as a weapon was greatly reduced once protective masks were widely available for wear on the battlefield. Chlorine turns to hydrochloric acid when it contacts the moisture of the airway; it then causes chemical burns to the tissue. It produces signs and symptoms seen with exposure to both central and peripherally acting agents. Its action is a reminder that even though central damage may seem like the primary concern in some patients (e.g., they are coughing and wheezing), the medic must always treat the casualty as if they could develop peripheral symptoms and take seriously any patient complaints about feeling chest tightness or having breathing difficulty.

PROTECTION

The military mask, if fitted with a C2A1 filter canister, will protect against chlorine, phosgene, PFIB, NO_x, and HC smoke in the open battlefield. Specific filters, or the use of a self-contained breathing apparatus with its own air supply, are mandated for other TICs, such as ammonia. Masks will not be effective in environments where the TIC displaces oxygen, such as occurs with carbon dioxide.

DETECTION

Chlorine and ammonia have their own distinctive odors. Phosgene smells like newly cut grass, newly mown hay, or green corn. It is important to remember that odor is not a reliable detection method, and this does not protect against toxic inhalation effects. There are no specific field detection devices for these compounds; however, the ACADA can detect battlefield agent vapors when deployed as an area surveillance tool.

PHYSICAL PROPERTIES

Lung-damaging TICs are typically heavier than air and hang close to the ground when released. They tend to evaporate and disperse very quickly depending on temperature and wind conditions. If the TIC is in liquid form at room temperature, then it will tend to give off a vapor. Vapors can become trapped in clothing fibers and “off-gas” to affect those who are nearby and have no respiratory protection. Although skin decontamination after vapor exposure is not a high priority, clothing should be removed and the underlying skin decontaminated with soap and water.

MECHANISM OF ACTION

Central Airway. Centrally-acting TICs, such as ammonia and HD, will form strong acids or bases (alkali) with the water in the tissues of the central airway and then destroy these tissues. Damaged tissues will swell and can slough into the airway, restricting breathing.

Peripheral Airway. Phosgene is the most studied peripheral agent. It causes pulmonary edema, which is life threatening. Less is known about the other compounds; however, it is believed that they are very similar.

Phosgene causes effects in the lung by inhalation only. It does not cause lung effects when absorbed through the skin, injected, or orally ingested.

When inhaled, phosgene travels to the very end of the smallest airways, the bronchioles, and causes damage to these airways. Additionally, it causes damage to the thin membrane that separates the smallest blood vessels (the capillaries) and the air sacs (the alveoli). Phosgene reacts with the proteins and enzymes in these alveolar-capillary membranes to cause damage to the membranes. These membranes usually function to separate the blood in the capillaries from the air in the alveoli, but when the membranes are damaged, they

cannot do this. Blood, or at least the liquid part of the blood, the plasma, can leak through the damaged membrane into the alveoli. When the plasma leaks into the alveoli, the air sacs become full of fluid, and air cannot enter them. Therefore, exchange of oxygen from the air into the blood is hindered, and the casualty suffers oxygen deprivation. The extent of the lack of oxygen depends on the extent of the phosgene exposure and the number of alveoli filled with plasma. This is similar to what happens with drowning, in that the alveoli fill up with fluid. However, in this instance, it is fluid from the blood, not from an external source. For this reason, phosgene poisoning is sometimes referred to as “dry land drowning.”

CLINICAL EFFECTS

Centrally-acting agents. Immediately or shortly after exposure to these gases or vapors, the individual can develop laryngospasm, though this is not true in all exposures. As the airways are irritated and damaged, the individual will sneeze and have pain in the nose (nasopharynx inflammation); can develop painful swallowing (oropharynx inflammation); hoarseness, a feeling of choking and noise with exhalation (larynx inflammation); pain in the chest, coughing, and wheezing during breathing (trachea and bronchi inflammation). This can progress to peripheral effects if the exposure is

great enough where the TIC has reached the peripheral airway. Scarring of the central airway can create permanent airway narrowing depending on the agent involved and the dose received.

Peripherally-acting agents. Very shortly after exposure to phosgene or other agents affecting the peripheral airway, the casualty may typically have an asymptomatic period of 30 minutes to 72 hours, but most significant exposures have a latent period less than 24 hours. The duration and concentration of the exposure will determine the time to symptom onset. The casualty may notice irritation of the eyes, nose, and throat, but more commonly, there may be no effects during or immediately after exposure. The **major effects** from phosgene exposure (and the other compounds), like the effects from mustard, **do not occur until hours later.**

The casualty will notice shortness of breath between 2 and 24 hours after exposure. Initially, this may be mild, and the eventual severity of the shortness of breath (dyspnea) will depend on the amount of exposure. As the damage progresses, the dyspnea will become more severe, and soon a cough will develop. If the damage is severe, the casualty will start coughing up clear, foamy sputum, the plasma from his blood that has leaked into his alveoli.

A casualty with a very mild exposure to phosgene (or another of these compounds) will develop dyspnea 6 to 24 hours after exposure. He will notice it first after heavy exertion; however, later he will become short of breath after any activity. With proper care, he will do well and recover completely.

A casualty with a severe exposure to phosgene (or another of these compounds) will notice shortness of breath within **four to six hours** after exposure. Increased difficulty to breathe, even at rest, will occur, and despite intensive pulmonary care, the casualty may not survive.

The average casualty from a lung-damaging agent will be in between these two extreme cases. When the onset of dyspnea is greater than six hours after exposure, there may be progression to dyspnea at rest. However, with good pulmonary care beginning early after the onset of effects, the casualty should recover completely.

FIELD CARE

The medic/combat lifesaver should be alert to the possibility that patients can be exposed to lung-damaging agents even when battlefield agents are not being used. Exposure to

hazardous, lung- damaging TICs is a likely possibility from industrial sabotage, from exposure to the smokes from burning vehicles, and during common military operations.

A casualty who complains of shortness of breath should be questioned extensively about exposure to smoke from burning Teflon®, gunpowder, or industrial chemicals.

The most important things to do for such a casualty are to ensure he/she is free from contamination (he/she is out of the smoke or wearing a mask) and is **kept completely at rest** (preferably placed on a litter so they do not walk). Even a little exertion can greatly intensify the effects of these agents and speed the progress of pulmonary edema. A casualty who is short of breath requires assisted ventilation with oxygen, or oxygen alone.

Those suspected of exposure to lung-damaging TIC should be observed for 24 to 36 hours, even if they are not immediately having difficulty breathing. Those with a complaint of chest tightness should be rested immediately. A dyspneic casualty **must be evacuated as quickly as possible** to a medical facility that can provide intensive pulmonary care, as the patient's condition can rapidly deteriorate once the lungs begin to fill with fluid. Survival is less likely for a casualty who becomes dyspneic

within the first four hours after exposure, as pulmonary edema is already rapidly occurring. The casualty will certainly not survive without proper pulmonary care. A casualty who first experiences breathing difficulty more than four hours after exposure has a good chance of survival if appropriate medical care is provided.

RIOT CONTROL AGENTS

CN, CS, CR, OC, and DM

SUMMARY

Signs and Symptoms: CN, CS, CR, and OC: tingling and pain on exposed skin and mucous membranes, burning in the nostrils and tearing of the eyes. With severe exposure: laryngospasm. **CN, CS, CR:** with severe exposure: respiratory discomfort and skin burning, blistering. **DM:** delayed skin irritation, vomiting, and malaise.

Detection: no detector.

Decontamination: CN, CS, CR, and DM: eyes: thoroughly flush with water, saline, or similar substance. Skin: flush with copious amounts of water, soap is beneficial. Generally, decontamination is not needed if the wind is brisk. **OC:** Pain may increase if water used for decontamination of OC. This is best decontaminated using baby shampoo, milk, or vegetable oil.

Management: Usually none is needed; effects are self-limiting.

RIOT CONTROL AGENTS

These agents irritate the skin, mucous membranes, and airways, causing the individual to be unable to perform their normal duties due to discomfort. Riot control agents have been called irritants or tearing agents.

The riot control agents frequently used today are CS, CR, CN, and OC because of their high safety ratio (the lethal dose far exceeds the dose needed to cause irritating effects). OC is very popular for police use on individuals and small crowds and CS for dispersal of large crowds. The military uses CS for mask confidence training. Exposure to riot control agents has occurred during the excavation of buried containers of the agent on military reservations and when individuals entered areas where large amounts of the agent were previously released and the residue remained.

**Table: Riot Control Agent
Characteristics**

Agent	Other Names	Physical Properties at Standard Temp	Dispense Method/Color/Odor
CN	Mace®	Aerosolized crystalline solid	Liquid spray (with solvent), explosive dispersal or in a smoke generating mixture that produces a white smoke cloud. Odor like apple blossoms.
CS	Corson and Stoughton	Aerosolized crystalline solid Flammable	Liquid spray (with solvent), explosive dispersal or in a smoke generating mixture that produces a white smoke cloud. Pungent pepper odor.
CR		White or yellow solid	Typically as aerosolized powder from grenades or put in solution.

			White cloud and powder produced. Pepper like odor.
DM	Adamsite	Yellow-green crystalline solid	Explosive dispersal or as a particulate smoke from a heat generating device that produces a canary yellow cloud which becomes colorless as it dissipates. No odor but irritating to airways.
OC	Pepper spray	Sticky resin that is suspended in a solvent	Has replaced CN in most police forces. Liquid or foam spray. Colorless resin suspended in solvent. Odorless unless combined with a scent (e.g., citrus).

PHYSICAL CHARACTERISTICS

As a group, the riot control agents CN, CS, CR, and DM are solid crystalline powders that can be suspended in a liquid and aerosolized. Oleoresin capsicum (OC), from cayenne peppers, is not a solid, but a resin that can be mixed in a liquid solution.

DETECTION

There are no detectors for these agents.

EFFECTS

The agents CN, CS, and CR immediately irritate tissues and produce temporary discomfort causing pain in the eyes, copious tearing, the eyelids to spasm shut, sneezing and a heavy nasal discharge. Airway irritation causes coughing and shortness of breath. Exposure to significant amounts of CN, CS, and CR can cause skin redness and skin blistering. DM is unique in that its effects are delayed for several minutes and exposure will cause skin discomfort, vomiting and mental malaise and depression. OC is also unique in its mechanism of action. In large concentrations, as in the riot control agent OC, capsaicin causes the mass release of the neurotransmitter substance P. This causes an overwhelming sensation of pain until the body's store of substance P is depleted.

SELF-AID AND BUDDY AID

The first action to take for those exposed to CN, CS, CR, and DM is to remove the individual from the aerosolized cloud. A wet cloth over the nose and mouth can help reduce the number of aerosolized particles inhaled. If a protective mask is available then it should be donned. Special protective clothing is not essential. Street clothing that covers the arms and legs will help to protect the skin from contact with the agent. If a person's exposure occurs in a well-ventilated area, then severe skin and lung irritation is unlikely. High dose exposure, for example when an individual is in the agent cloud for prolonged periods in a confined space, can cause skin blistering, upper airway difficulties, and laryngospasm if protective garments and respirators are not worn. In large doses, DM will cause vomiting and mental depression, which can last for several hours after exposure. OC is dispensed as a liquid or foam spray containing resins that stick to the skin. Dabbing the agent with a cloth may help to reduce the amount of OC resin on the skin. The pain from OC will recede over time without decontamination.

COMBAT LIFESAVER/MEDIC ACTIONS

The medical treatment actions provided by the combat lifesaver/medic are little more than

what can be provided through self-aid. Normally the eyes will become bloodshot and red. If particles of a crystallized agent get into the eye, the eye should be irrigated with copious amounts of clean water and treated with antibiotic eye ointments. Pieces of exploding canister have been known to damage the eye. Impaction cases should be treated according to eye injury protocols and follow-up consultation provided by an ophthalmologist. Open blisters on the skin can be irrigated with sterile saline and covered with antibiotic ointment. Inhalers and supplemental oxygen should be administered to those with breathing difficulties, such as asthmatic conditions, which may become exacerbated. Irritated skin can be washed with a mild baking soda solution to normalize skin pH. Washing the eyes with baby shampoo and rinsing with copious amounts of water can help reduce the eye pain from exposure to OC and other riot control agents.

CASUALTY DECONTAMINATION

No decontamination is required with most exposures to CN, CS, CR, and DM. Individuals can move briskly in a well-ventilated area with eyes and mouth closed, while flapping their arms and rubbing their hair, to remove the dry agent from clothing and hair. With heavy exposure individuals can decontaminate themselves with soap and water. Water may

reactivate OC in the skin and cause pain. If water is used, it must be in a continuous and plentiful flow. For OC decontamination, it is best to wash with baby shampoo, milk, or vegetable oil to help break up the resin and help neutralize the action of OC.

INCAPACITATING AGENTS

BZ, Fentanil Derivatives

SUMMARY

Signs and Symptoms: **BZ:** dilated pupils; dry mouth; dry skin that is red and warm to touch; short attention span; impaired memory; distorted perception – sees objects as being distorted or larger in size or quantity. **Fentanil/Carfentanil:** sleepy, unconscious, vomiting, decreased breathing.

Detection: no detector.

Decontamination: **BZ:** it can be in a powder form, decontaminate with soap and water; **Fentanil/ Carfentanil:** not needed.

Management: **BZ:** Antidote: physostigmine. **Fentanil:** Naloxone/naltrexone. **Both:** supportive care: monitoring of vital signs. With Fentanil, maintaining the airway is critical until effects wear off.

INCAPACITATING AGENTS

These chemical agents are designed to act on the nervous system to affect an individual's mental alertness so they cannot perform their work activities. Several nations, including the U.S., developed these weapons, but in the 1970s the U.S. destroyed their stockpiles of these agents. Two incapacitating agents recently employed were the anticholinergic BZ (in the same drug family as atropine), allegedly used by the Serbians in 1980; and a Fentanil derivative, a narcotic opioid, possibly carfentanil (an approved veterinary sedative), suspended in a gas, which was used by the Russians to subdue Chechen terrorists during the 2003 Moscow theater hostage incident.

PHYSICAL CHARACTERISTICS

BZ is a crystalline solid at standard temperature and pressure. Its high melting point makes it ideal for dispersal in explosive munitions. Suspended in solvents, it can contaminate food or be absorbed through the skin. Fentanil derivatives can be aerosolized and suspended in a gas, such as halothane, an inhaled anesthetic.

DETECTION

There are no detectors for these agents.

EFFECTS

BZ interferes with the cholinergic synapses in the CNS causing disruptions of memory, problem solving, attention and comprehension. Signs of anticholinergic poisoning progress as follows: increased body temperature (hot as a hare); no sweating causing the skin to be dry to the touch (dry as a bone) and red (red as a beet); slurred speech, stumbling gait, slowness of movement and thinking, delirium (mad as a hatter). Patient delusions are characteristically based on real objects: for instance they may see someone's hand as holding a hamburger and bite the person's hand; they may shoot at clouds thinking they are flocks of ducks; or hide, thinking small animals or shadows are large, wild animals. Movement will be clumsy, and thinking slowed. Symptoms are seen several hours after exposure and progress in intensity for several days until the toxin is eliminated in the urine from the body and recovery begins.

Fentanil derivatives, such as carfentanil, are opioids that are 8,000 times more powerful than morphine. They rapidly cause a state of euphoria followed, within seconds to minutes, by sleep and unconsciousness, depending on the

dose. In high doses they can cause vomiting, which can obstruct the airway and interfere with brain function needed to regulate breathing.

SELF-AID AND BUDDY AID

Those exposed to BZ have difficulty performing their duties and following instructions. Weapons and other harmful items must be removed from these individuals. In a chemical environment patients will need others to help them mask in the event of a follow-on chemical attack. Protective ensemble must be worn by those assisting the contaminated patient until decontamination is accomplished. The ability to sweat is diminished, making the patient susceptible to heat stress. Patients should be moved to the shade and cooled with water or damp cloths. Evacuation to the rear should be considered as early as the situation permits.

Fentanil derivatives cause drowsiness and sleep. Casualties must be moved from the contaminated area as soon as possible. Patients must be positioned to maintain an open airway, for example on their side, with frequent checks to ensure that vomit does not obstruct the airway.

COMBAT LIFESAVER/MEDIC ACTIONS

BZ casualties may act on their delusions so they must be kept safe from harming themselves or others. Behavioral symptoms will worsen over the course of a day or more, so patients should be evacuated to a medical facility as soon as feasible. Heat stress is also a real concern. If available, the antidote physostigmine can be given by injection (45 mcg/kg in adults / 20 mcg/kg in children) or orally, mixed with flavored drink, if the patient is cooperative. IV administration should be avoided as overdose symptoms, similar to nerve agent, can result if not closely monitored. The antidote must be re-administered every hour and titrated to behavior. The antidote is primarily given to manage behavior during transport.

Fentanil derivatives will cause death if the respiratory system is compromised. Properly positioning the patient on their side is critical to ensure that the tongue and vomit does not obstruct the airway. Supplemental oxygen is always appropriate. Intubation is indicated if respirations are depressed. The opioid antagonist naloxone or naltrexone (given routinely for heroin overdose) is an effective antidote, which rapidly reduces the symptoms

CASUALTY DECONTAMINATION

BZ casualties must be decontaminated, as dry particles of the agent can still remain on outer clothing, on the skin, or in the hair. Removal of the outer clothing, accompanied by a water, or soap and water, wash is the best solution. Decontamination with water also helps to cool the patient. Those providing decontamination must wear protective masks and protective clothing.

Fentanil derivatives do not require decontamination as they quickly evaporate. Emergency responders do not require respiratory protection if the area has adequate ventilation.

BIOLOGICAL AGENTS

The course of human history has been greatly affected by naturally occurring diseases. AIDS, influenza, malaria, cholera, tuberculosis, plague, and smallpox have killed hundreds of millions of people and profoundly disrupted or destroyed cultures, societies, and civilizations. From ancient times, man has tried to harness the destructive potential of biological agents. With the modern advent of the Germ Theory of Disease and worldwide industrialization, our ability to unleash the destructive potential of biological agents on a large scale has grown considerably.

Today, in the Global War on Terrorism (GWOT), the threat of biological attacks continues. Technological advances in chemistry, microbiology, and particularly genetic engineering are making it easier for potential terrorists to develop or acquire novel biological agents or highly infectious “superbugs” that are resistant to antibiotics and vaccines. Due to their relatively low cost and high lethality, biological weapons have been referred to as the “Poor Man's A-Bomb.”

To minimize these threats and conserve the fighting strength, military health care providers must be knowledgeable about biological weapons, the medical management of

biological casualties, and ensure appropriate countermeasures are taken.

CHARACTERISTICS OF BIOLOGICAL AGENTS

Biological weapons are developed from living organisms and viruses capable of causing disease and death in humans, animals, or plants. Weapons associated with high mortality are referred to as lethal agents, and those that usually produce severe illness, but not death, are referred to as incapacitating agents.

Categories of agents. The three general categories of bio-agents are: biological toxins, biological modulators, and pathogens.

Biological toxins or biotoxins are poisons derived from plants, animals, and microorganisms. Like the chemical agents, their onset of action is usually quite rapid. Examples include the staphylococcal enterotoxin B, botulinum, and ricin toxins.

Bio-modulators or bio-regulators are proteins or peptides produced in small quantities in the human body to help regulate the nervous and endocrine systems. They affect many bodily functions including pain sensation, blood pressure, respiration, emotions, memory, and sleep. For example, endogenous opioids are

bio-modulators produced in our bodies in small quantities to help us cope with pain. Large exogenous doses, however, can profoundly depress respiration and lead to death. Further discussion of this category of agents is beyond the scope of this handbook.

Pathogens are microorganisms that cause disease, such as viruses, bacteria, rickettsia, and fungi. They are the classical agents of biological warfare and the focus of this chapter.

These organisms differ from the other biological and chemical warfare agents in that they can infect and replicate within a susceptible host, have an incubation period of days to weeks before clinical signs and symptoms manifest, and may go on to infect subsequent hosts long after the initial exposure.

Portals of Entry. Biological warfare (BW) agents can gain access into susceptible hosts through three portals of entry, depending on how they are weaponized.

The respiratory tract is susceptible to aerosols. *Example: pneumonic plague.*

The digestive tract is susceptible to infection from intentionally contaminated food and water. *Example: cholera.*

The skin is susceptible when direct contact with pathogens occurs in non-intact areas damaged by cuts, punctures, or abrasions.

Example: cutaneous anthrax.

Psychological Manifestations. Bio-agents can also have a profound effect on the human mind. Expect numerous indirect casualties from psychogenic illnesses when there is an actual or perceived BW threat.

Educating and counseling troops about the threat, instituting appropriate countermeasures, and employing stress control teams early on can significantly reduce combat stress reactions and lessen demand for medical services.

RECOGNITION OF A BIOLOGICAL WEAPONS ATTACK

Biological warfare uses unconventional weapons, and most methods of dissemination will be covert and difficult to identify early on. Outdoors, aerosols are most likely to be sprayed during the hours of limited visibility between dusk to dawn. This is when UV exposure that can kill the organisms is minimal, and temperature inversions help to keep aerosols near ground level with less dispersion. Indoors, bio-aerosols elude the senses by being essentially odorless, tasteless, and invisible.

Food and water contaminated just prior to consumption would be very difficult to detect.

Aerosols can be disseminated by jets, missiles, crop dusters, agricultural sprayers, and modified chemical warfare munitions, such as artillery shells, bomblets, or mines. More covert techniques may involve the use of hand pumped sprayers, aerosol spray cans, modified fire extinguishers, small aerosol generators with timers, and sprayers placed on automobiles or boats to look like exhaust emissions.

Appearance of Weaponized Agents.

Unlike many chemical agents, liquid bio-agents are non-oily and will typically be translucent and slightly more viscous than milk. Unless dyed, bacterial agents in the form of a liquid or powder will likely have a light brown or amber appearance. Only sophisticated production and purification methods will produce a white bacterial powder. Dried and liquid viral agents can be of several colors depending on their growth medium; they may be off-white, yellow, brown, or pinkish-red.

DETECTION

Limited real-time aerosol detection is technically possible in the field with the Biological Integrated Detection System (BIDS) that a small number of units may have access

to. Rapid identification of BW agents is also possible if samples can be examined from suspicious ordinance, spraying devices, residues or powders.

For efficient environmental detection, teamwork is necessary.

Nuclear/biological/chemical (NBC) reconnaissance teams collect aerosol samples. Preventive medicine personnel collect suspect contaminated water samples. Veterinary personnel collect suspect food samples and animal specimens. Medical personnel collect patient specimens. Supporting labs evaluate samples for evidence of pathogenic organisms or biotoxins.

Laboratory Evaluation for a BW Attack.

Quick tests can be performed in the field to help rule in or out the possibility of a biological exposure. Samples can be tested with litmus paper or a pH meter. If the pH is near neutrality (7.0), viable organisms could be present. The greater the acidity or alkalinity, the less likely it is that any human pathogens will be found. Qualitative Ninhydrin tests may show the presence of amino acids. If pH and protein tests are consistent with biological agents, *samples may be sent to a lab for further testing. If the sample is unlikely to be a biological agent, it should be evaluated as a potential chemical agent.*

Clothing and equipment are unlikely to reveal significant contamination from an aerosol, but if suspicious powders or liquids are found, place samples of the contaminated materiel in double zip-locked plastic bags for further testing.

Soon after a C/B attack, consider taking baseline serum samples of all personnel who may have been exposed. Serial serum samples may show changes over time, which helps with the identification of biological and chemical agent exposure. The results may be useful later to epidemiologists evaluating post-deployment syndromes, and assist casualties applying for service related disability claims.

Draw 20-ml of blood into a tiger top tube and centrifuge for 10 minutes. If these are unavailable, use red top tubes. If clinically indicated, throat swabs, aerobic and anaerobic cultures, sputum, urine, tissue, feces, scrapings, and other specimens should be submitted to a higher lab where they may undergo various confirmatory tests such as ELISA, PCR, toxin assays, microscopic examination, etc. Even if they appear to have no current clinical value, they may be useful later in important epidemiological investigations.

The human respiratory system acts like a suction and filtration system for air, making the

nares, cheeks, and hairy portions of the face of people exposed to an aerosol good locations to find the organisms. Taking early post-exposure samples with synthetic swabs made out of rayon is preferable, but field expedient sampling with Q-tips® will also work.

All samples should be sent as soon as the tactical situation permits and given thorough documentation to include person, place, time, and circumstances of possible exposure.

Medical Intelligence. Intelligence sources may indicate that a BW attack has occurred, prompting a unit to initiate education, vaccination, chemoprophylaxis, treatments, use of protective equipment, or other countermeasures to mitigate risk.

Epidemiology. In the absence of direct evidence of a BW attack or solid medical intelligence indicating that an attack has occurred, recognition of BW agents must be based on investigations of outbreaks to find a common source of exposure.

The first indication that a BW attack has occurred may be the appearance of a large number of personnel at sick-call presenting with similar signs and symptoms. Soldiers with increased susceptibility, or who were exposed to higher doses of the pathogens, become ill first

and act as “sentinel canaries.” If medics maintain a high index of suspicion, they may be able to diagnose the exposure early on, and quickly institute BW treatment and countermeasures that can save many lives.

Many animals can act as “sentinel canaries” for human pathogens and provide clues of a BW attack. Consult with veterinary personnel if signs of suspicious animal deaths and illness occur.

Epidemiologic clues of a possible BW attack:

- Tight cluster of casualties
- High infection rate
- Unusual geography
- Apparent aerosol route of infection
- Infection with more than one BW agent
- Unusual clinical presentation
- Unusual munitions
- Animal epizootics
- Sentinel dead animals of multiple species
- Lower attack rates among the protected

Syndromic Surveillance. Surveillance is the cornerstone of epidemiology. Medics contribute by accurately documenting patient care and DNBI data, and assisting with pre- and post-deployment health assessments.

Many BW agents will present with non-specific flu-like signs and symptoms, but some presentations will narrow the differential diagnosis:

Non-specific – Tularemia, brucellosis, Q-fever, viral equine encephalitis (VEE)

Pneumonia – Tularemia, plague, staphylococcal enterotoxin B (SEB)

Neuromuscular – Botulism, VEE

Bleeding – Ricin, plague, viral hemorrhagic fevers (VHF)

Dermatologic – Smallpox, plague, VHF, T-2 mycotoxin

RESPONDING TO A BIOLOGICAL AGENT ATTACK

Immediate action to a suspected BW aerosol is the same as for a chemical agent exposure. An enemy may deploy chemicals in conjunction with biological agents or use multiple BW agents simultaneously.

MOPP gear provides excellent protection against all biological agent aerosols. Since the primary routes of entry will be through the mouth and nose, masking by itself may be sufficient to prevent illness. Effective field expedient respiratory filters can be improvised by breathing

through two or more layers of the BDU T-shirt or several layers of tissue paper.

DECONTAMINATION

Primary BW aerosols of the ideal size can behave as gases that are readily inhaled into the lungs. Fortunately, these aerosolized pathogens are very unlikely to adhere to people, clothing, or equipment. This reduces the need for extensive decontamination.

Larger particles are much less infectious via the inhalation route and quickly fall to the earth where they are likely to adhere to various surfaces and significantly reduce the risk of re-aerosolization or secondary contamination.

Whether in the air or on the ground, BW agents undergo biological decay from environmental variables such as UV radiation, temperature, and humidity. Air currents promote dilution, reducing their effectiveness. With the exception of anthrax spores and the rickettsia that cause Q-fever, most BW agents will pose little threat of infection after approximately 24 hours of environmental exposure outdoors. Therefore, most biological agents are considered non-persistent.

With chemical and biological agent exposure, decon casualties quickly and as close

to the areas where they were contaminated as possible. Patients must be decontaminated prior to entering a clean treatment area at an MTF or undergoing medical evacuation.

Soap and water is sufficient for patient decontamination of most biological agents. A 0.5% Cl solution can also be used. Disinfect wounds with betadine or iodine if available. Sterilize materiel as indicated with full strength bleach, steam, boiling water, or dry heat. Place washed clothing outdoors for one week if possible to be dried and decontaminated by the sun and wind.

Field expedient mass decontamination of BW casualties can be done in uncontaminated lakes and streams, large stationary or small portable swimming pools, and water buffaloes with hyperchlorinated water. Consider mass showering in fixed facilities, with fire and water trucks, or garden hoses. When possible, use hot water if outdoor temperatures are cold.

TRIAGE AND EVACUATION

Triage of BW agent casualties may differ significantly from that of chemical agent casualties. With chemical agents, expect a large number of casualties presenting at about the same time. With biological agents, the variable incubation period of pathogens and the

delayed onset of action of many biotoxins mean that casualties will present over a period of hours to weeks. Therefore, most BW casualties will be triaged as “Delayed” or “Minimal.”

Continue to monitor casualties and change their triage category accordingly. Provide reassurance and psychological first aid while the patient is awaiting further treatment and evacuation to a higher level of medical care.

The evacuation category will depend on the patient's current status and prognosis. When calling in a 9-line medevac request during wartime, use brevity code “B” in line 9 for biological contamination.

Evacuation platforms with good front to rear ventilation significantly lower the risk of contamination to the vehicle and its occupants.

Inhalational Anthrax (*Bacillus anthracis*)

Anthrax is an acute bacterial infection of the skin, lungs, or gastrointestinal tract. Primary threat is from an aerosol causing the inhalational form of anthrax.

Characteristics. Lethal agent. Aerobic, spore forming, rod-shaped, gram + bacteria. Case Fatality Rate (CFR) if untreated: 5% (cutaneous), 30% (GI), and 90% (inhalational).

Incubation periods are typically 1 to 6 days, with an average of 48 hours. Spores can survive in the environment and remain viable for years.

Pathogenesis. Aerosolized agent enters body through the lungs and is engulfed by macrophages in which spores germinate, reproduce, and release toxins that cause cellular necrosis, edema, and hemorrhage in the lungs and mediastinal lymph nodes. Frequently spreads to the meninges. Death results from sepsis, hemorrhagic shock, or respiratory failure.

Symptoms. Malaise, fatigue, myalgia, headache, dyspnea, shortness of breathe, chest pain.

Signs. Fever, cough, tachypnea, hypotension, meningitis, stridor, diaphoresis, cyanosis. Pathognomic widened mediastinum on CXR secondary to hilar adenopathy and hemorrhagic mediastinitis.

Differential Diagnosis. Pneumonia, pneumonic plague, Tularemia, gram negative sepsis, SEB inhalation.

Chemoprophylaxis. Oral ciprofloxacin or doxycycline for known or imminent exposure.

Chemotherapy. Ciprofloxacin 400 mg IV q12, or doxycycline 200 mg IV loading dose

followed by 100 mg IV q12. Multi-drug regimens may be more effective than single antibiotic therapy. Use oral ciprofloxacin, doxycycline, amoxicillin, or penicillin as tolerated if IV meds are not available in the field.

Precautions. Standard precautions only. No person-to-person transmission.

Prevention. Biothrax anthrax vaccine absorbed. Six shot series given over an 18-month period, followed by yearly boosters. After a known exposure, start series in unimmunized personnel, and give booster shots to personnel who are not current in the series.

Cholera (*Vibrio cholerae*)

Cholera is an acute bacterial infection of the gastrointestinal tract. Primary BW threat is from sabotage of food and water supplies.

Characteristics. Incapacitating agent. Gram negative, crescent shaped, motile rod. Incubation period of 4 hours to 5 days, with an average of 2 to 3 days. Diarrheal illness usually lasts 3 to 5 days. Most illnesses are subclinical and the CFR is only 1% if treated appropriately. Untreated, severe diarrhea can cause death within hours and the CFR can be as high as 50%.

Pathogenesis. Agent enters the GI tract after consumption of contaminated food and water. Organisms adhere to the intestinal mucosa and secrete an enterotoxin, which elicits a secretory diarrhea that can lead to severe dehydration, electrolyte imbalances, hypovolemic shock, and death.

Symptoms. Painless diarrhea, abdominal discomfort, nausea, LH, malaise, thirst, weakness.

Signs. Profuse rice-water stools, emesis, increased or decreased BS, non-tender abdomen, fever, hypotension, dehydration, hypovolemic shock.

DDx. Shigella, E. coli, salmonella, ICAMpylobacter, norovirus.

Chemoprophylaxis. Reserve antibiotics for symptomatic personnel.

Chemotherapy. Aggressive rehydration with: Oral rehydration solution (ORS) or IV Ringers Lactate. Doxycycline 100 mg PO BID for 3 days. Alternates: TMP-SMX, tetracycline, ciprofloxacin.

Precautions. Enteric precautions, person-to-person transmission unlikely.

Prevention. Secure approved food and water sources from sabotage. Enforce proper field sanitation and hygiene. Cholera vaccines have limited efficacy, and none are currently sold in the U.S.

Plague (*Yersinia pestis*)

Plague is a bacterial disease known in the middle ages as the Black Death, and has killed hundreds of millions. Primary threat is from an aerosol causing primary pneumonic plague. Secondary threat is from the release of infected fleas causing bubonic plague, which can spread through the lymphatics and blood stream to cause septicemic plague.

Characteristics. Lethal agent. Bipolar “safety pin” appearance on microscopy. Incubation period 1 to 8 days, with an average of 2 to 4 days. If untreated, the CFR for bubonic plague is 60%, CFR for pneumonic plague >95%.

Pathogenesis. Aerosolized agent enters body through the lungs where virulence antigens can cause a necrotizing pneumonia. Organisms traveling through the bloodstream can lead to sepsis, spread to the liver, spleen and CNS and cause further damage. Death results from respiratory failure, circulatory collapse, or internal bleeding.

Flea bites lead to inflamed, hemorrhagic, and exquisitely painful lymph nodes called “buboes.” Organisms travel from the lymphatics to the blood stream leading to systemic disease.

Symptoms. Fever, chills, malaise chest pain, swollen and painful lymph nodes called buboes, headache, meningitis.

Signs. High fever, buboes, severe pneumonia, cough, hemoptysis, cyanosis, convulsions, shock, hemorrhagic skin changes and blackening of skin at extremities, DIC, septic shock. Chest x-ray is variable but will likely show patchy or consolidated bilateral infiltrates.

Differential Diagnosis. Pneumonia, ARDS, meningitis.

Chemoprophylaxis. Doxycycline 100 mg PO BID for 7days. Alternates: ciprofloxacin, tetracycline (TCN).

Chemotherapy. IV/IM streptomycin. Alternates: 200mg IV doxycycline once, then 100 IV BID for 14 days, gentamicin, ciprofloxacin. If IV/IM medications are not available in the field, use PO meds.

Precautions. Standard precautions for bubonic plague, respiratory droplet precautions for suspected pneumonic plague. Quarantine.

Prevention. No FDA vaccine is currently licensed in the U.S.

Q-Fever (*Coxiella burnetti*)

Q-fever is an acute and occasionally chronic rickettsial disease that presents as a non-specific febrile illness or atypical pneumonia. The threat is from an aerosol or contamination of food.

Characteristics. Incapacitating agents are highly infectious and environmentally persistent rickettsial organism, with an incubation period of 7 to 41 days, average 2 to 3 weeks. Acute form is a self-limited febrile illness 2 to 14 days in duration.

Pathogenesis. Agent enters the body through the lungs or GI tract, replicates within phagolysosomes, and spreads throughout the body eliciting systemic illness and numerous non-specific signs and symptoms in the host.

Symptoms. Severe headache, chills, myalgia, and fatigue. Less common symptoms are nausea, vomiting, diarrhea, abdominal and chest pain.

Signs. High fever, dry cough, sweats, and myalgia. PE of chest is usually normal, but inspiratory rales may be present, and consolidation may be seen on chest x-ray.

Differential Diagnosis. Atypical pneumonias, bacterial and viral pneumonias.

Chemoprophylaxis. Doxycycline 100mg PO BID for 5 days. Alternate: TCN.

Chemotherapy: Try to start antibiotic therapy 8 to 12 days post-exposure. Doxycycline 100 mg PO BID for 14 to 21 days. Alternates: TCN, ciprofloxacin, TMP-SMX.

Precautions. Standard precautions. Rare person-to-person transmission, but secondary aerosols from fomites, such as blankets, can spread the disease.

Prevention. Secure approved food and water sources from sabotage. Enforce proper field sanitation and hygiene. No FDA approved vaccines currently available in U.S.

Smallpox (*Variola major*)

Smallpox is a systemic viral illness that killed millions before it was eradicated from nature by

1980. Primary threat is by an aerosol release of smallpox acquired from laboratory specimens.

Characteristics. Lethal agent, highly contagious virus with a 30% CFR. Incubation period 7 to 19 days, with an average of 12 days. Duration of illness-4 weeks.

Pathogenesis. Aerosolized agent enters body through the lungs. Replication within cells can lead to an overwhelming viremia, high levels of circulating immune complexes, with illness and death attributed to toxemia.

Symptoms. Malaise, rigors, headache, backache.

Signs. Macular-papular rash that progresses to characteristic vesicular pustules, which become scabs and scars, high fever, vomiting, prostration, delirium.

Differential Diagnosis. Chickenpox, monkeypox, allergic contact dermatitis, erythema multiforme with bullae.

Chemoprophylaxis. None.

Chemotherapy. No effective medications, supportive treatment only.

Precautions. Respiratory precautions, strict quarantine of patients and close contacts.

Prevention. Wyeth Dryvax vaccine is very effective when given prior to exposure. If given after an exposure, but prior to onset of symptoms, can prevent or significantly reduce the severity of disease.

Tularemia (*Francisella tularensis*)

Tularemia is bacterial disease with multiple manifestations depending on the portal of entry. The pneumonic and typhoidal forms could occur after an aerosol exposure and have a CFR of 30-60% if untreated.

Characteristics. Lethal agent. Highly infectious, gram negative coccobacillus. Incubation period 1 to 21 days, with an average of 3 to 6 days.

Pathogenesis. Agent can enter and infect the body through all three portals of entry causing local lymphadenopathy, ulcerations, and a fulminating sepsis which can lead to death.

Symptoms. Fever, chills, malaise, myalgia, fatigue, respiratory distress.

Signs. Fever, tachycardia, tachypnea, non-productive cough, mucous membrane lesions,

hypotension, prostration, sepsis. Chest x-ray may show effusions, lobar consolidation, cavitation, or hilar adenopathy.

Differential Diagnosis. Pneumonia, gram negative sepsis, mononucleosis, rickettsial diseases, malaria, ARDS.

Chemoprophylaxis. Ciprofloxacin 500 mg PO BID for 14day. Alternate: Doxycycline, TCN.

Chemotherapy. Ciprofloxacin 400 mg IV q12 x 10d. Alternate: IV/IM Doxycycline, TCN, streptomycin, gentamicin. Oral ciprofloxacin or doxycycline if the IV/IM form is not available in the field.

Precautions. No person-to-person transmission.

Prevention. No FDA approved vaccine is available in the U.S.

Viral Hemorrhagic Fevers (VHF)

A variety of viruses that cause fever and bleeding of varying severity. Examples include: Ebola, Marburg, Hanta, dengue, yellow fever, Lassa fever, Rift Valley fever, Crimean-Congo hemorrhagic fever, Argentinean, Bolivian, Venezuelan, and Korean hemorrhagic fevers. Threat exists that these viruses may be

weaponized for aerosol dispersal, or that large numbers of infected biting insects are released.

Characteristics. Lethal and incapacitating agents. Incubation period can be days to months. CFR <10% (HFRS) up to 90% (Ebola).

Definitive diagnosis is often only possible with sophisticated lab tests not readily available in the field.

Pathogenesis. Poorly understood and varies among the viruses.

Symptoms. Fever, myalgia, malaise, fatigue, and prostration.

Signs. Fever, conjunctival injection, petechiae, hypotension. Severe illness may have shock, multiple organ system failure, disseminated intravascular coagulation (DIC), and death.

Differential Diagnosis. Viral syndrome.

Chemoprophylaxis. Ribavirin 500 mg PO qid for 7 days, if available, may be somewhat useful for post-exposure prophylaxis to some VHF agents.

Chemotherapy. IV ribavirin, if available, may have some efficacy.

Precautions. Contact isolation and possibly quarantine. Droplet precautions should include use of a mask and eyewear or face shields. Thorough disinfection.

Prevention. The only FDA licensed VHF vaccine is for yellow fever.

TOXINS

Botulinum Toxin, Ricin, SEB, etc.

SUMMARY

Signs and Symptoms: These depend upon the specific toxins. Botulinum toxins cause descending weakness and paralysis (including respiratory-muscle paralysis) along with dry mouth and dilated pupils. Ricin and SEB cause different presentations depending upon the route of exposure.

Detection: No field detectors commonly available. Detection of exposure is mainly by a high index of suspicion and by clinical recognition of signs and symptoms.

Decontamination: Clothing removal and skin cleansing using water (with or without soap) is generally sufficient.

Management: For almost all toxins, treatment is supportive only. This includes the potential necessity of ventilatory support for weeks following exposure to botulinum toxins, although a botulinum toxoid is effective if given before signs and symptoms appear. Active immunization with botulinum toxoid is available only as a pre-exposure measure for those at demonstrated high risk.

TOXINS

Although *toxin* is sometimes used as a general synonym for *poison*, it is more strictly defined as a poisonous chemical produced by a living organism. Unlike biological organisms, toxins do not replicate inside hosts or cause infection (rather, they produce “intoxication,” or poisoning); and victims of toxins are not “contagious.”

CLASSIFICATION AND MECHANISMS OF ACTION

There are hundreds of toxins, but most have not been developed for use as mass-casualty weapons. Toxins can be grouped according to source as bacterial, algal, fungal, plant, marine dinoflagellate, marine soft coral, arthropod, molluscan, and vertebrate toxins. Additionally, they can be divided by mechanism of action into *neurotoxins* (toxins that affect neurotransmission by affecting the release of neurotransmitters from the ends of neurons), *cell-damaging toxins*, and *superantigen toxins* (which nonspecifically activate the immune system).

DETECTION

Advanced laboratory instruments that can detect toxins in the environment or in biological

samples are not generally available in the field environment. Detection of toxin exposures will rest primarily upon a high index of suspicion and clinical recognition of signs and symptoms.

PHYSICAL PROPERTIES AND PROTECTION

Toxins can be dissolved in various other substances or spread as aerosols and may not be visible or irritating; exposure can occur without the knowledge of the victim. Aerosolized toxin would be inhaled or could settle on the skin, although only a few toxins are dermally active. Toxin could also be ingested or injected. Protection against inhalation and skin contact is provided by the chemical/biological protective mask and by any clothing that covers the skin.

DECONTAMINATION

Removal and laundering of clothing and skin cleansing using water (with or without soap) is all that is usually necessary. Because toxins are poisons rather than living organisms, disinfection and sterilization are not applicable.

Specific Toxins

Botulinum toxins. Botulinum toxins, a group of seven related neurotoxins produced by

the bacterium *Clostridium botulinum*, are the most potent poisons known and cause botulism after ingestion or by toxin production in wounds. Victims exhibit descending skeletal-muscle weakness (beginning with blurred vision, inability to open the eyelids fully, and difficulty swallowing) within 12 to 36 hours after inhalation of aerosol, or up to several days after ingestion. The pupils dilate and the mouth is dry. Eventually, respiratory paralysis leads to death, unless ventilatory support can be established and maintained for several weeks. Intravenous and intramuscular administration of botulinum antitoxin is effective during the latent period but rapidly becomes ineffective after signs and symptoms begin to appear. A toxoid is available to vaccinate laboratory workers at known risk of exposure.

Ricin: Ricin, a cell-damaging toxin extracted from the castor bean plant (*Ricin communis*), has been used in covert assassination attempts by injection. It binds to ribosomes and impairs protein synthesis. Ingestion produces mainly gastrointestinal effects, inhalation causes damage to both the central and peripheral compartments of the respiratory tract (leading to airway necrosis and pulmonary edema), and injection generally spares the respiratory tract but leads to widespread organ necrosis and disseminated intravascular coagulation. No antitoxin (for

passive immunization after exposure) or toxoid (to produce active immunization prior to exposure) is available in humans, so treatment is supportive only.

Staphylococcal enterotoxin B (SEB).

SEB is a superantigen toxin that is seldom lethal but causes incapacitating (although self-limited), abrupt-onset abdominal pain, vomiting, and diarrhea after ingestion. Difficulty breathing, nonproductive coughing, fever, chills, and headache appear beginning 3 to 12 hours after inhalation of aerosolized toxin. Treatment is supportive.

T-2 toxin. T-2 toxin is one of the trichothecene mycotoxins (mycotoxins are toxins produced by fungi) and was alleged to have been used as “yellow rain” in Laos and ICAMBodia in the 1970s. Within 10 to 30 minutes after inhalation or ingestion, it can cause bloody vomiting and diarrhea, chest pain, and dizziness. Skin blisters can appear after skin contact. Death can follow weeks later from bone-marrow suppression, liver failure, or internal bleeding. Treatment is supportive.

Aflatoxins. Aflatoxins, once stockpiled by Iraq, are fungal toxins that are acutely toxic as well as being immunosuppressive, mutagenic, and carcinogenic. Acute effects include

abdominal distress, pulmonary edema, and convulsions. Treatment is supportive.

Abrin. Abrin is a cell-damaging toxin found in jequirity beans. It is similar to ricin but in mice is 75 times more toxic. Treatment is supportive.

Epsilon toxin from *Clostridium perfringens*: Epsilon toxin from the bacterium *Clostridium perfringens* was investigated by Iraq as a potential mass-casualty weapon. It is a cell-damaging toxin that, when ingested, increases the permeability of the small intestine and leads to increased absorption and damage to blood vessels especially in the kidney, liver, and brain. Inhalation would presumably damage pulmonary blood vessels as well. It is also dermally active and can cause skin lesions. Treatment is supportive.

Domoic acid. Domoic acid is an excitatory neurotoxin responsible for amnesic shellfish poisoning (ASP). Seizures may be part of the clinical picture. Treatment is supportive.

Epibatidine, anatoxin-a, and anatoxin-a(s). Epibatidine (produced in the skin of poisonous frogs) and anatoxin-a (from cyanobacterial, or blue-green algae) produce the nicotinic effects of nerve agents; anatoxin-a(s), another cyanobacterial toxin, produces both the nicotinic and the muscarinic effects of nerve

agents. Treatment is identical to that for nerve agents.

Saxitoxins. Saxitoxins (STX) are cyanobacterial (blue-green algal) toxins that cause paralytic shellfish poisoning, or PSP. It has been considered for coating bullets and can cause death within 10 seconds via paralysis. Treatment is supportive.

Tetrodotoxin. Tetrodotoxin (TTX) is a marine neurotoxin found in certain saltwater fish (such as puffer fish), crabs, starfish, blue-ringed octopi, newts, and salamanders. It could be inhaled or ingested and causes death via paralysis. Treatment is supportive.

Palytoxin. Palytoxin is a cyanobacterial (blue-green algal) toxin concentrated in corals. It is nearly as potent as botulinum toxins and causes cardiotoxicity and vascular collapse. Intracardiac injection of vasodilators may be the only recourse.

FIELD MANAGEMENT OF CASUALTIES ON THE CONTAMINATED BATTLEFIELD

The single most important concern for the combat lifesaver/medic during operations on the contaminated battlefield is the timely and proper management of casualties. Providing timely and proper management must begin with preparations long before deployment. The required preparations can be divided into several elements.

- Training individual unit members to correctly identify chemical agent exposure based on signs or symptoms and to correctly perform self-aid or buddy-aid and decontamination
 - Training the combat lifesaver and medic to correctly identify chemical agents based on observed signs or symptoms experienced by the casualty.
 - Complete understanding of the severity of exposure based on signs and symptoms.
 - Correct identification of route(s) of entry of the agent and method of exposure (from liquid and/or vapor) based on signs and symptoms.
 - Triage chemical casualties or mixed conventionally wounded and chemically contaminated for mass casualty situations.

- Correct treatment of casualty in response to symptom(s), proper use of antidotes, and other supportive care that may be required during or after initial treatment (i.e., assisted ventilation or airway suction).
- Complete understanding of the various casualty types that can be encountered on the contaminated battlefield.
- Complete understanding of ambulatory and litter casualty decontamination operations at the MTF.
- Identification of personnel limitations and equipment shortfalls in support of casualty decontamination and treatment.
- Understanding the impact of contaminated and/or decontaminated casualties on evacuation operations.

Once deployment is complete, the combat lifesaver/medic must be aware of additional elements that also impact NBC contaminated casualty management operations. These battlefield elements, at a minimum, are as follows:

- Current enemy chemical capabilities, enemy chemical employment capabilities (i.e., artillery, rockets, or spray), and anticipated enemy chemical employment.
- Tactical intelligence gathered after the verified enemy use of chemical agents.

- Current protective posture of the unit and how vigorously it is maintained.
- Current status of unit and individual chemical defense readiness.
- Morale and confidence of individual unit members, both in the unit and each other.
- Complete understanding of current and near-term combat operations.

All of these elements, when considered together, allow the combat lifesaver/medic to take a proactive readiness posture for casualty management operations on the contaminated battlefield. The following sections will expand on these elements.

TRAINING

Medical personnel and non-medical augmentees who are involved in the patient decontamination effort must be trained or show proficiency in the following:

NOTE: The list below is suggested as a guide for a training program to support casualty decontamination operations. The list has obvious tasks that are medical only and should only be taught to medical personnel. However, some tasks are applicable to all and should be taught to all.

- Drink from a canteen while wearing the protective mask.
- Recognize signs or symptoms of heat injury.
- Identify liquid chemical agents using M8 Chemical Detector Paper.
- Detect chemical agents using M9 Chemical Agent Detector Tape.
- Evaluate a casualty.
- Prepare decontamination solutions for patient decontamination operations.
- Recognize signs and symptoms of chemical exposure.
- Administer nerve agent antidote to self (self-aid).
- Administer nerve agent antidote and CANA to buddy (buddy-aid).
- Transport litter casualties using both two-man and four-man litter carries.
- Conduct casualty litter exchange using log-roll method.
- Remove litter casualty's contaminated clothing.
- Perform litter casualty's skin decontamination.
- Operate Chemical Agent Monitor (ICAM).
- Wound or injury management during litter and ambulatory patient decontamination.
- Remove ambulatory casualty's contaminated clothing.

- Monitor patient for residual contamination after completion of decontamination process.
- Prepare the M22 ACADA for operation.
- Place the M22 ACADA in operation to monitor the clean treatment area and the MTF.
- Operate the M256A1 Chemical Agent Detector Kit.
- Conduct unmasking procedures using the M256A1 Chemical Agent Detector Kit.
- Decontaminate open wounds.
- Describe and perform emergency medical treatment required to stabilize a casualty for decon.
- Identify triage requirements based on signs or symptoms.
- Transcribe patient field medical card at the Hot Line and shuffle pit.
- Chemically protected shelter (CPS) exit/entrance procedures.
- MOPP gear exchange.

EXPOSURE HISTORY

An important informational link between the Soldier and the MTF will be the history surrounding the exposure, the Soldier's activities since the exposure, and the progression of symptoms. The following questions may be helpful:

At Time of Exposure:

- Did M9 Chemical Detector Paper react?
- Was agent verified in liquid or vapor or a combination of both?
- How was the agent identified and verified?
- What actions occurred and when did they occur in relation to the time of detection? (i.e., skin decon, flushing eyes, etc.)
- What level of MOPP was the casualty wearing at the time of exposure?
- If not at any MOPP level, did the casualty don the IPE over his exposed battle uniform?
- What was the exposure time in the environment?

After Onset of Symptoms:

- Were MARK I Kits/ATNAA and/or diazepam used, and if so, when in relation to the onset of symptoms?
- Has the Soldier been taking the Nerve Agent Pretreatment Pill (NAPP)? When did he take the last one and how many?
- How long since the last onset of symptoms?
- What symptoms has the casualty experienced?
- What activities has the individual engaged in since the initial exposure?

- What was the casualty doing when the symptoms began?
- What level of MOPP was the casualty in when symptoms began?

Knowing the Soldier's protective posture at the time of exposure, the time taken to react to the exposure, and the actions taken by the Soldier in response to the exposure will assist the triage effort and subsequent treatment effort at the MTF. Obtaining as complete a history as possible, coupled with unit chemical survey data, will enhance the triage and treatment effort for the casualty at the MTF. Providing too much information on the field medical card is far better than not providing enough.

The combat lifesaver/medic must also be aware of the various factors influencing production of the casualty types. These factors are as follows:

- The protective posture of the unit at the time they encountered the chemical agent.
 - Was the encounter a result of movement through the chemical contamination or a result of direct attack on the unit?
 - Was movement through the chemical contamination deliberate or unintentional?
 - Was the unit in contact with enemy forces at the time of the encounter?

- Did the unit encounter chemical agents in vapor form only, liquid form, or a combination of both?
- Has the unit's chemical survey team verified the agent?

Understanding the circumstances that produce the casualty will help the combat lifesaver/medic in the casualty's triage, treatment, and evacuation.

CASUALTY EVALUATION

The combat lifesaver/medic will encounter seven general categories of casualties on the contaminated battlefield. They are listed below.

- Exposed and contaminated
- Exposed and not contaminated
- Conventionally wounded, exposed, and contaminated
- Conventionally wounded, exposed, and not contaminated
- Conventionally wounded, not exposed, and contaminated
- Conventionally wounded, not exposed, and not contaminated
- Psychological

This list may seem obvious at first, but it is presented for a reason. The proper management of casualties must begin with an

in-depth understanding of the various types of casualties and the specific treatment needs of each.

When the combat lifesaver/medic is confronted with one or more casualties on the contaminated battlefield, a deliberate decision-making process must begin. Taking deliberate steps to evaluate the casualty, regardless of condition, will allow him to be triaged into the correct category. This, in turn, will optimize the casualty's care and his chance of eventual return to duty.

At times, the medic will need to decide which course of action to follow. The deciding factor will always be to treat the condition that poses the most immediate threat to life and limb. The most critical step of the decision-making process is triage.

TRIAGE ON THE CONTAMINATED BATTLEFIELD

Triage is defined as the classification of patients according to type and seriousness of injury in order to provide the most orderly, timely, and efficient use of medical resources while providing maximal casualty care. Triage is necessary during a mass casualty situation or when the casualty load overwhelms medical resources. Under this circumstance, it is

necessary to sort and prioritize patients for care. When the number of casualties does not overwhelm medical resources, triage is not necessary.

During a mass casualty situation, the goal is to provide the best care for the most casualties. Ideally, care would be provided first to those who are in immediate danger of dying because of their wounds. However, this can be done only if resources to provide this care are available **and** if the care will not require an undue amount of time that might be spent caring for other casualties.

Chemical casualties may also have conventional wounds, and standard guidelines for the initial survey of a casualty must also be followed. These guidelines should be discussed with the medical officer in your unit and modified accordingly. Guidelines for surveying a chemical casualty prior to triage are provided below.

Surveying the Casualty

- Look for any field medical card that was initiated.
- Look for empty antidote autoinjector(s) attached to overgarment.
- Question the casualty's buddy regarding the following:

- Type of agent and how it was identified.
- Initial signs/symptoms.
- Conventional wounds noted in casualty by buddy and buddy-assisted first aid rendered.
- Prior treatment for suspected chemical exposure and/or conventional wounds.
- Use of nerve agent pretreatment drug (pyridostigmine).
 - Observe the casualty's protective clothing and equipment for signs of liquid chemical contamination.
 - Survey casualty for conventional injuries.
 - Survey casualty for continued signs/symptoms of chemical agent poisoning.
 - Determine whether or not the casualty can respond to a command.
 - Ask the casualty to describe signs and symptoms.
 - Observe whether or not the casualty responds in an orderly fashion when following simple directions. Suspect shock or CNS involvement if he cannot.
 - Observe the casualty for the following symptoms:
 - "Sweating" through the overgarment or through exposed skin; this could indicate a skin exposure to liquid nerve agent under the "sweat."
 - Labored breathing
 - Coughing
 - Vomiting

- Check pulse by placing fingers on carotid. Feeling through the hood might do this. If no aerosolized agent is still in the air, the triage officer, wearing the tactile chemical protective gloves, might reach under the hood and feel for the pulse on bare skin. The tactile gloves and the skin on the neck must be decontaminated before feeling for the carotid pulse.

- Check for pupil reactivity by covering both eye lenses with gloved hands, then uncovering and observing for pupil reaction.

Triage the patient.

Triage categories are **delayed, immediate, minimal, and expectant (DIME).**

- **DELAYED**

A **delayed** casualty is one who needs further medical care but can wait for that care without risk of compromising his successful recovery. He may require extensive surgical procedures and long-term hospitalization, but he is presently stable and requires no immediate care. A casualty with a leg wound or fracture is an example of a conventional casualty who would be delayed. A casualty recovering from severe nerve agent poisoning will be delayed. Most casualties with vesicant burns will be delayed.

- **IMMEDIATE**

A casualty classified as **immediate** has an injury that will be fatal if he does not receive immediate care. In a non-mass casualty situation, he would be the first casualty to receive care. However, in a mass casualty situation, particularly in a far-forward medical treatment facility, he may not receive this care. The required care may not be available at that level (e.g., a casualty may need major chest surgery, and that cannot be done at a BAS) or the time needed to provide that care might be so prolonged that other casualties would suffer. Examples of immediate casualties are provided below.

- Casualties who are not displaying signs and symptoms of chemical agent exposure but have a life-threatening conventional injury (i.e., gross external bleeding, sucking chest wound, flail chest, airway obstruction, tension pneumothorax, maxillofacial wounds in which asphyxia exists or is likely to occur, or severe head or spinal cord injuries where an expectant outcome is likely).

- Severe nerve agent casualties with or without conventional wounds. This would include those who have labored breathing or just stopped breathing but still have adequate circulation (a good blood pressure) and those who are convulsing or have convulsed.

-- Casualties from cyanide poisoning who are gasping or just stopped breathing, but still have adequate circulation.

-- Casualties in respiratory distress from phosgene, a phosgene-like substance, or a vesicant. The care required for these casualties exceeds that at the lower echelon medical treatment facilities. They should be triaged as immediate only if they can be quickly evacuated to a pulmonary treatment facility for intensive care.

- **MINIMAL**

A casualty who would be classified as **minimal** is one who (1) can be treated by a medic and does not need to see a physician or PA, (2) will not be evacuated, and (3) will return to duty within a day or so. Such casualties might be as follows:

-- Casualties with moderate to mild nerve agent poisoning who have taken the antidote, are recovering, and are not in distress.

-- Casualties who have minor conventional wounds.

-- Blister agent casualties with a small amount of erythema or a few small blisters in noncritical areas.

- **EXPECTANT**

The **expectant** casualty is one for whom medical care cannot be provided at the medical treatment facility and cannot be evacuated for more advanced care in time to save his life. This category is used only during mass casualty situations. This category does not mean that these casualties will not receive medical care.

- Transfer casualties for treatment/evacuation based on established priorities for treatment.

- Casualties who have been classified as “IMMEDIATE” are transferred to the contaminated medical treatment area for stabilization. After stabilization, these casualties are taken to the litter patient decontamination area.

- Casualties who have been categorized as “DELAYED” may or may not require treatment in the collective protection treatment area before evacuation. If they need to enter this clean area for treatment, they are sent to the ambulatory or litter decontamination line, whichever is appropriate. If they do not need treatment in this area, they are sent directly to the evacuation holding area.

- Casualties who have been categorized as “MINIMAL” may receive treatment in the collective protection treatment shelter or the contaminated emergency treatment area. If they

can be treated in the contaminated emergency treatment area and they have no break in their chemical protective overgarment (CPO), they will return to duty from this area. If they require treatment in the clean treatment area, they will be sent to one of the decontamination areas before entry into the clean treatment area.

Casualties who have been categorized as “EXPECTANT” will be transferred to designated contaminated holding areas. These casualties will be constantly monitored while in this area and provided with available comfort measures. They may require treatment not readily available at the lowest level of care.

AMBULATORY AND LITTER PATIENT DECONTAMINATION

(FM 4-02.7, Health Service Support in an NBC Environment)

Patient decontamination is a labor-intensive undertaking and will require augmentation personnel, additional or specialized equipment, and training for all personnel involved. Proactive planning will go far to minimize the impact on your unit and ensure the overall medical mission is not impaired. With a little ingenuity, training, and aggressive execution, an effective patient decontamination procedure can be established.

There are three levels of patient decontamination.

Immediate decontamination: Primarily performed to protect the individual. Here the contaminated person removes contamination from their individual protective ensemble (IPE), equipment, and the skin as quickly as possible after exposure. Another individual (buddy) provides immediate decontamination for a person who is unable to do it for him/herself.

Patient operational decontamination:
Performed to protect operators of transport

vehicles. Unit members remove as much contamination as possible from the casualty's IPE, equipment, and skin, without removing the IPE. This is done to prepare the individual for transport on designated "dirty" evacuation assets to the next level of medical care.

Patient thorough decontamination:

Operators of the patient decontamination station (PDS) perform this to protect medical facility staff and equipment and to reduce patient contamination. It involves removal of contaminated IPE and a thorough decontamination of any contaminated skin prior to a patient entering a medical treatment facility (MTF).

NOTE: It may be possible that the patient triaged as minimal or delayed never goes through patient thorough decontamination at the battalion aid station (BAS) or other far forward MTF. Instead, they may be treated in the "dirty" treatment area and returned to their unit. Other patients with more severe conditions, once stabilized, may have their IPE decontaminated but not removed. They are then "dirty" evacuated to the next level of care without going inside the BAS. At the larger MTF, they will undergo patient thorough decontamination before admission inside that MTF.

KEY ELEMENTS

When planning for patient decontamination operations, the following key elements must be considered:

- The mission of the unit
- Wind direction
- Security of decon site
- Access control to decontamination site
- Knowing the number of casualties to be treated
- Equipment sets/supplies
- Personnel requirements
- Work/rest considerations
- Establishing a patient decontamination station
- Litter casualty decontamination procedures
- Ambulatory casualty decontamination procedures
- Disestablishing a patient decontamination station
- Dirty evacuation assets

Wind Direction

Wind direction and speed are critical factors in planning because of the vapor hazard that will be present downwind from the **Patient Decontamination Station (PDS)**. When

planning for patient decontamination, the assumption must be made that, after decontamination operations begin, chemical agents in vapor and liquid form will be present in the patient decontamination site (i.e., open dirty dump, patient arrival and triage area, etc.). Consideration must be given to the effect that wind-driven chemical agent vapors have on other unit operations or on other co-located units. A valid concern of other unit commanders and your commander will be the uncontrolled effect vapors have. This one factor may cause you to plan for decontamination outside the unit area.

Knowing the anticipated wind direction and wind speed, plus the estimated duration for the direction and speed, will allow for a swift response to incoming chemical casualties. The wind information you will need can be obtained from the chemical officer or NBC NCO who get this data from the Chemical Downwind Message (CDM). This data can also be obtained from the S2/G2. The decontamination site will therefore initially be set up to take advantage of the prevailing wind, with the clean area operations always being upwind. In the event the predicted wind data shows a radical wind shift is predicted during decontamination operations, your set-up should be adaptable to allow for quick rearrangement.

Keeping track of the existing wind direction during the decontamination operation is the responsibility of the site Noncommissioned Officer in Charge (NCOIC). One of the best means of doing this is to attach short strips of the yellow marking ribbon to mounting stakes from the M274 Contamination Sign Kit or white engineering tape to tent poles, tent ropes, etc. One of these wind direction devices must be visible from the Hot Line when looking in any direction.

Moving the PDS must be considered if the wind shifts more than 30° from the prevailing wind direction. Wind shifts often are transient, so it is advisable to wait 10 to 15 minutes to see if the wind goes back to its original direction. Coordination for the disruption of patient flow and diversion during this waiting period should be considered in the preplanning phase.

Often wind speed will be less than 5 MPH for long periods. During these calm atmospheric conditions, chemical agent vapors will drift in almost any direction. This lack of wind direction will also require the planner to consider moving the decontamination site well outside the base cluster or support areas so that it will not adversely affect other units or the on-going conventional medical mission of the MTF.

Security of Decontamination Site

The same security considerations apply when choosing a decontamination site as with any other medical operation. A decontamination site has the same potential attack risks as the MTF. The Officer-in-Charge (OIC)/NCOIC can evaluate the risk by asking the following questions:

- What is the commander's estimate of possible enemy contact?
- What is the S2's intelligence on enemy weapons and tactics?
- What available terrain or structures can enhance the defense of the decontamination site?
- Can the site be defended?
- Is the site overly accessible, e.g., is it sitting on a hill or directly adjacent to a busy road where access is not controlled; can the site be visually acquired from a distance?
- Can the site be quickly evacuated if necessary?
- Can key locations be sandbagged for added protection?
- Will the site be located in an area under light discipline?
- Will the decontamination operation be functional in complete darkness?

- Are communication means available for medical or operational emergencies?
 - Can protection for the PDS arise from the primary supported unit and be augmented as needed?
 - Will “dirty” evacuation assets be available, ambulance or rotor wing aircraft, to take some patients for decontamination at the next level of care?
-

Access Control to Site

An **entry control point (ECP)** must be established to control movement of all facilities into the MTF or the PDS. (FM 4-02.7, Health Service Support in a Nuclear, Biological, and Chemical Environment). Engineering controls, such as concertina wire or other sturdy fencing material should be used when available to restrict travel across the Hot Line to the clean area, except through guarded entry control points. The ECP should be located at a distance far enough from the MTF to minimize any vapor hazard that may occur from contaminated vehicles stopping at this point. Without extensive chemical agent monitoring ability, rapid decisions must be made as to which vehicles and vehicle contents are contaminated and must proceed to the decontamination site, and which are clean and may proceed directly to the MTF. To facilitate identification of evacuation vehicles carrying clean or contaminated

casualties, prior direct coordination between the MTF and supporting evacuation units, both air and ground, on a standardized identification method must occur. This coordination should happen prior to deployment. One may also consider any vehicle to be contaminated or that it carried exposed Soldiers, despite actual risk. This will allow for increased flow through the ambulatory decontamination line and possibly prevent accidental “clean side” exposure.

One solution is to use fabricated metal triangles with the NATO standard dimensions of 28 cm x 20 cm x 20 cm. To maximize ICAMouflage, paint the triangles with flat green chemical agent resistant coating (CARC) paint. On the three separate triangles, paint the words ATOM, BIO, or GAS in flat black CARC paint. This will give the evacuation vehicle crew the ability to designate what casualty type is on board. Attach the triangles to the front end of the evacuation vehicle so the ECP personnel can observe it at a distance. Use chemlights for night operations. Show a yellow chemlight for chemical casualties, a blue light for biological casualties, and a red light for radiation casualties. Attach the chemlight to the front end of the vehicle, below the level of the hood, to preclude its interference with the driver’s night vision.

The Soldiers manning the ECP should be equipped with a pair of binoculars and night vision goggles (NVG) for standoff inspection of the approaching evacuation vehicle. Once the vehicle halts at the ECP, the ECP personnel should conduct a cautious approach of the vehicle. They should note the MOPP level the evacuation vehicle crew is in and, regardless of MOPP level, question the crew about any patient signs or symptoms related to agent exposure and about the vehicle's contamination status. The personnel at the ECP are in MOPP IV posture.

Use M8 or M9 paper to make a rapid determination of whether or not a liquid chemical agent is present on, or in, a vehicle. Use the IICAM to detect vapor coming from any liquid contamination on, or in, a vehicle. Visually inspect the vehicle at the ECP and test any suspect liquids on the vehicle with M8 paper: results are sent to the Casualty Decontamination Center (CDC). Areas likely to have liquid contamination are the vehicle's wheel well areas, tires, and rear portion of the vehicle. If the outside of the vehicle is contaminated and the patient needs to be transported to the next level of care, plans must be in place to transfer the casualty from that vehicle, which has outside contamination, to another without outside contamination. The "dirty" vehicle with outside contamination would then return to the battlefield

to pick up more contaminated patients. Non-standard evacuation platforms can be used if adequate ambulance assets are not available to transport casualties to the next level of care. The commander may want to restrict vehicles with exterior contamination from moving through the unit area. Litter teams may also be utilized to transfer casualties. As a final resort, the contaminated evacuation vehicle may be routed into the casualty decontamination site on a route that has minimal impact on vehicle movement into the MTF.

Control of vehicle movement to specific routes and areas within the decontamination site is a critical safety issue, even during combat operations. This can involve routing vehicles along a clearly marked, one-way path for the ECP to the chemical casualty decontamination site. Then, ideally, return to the ECP should be along the same route. If vehicles are not kept on the proper path, clean areas are likely to become contaminated, and both patients and personnel are subject to being run over during night operations. Planning for vehicle movement must always include night operations and operations in low visibility conditions.

Control of personnel movement is necessary to ensure that casualties and site personnel do not accidentally cross the Hot Line without first being decontaminated and to secure

the PDS and MTF sites from enemy infiltrators. Concertina wire works well to keep personnel in the desired areas, and a clearly marked, one-way route helps to ensure that correct entry and exit points are used. To reinforce the physical barriers in place, night operations must also use visual control measures that conform to light discipline guidelines.

Numbers of Casualties to be Treated

Having an advanced knowledge of the numbers of casualties and types of injuries expected is very helpful in logistical planning, but not always possible. Practicing procedures for the resupply of the PDS from the clean side of the Hot Line is important. Position some supplies in the PDS area, but a majority should be covered, and pre-positioned in kits, on the clean side of the Hot Line. They are handed to personnel working at the PDS, as needed, to replace used supplies as the numbers of patients increase. This may prevent unnecessary disposal of large numbers of medical supplies that might be considered contaminated if they were positioned in the contaminated PDS area and never used.

Equipment and Supplies

A suggested minimum list of additional items needed to support the casualty decontamination

site is provided at Appendix B. The sets will service specific numbers of Soldiers based upon the facility's level of care. Typical BAS sets for Chemical Treatment and Decontamination will cover 30 and 60 patients, respectively. Typical trauma and sick call will cover for 3 to 5 days' worth of patients.

Personnel Requirements

Provided below is a minimum suggested list of personnel to staff the CDC. Although a fully effective litter decontamination procedure can be performed by just two augmentees and triage can be handled with minimal staff, planning must include staffing for both the operational and support staff. The in-depth planning required for operating the decontamination site must include the anticipated casualty load, day or night operations, weather conditions, work and rest rates for personnel, logistical support for the site, and the acceptable impact on conventional medical operations that are still ongoing.

Site Command and Control Cell:

- 1 Officer
- 1 NCOIC (will also serve as safety officer)

NOTE: The individual appointed as the safety officer must be able to move freely throughout the dirty area of the PDS to check with

personnel to ensure that they are not showing symptoms of heat stress and are following safe patient handling procedures.

Triage/Emergency Medical Treatment Area:

- 1 EMT NCO as Triage Officer or DDS
- 1 EMT
- 16 litter bearers (two 8-man teams)

Litter Casualty Decontamination Area (at least 2 teams with the following):

- 1 Improved Chemical Agent Monitor (ICAM)
- 4 Decontamination Augmentees
- 1 EMT

NOTE: The four augmentees perform patient decontamination. They can also replace litter bearers during casualty decontamination as needed, remove contaminated litters, and replace clean litters during transfers between clothing removal and skin decontamination. Additionally, the augmentees bag waste from the litter decontamination area, replace bleach solutions after every two patients, and pour old bleach solutions onto waste in the bags, thus allowing the liquid to absorb into the clothing.

Ambulatory Casualty Decontamination Area:

4 Decontamination Augmentees

1 Medic

Litter Washing/Decontamination Point:

Not manned

NOTE: In the event of chemical or biological agent contamination, augmentees decontaminate any decontaminable (mesh) litters by scrubbing a 5% bleach solution over the entire surface of the litter, including handles. They then should allow the litter to dry for 15 minutes and then rinse it with fresh water. This wait time will allow the bleach to neutralize any chemical agent on the litter. If canvas litters are used, the augmentees will remove any barrier materials (plastic sheeting) used to protect the wooden handles and canvas cover and place these materials in a plastic bag. If the barrier material is in short supply, the plastic sheeting can be scrubbed with 5% bleach, allowed to dry for 15 minutes, and then rinsed with water. The canvas litter handles will be wiped with a 5% bleach solution. Do not use the bleach solution directly on the canvas as it will destroy the material. Canvas litters should only be used for transport of patients in the dirty area and not brought into the MTF if they have been on the dirty side of the Hot Line. Contaminated canvas

litters cannot be thoroughly decontaminated as the wood and canvas will absorb chemical agents. When not decontaminating a litter, two of the augmentees will transport waste to the dirty dump.

Clean Treatment Area:

2 Litter Bearers
1 EMT
MD/DDS

Logistical Support Point:

1 Medical Supply NCO
1 Soldier

TOTAL: 27 to 40 Soldiers

Work/Rest Considerations

This single consideration will have a direct impact on the efficiency of personnel and replacement needs of personnel. A complete understanding of the available information on this subject, coupled with common sense and experience, will enhance the planning process and address work force needs. Establishing a work/rest cycle is dependent on several factors, as listed below.

- How rested are the Soldiers?
- Have the Soldiers been acclimated?
- Has a command drinking policy been in effect regardless of MOPP Level, thus affecting how well hydrated the Soldiers are?
 - What is the anticipated relative humidity?
 - What is the anticipated temperature?
 - Will overhead cover (shade) be available?
 - How many heat casualties will the commander accept?

Suggested background information can be found in FM 3-11.4 Multi Service, Tactics, Techniques, and Procedures for Nuclear, Biological and Chemical (NBC) Protection.

Establish a Patient Decontamination Station

The care of contaminated casualties, although more complicated than that of conventional casualties, must not stop the ongoing medical mission. Medical officers and medical NCOs must develop realistic, battle-focused plans. They must then refine and validate these plans in challenging training if health service support (HSS) on the future battlefield is to be successful.

Historically, the single area of contaminated casualty care that has caused the greatest amount of trouble for medical units has been the actual decontamination effort. Beginning with this section, through the final section on disestablishing a decontamination site, you will be presented with material derived from recently conducted tests, doctrinal procedures, and the practical experiences of medical and chemical NCOs. The following section presents suggestions or “food for thought” on how to successfully conduct contaminated casualty decontamination. Each level of medical care must have an operational PDS function.

Before we get into the actual material on establishing a decontamination site, it is important to discuss where these contaminated casualties originate. A picture of the C/B battlefield is required if planning is to anticipate,

with some degree of accuracy, the appropriate level of preparation required for casualty decontamination and care.

The C/B Battlefield

Chemical agents can be introduced into the environment as one of the following, depending on the weapon system used:

- Solids
- Liquids
- Gases/Aerosols

Biological agents can be introduced into the environment in wet or dry form. Examples are provided below.

- Aerosols
- A slurry mix (wet)
- Large thick drops
- A dry powder
- Spores
- Vectors

Regardless of which form a C/B agent is in when introduced, there is one common result-- chemical or biological weapons will contaminate personnel, terrain, and equipment on the ground. However, it is not enough to say that contamination occurs. It is also important to

discuss the extent of the contamination and how long it will last.

Chemical Contamination

The most common misconception people have about chemical contamination is that vast areas of the battlefield will be contaminated by liquid chemical agents. Another misconception is that everything in the contaminated area will be “dripping” with chemical agents. The method for predicting the affected areas from a chemical attack is presented in FM 3-3, Chemical and Biological Contamination Avoidance, Chapter 3. The contamination prediction tells two important things about a chemical attack. First, it shows the attack area, i.e. the area in which liquid contamination can be found. Second, it shows the hazard area, i.e. the area downwind from the attack area that can be affected by chemical vapors originating in the attack area. The prediction also shows whether the attack was an air contaminating attack (Type A), which has little or no liquid contamination on the ground, or a ground contaminating attack (Type B).

Contaminated casualties coming from the attack area can pose both a liquid hazard from liquid on their clothing and equipment, and a vapor hazard from evaporating liquid agent as well as vapors trapped in clothing fabric and hair. Casualties in the attack area will pose the

greatest risk during initial medical treatment and patient decontamination because of the potential liquid contamination that may be cross-transferred to the Soldier medic/combat lifesaver, the interior of evacuation vehicles, or to non-medical augmentees performing patient decontamination. Because of these liquid and vapor problems, it is important to understand as much as possible about the attack and hazard areas.

Exposure to a vapor will pose less of a hazard to decontamination operators than exposure to liquid agent or concentrated aerosols. Often vapor exposures, predominant in a Type A attack, will quickly volatilize (evaporate) before the patient reaches the decontamination station. In these cases, removal of clothing and a brisk rubbing or washing of the hair (if the hair was exposed and unprotected by IPE) may be all that is needed to release the trapped vapors. Most toxic industrial chemical (TIC) releases that involve a vapor plume can be categorized as a Type A attack.

The dimensions of the attack area based on the type of agent employed and weapon system used is provided in FM 3-3. The dimensions represent an area that will be larger than the actual area contaminated by a liquid chemical agent. The following illustrates this point:

NOTE: In the spray attack or artillery attack by several artillery regiments, the Type B attack area is predicted to be shaped like a cylinder. Although it can be several kilometers in length, it will be no more than 2 km wide at any point. This type of attack will contaminate the greatest area of all the attack types shown.

The Type A attack occurs when threat forces believe that a large concentration of chemical agent vapors will surprise U.S. forces and cause casualties through inhalation. This attack usually is conducted by firing large numbers of highly volatile (non-persistent) chemical agent munitions into a relatively small area or through the purposeful targeting or sabotage of industrial chemical storage tanks creating a toxic cloud of TIC. These nonpersistent agents are:

- Nerve Agents – GB, GD
- Pulmonary Agent – CG
- Vesicating Agent – CX
- Cyanide Agents – AC, CK

Most TICs release with resulting vapor plume.

The Type A attack will not normally be placed on a unit's position but will occur "off-target," i.e. at some distance away from the unit to maximize the development of a vapor cloud

and the number of casualties through inhalation. This will be particularly true of an attack that uses the G-series nerve agents, the pulmonary agent CG, the vesicating agent CX, or the purposeful destruction of storage facilities to release TIC. If a cyanide agent is used, the attack will most likely be in or extremely close to a unit's location because of the rapid expansion of cyanide vapor in the air and the ability of cyanide vapor to mix easily with the surrounding air causing its rapid dilution. Cyanide is most effective in enclosed spaces, such as buildings.

A casualty in the Type B attack area presents a potential liquid hazard, as well as an off-gassing vapor hazard, while the casualty in the Type A hazard area will pose only an off-gassing hazard. However, in most cases, any liquid chemical agent found on this casualty will be minimal due to the rapid evaporation of the highly volatile (non-persistent) liquid chemical agents from the outer material of the individual protective ensemble (IPE). Although the M9 chemical detection tape worn by casualties in the attack area will show a positive color reaction upon exposure to any liquid chemical agents, it may be difficult to detect and identify the agent using M8 detection paper during triage at the decontamination site because of evaporation. The IICAM may be useful here.

The Type B attack occurs when threat forces believe that terrain denial or the creation of a chemical barrier will slow U.S. forces or cause our forces to maneuver around the obstacle, potentially into a pre-planned killing zone. The use of a Type B attack on choke points (i.e., narrow points in a valley, road junctions, or crossing points at water obstacles) can be expected, especially if U.S. forces are in these locations. Threat forces will use persistent chemical agents. These have a low volatility, taking more than 24 hours to fully evaporate. The persistent chemical agents are as follows:

Nerve Agents - TGD (thickened GD), VX
Vesicating Agents - L, H, HD

The Type B attack area can be several times larger than the Type A area. The Type B attack represents the worst case scenario for medical support because of the long-term hazard posed by liquid chemical agents. The Type B attack is used for planning purposes until deliberate chemical surveys indicate a Type A attack has occurred. Also, the Type B attack is most likely to be placed on or near our units to maximize the effect liquid and heavy vapor contamination will have on our personnel and equipment.

A casualty caught in the open without overhead cover during a Type B attack will have

easily visible, oily splashes or a large number of oily spots of varying sizes on their IPE. The mask carrier and load-bearing equipment (LBE) will also have spots or smears that cannot be a result of perspiration. The M9 detection tape may also have positive indications of chemical agent drops (some as small as 100 microns) and a few streaks.

After the actual attack has stopped, the individual will probably contact objects, such as plants or equipment that have agent on them. This can smear agent on IPE and protective gloves, causing oily smears or spots of varying sizes. The M9 detection tape will have more streaks than spots, which could indicate the casualty brushed against the liquid while moving.

Casualties in the hazard area of the Type B attack will pose the same hazard as a Type A casualty, i.e., off-gassing vapors from the IPE.

Biological Contamination

While the information available on chemical contamination is extensive, the same cannot be said for the incubation period of biological agents. Our forces may not know that a biological attack has occurred, or even which biological agent was used, until several days to a week after the attack has actually occurred.

This basically means that the prediction method in Chapter 4 of FM 3-3 will be used to assess what terrain was potentially contaminated, which units were present in the predicted area or contamination, and how long these units remained in the affected area. Knowing which units were in the area will allow for a medical response that is appropriate for the agent used and the anticipated casualty load.

In Chapter 4 of FM 3-3, two types of biological attack are presented, the Type A attack (air contaminating attack) and the Type B attack (ground contaminating attack). The Type A attack is considered the worst case scenario and is used for planning purposes because this type of attack will contaminate the great amount of terrain and affect the greatest number of personnel. The attack area for a Type A attack is always 1 km in diameter (unless a larger size is observed or determined through a survey), while the total downwind distance of the Type B hazard can vary from 32 km out to several hundred kilometers.

The total downwind distance will produce a hazard area of enormous proportions. Any casualty from any location within the attack area or hazard area that requires medical support must be considered contaminated and handled appropriately. This standard response should continue until deliberate biological sampling has

taken place and the laboratory analysis of the samples indicates that the biological threat no longer exists.

The Type B attack will have only an attack area, which is shown on a map as a circle, with a minimum diameter of 5 km unless a larger size is determined through a survey or by observation. Any personnel from within this circular attack area who require medical support must be considered contaminated and handled appropriately.

Tactical Planning

When a C/B attack occurs on or near the unit, a medical platoon is supporting the medical platoon leader (field administrative assistant) and the medical platoon sergeant must be prepared to quickly and efficiently transition from conventional casualty operations to contaminated casualty operations. To accomplish this transition, the medical platoon leader or medical platoon sergeant must be alerted almost as quickly as the unit commander that a C/B attack has occurred. In order for this information to be obtained in the quickest fashion, one of these personnel must be located in the unit tactical operations center (TOC). He or she must monitor both the unit's internal command (COM) radio net and/or the admin/log (A/L) radio net. When an attack occurs, a NBC-1

(CHEMICAL) Observers Report will be sent, or a code word will be sent via the COM or A/L radio net. This will alert the unit that a chemical attack has occurred. Because the unit NBC NCO or chemical officer will lack vital C/B survey information during the first hour or so after an attack has occurred, it must be assumed that, in the case of a chemical attack, a Type B attack has occurred. Likewise, in the event a biological attack is suspected, a Type A attack must be assumed.

The medical response must begin with a hasty evaluation of the attack, the factors that can indicate the type of casualties most likely to be seen, and the type of contamination these casualties will bring in with them--liquid vs. vapor, chemical vs. biological. This evaluation will be based on the following:

- The location of all units supported by the medical platoon.
- The location of the attack (Line F of the NBC-1 Observers Report).
- The type of agent and type of attack (Line H of the NBC-1 Observers Report). If Line H is unknown, then assume a Type B attack.
- Which units are in the attack area.
- Which units are in the hazard area.
- The readiness posture of any unit inside the predicted attack area and/or predicted hazard area.

-- What MOPP level was the affected unit in?

-- What type of terrain has the unit occupied?

Built-up (urban) terrain could indicate that overhead cover was available to shield personnel against the initial liquid contamination. Wooded terrain could also indicate some overhead cover provided by the forest canopy. Desert terrain indicates very little overhead cover.

-- How long had the unit been in its position?

-- If nerve agent is suspected, was the unit taking Nerve Agent Pyridostigmine Pretreatment (NAPP)? This will not alter treatment.

-- If nerve agent is reported, how was the agent verified? M22 ACADA, or M256A1 detector sampler indicate **ONLY** a vapor/aerosol hazard. M9 tape indicates an aerosol or liquid hazard, M8 detector paper indicates **ONLY** a liquid hazard. Any combination of M8 detector paper, the M22 ACADA, and M256A1 detector-sampler indicates both a liquid and vapor hazard.

• Is the attack only a chemical attack, or are conventional High Explosive (HE) munitions being used alone or along with a ground attack?

- If a biological attack is suspected, what were the indicators?
 - Did any suspicious liquid fail to cause a reaction on M9 tape or M8 paper?
 - If aerosols were observed being disseminated, did the M22 ACADA, M256A1 chemical detection sampler, or IICAM fail to indicate a chemical agent?
 - Did any biological agent rapid detection field tests indicate a possible biological agent?

These questions are by no means all that can be asked but are critical in determining a hasty plan of action. The unit's executive officer must be notified that contaminated casualties will be arriving and that some evacuation assets may be contaminated. The executive officer will, in most situations, make the final decision if the decontamination of casualties will take place within the unit area or if it must take place at a location outside the unit area that will not affect ongoing support operations.

NOTE: Biological casualties who arrive at the MTF with flu-like symptoms and have bathed in the last day or two have already decontaminated themselves. Most biological agents do not live on clothing for more than a day or two and are killed by heat or sunlight exposure. The exception is anthrax spores, which remain a hazard for months to years, and can be trapped

in clothing fibers and hair if it has not been changed or washed since the attack.

Establish the Decontamination Site

The ability of the medical platoon, or more specifically the treatment squad, to establish the decontamination site will depend greatly on unit support. Long before the medical platoon deploys, the unit commander, first sergeant, and executive officer must understand the need for manpower and equipment support. Additionally, when possible, the commander should pre-designate in the tactical standing operating procedures (TSOP) which sections of the headquarters unit will provide personnel or equipment to the medical decontamination site. The medical platoon leader should ensure that the sections tasked to provide personnel are trained prior to deployment and that after deployment, these sections receive quick refresher training when possible.

Log of Assigned Personnel

When a C/B attack occurs, the required personnel and equipment must be available almost immediately. The medical platoon leader or platoon sergeant must maintain a current status of required support equipment and a continuously updated roster (by name) to ensure that gathering of personnel and equipment can

occur when a timely response is critical to patient care.

Battalion Level

Outside a 1 km stand-off distance from the edge of the predicted downwind hazard area, all personnel can remain in MOPP 2 during the set-up of the decontamination site. In this area, the site should be free from both liquid and vapor contamination. It is recommended that one Soldier in MOPP IV conduct continuous monitoring during site set-up at a location at least 1 km away. This Soldier should use the M22 ACADA regardless of what agent has been reported. Initial NBC-1 Observers' Reports received at the tactical operations center (TOC) during testing scenarios and field training exercises often contain incorrect information about which agent was actually encountered. As long as the monitor continues to report no contact with chemical agent vapors, all personnel can remain in MOPP 2 until the first casualties are 5 to 10 minutes away. The number of casualties is reported at this time so that initial supplies can be positioned in the PDS area.

If the selected site is within the 1 km stand-off distance or within the predicted downwind vapor hazard area, all personnel must be in MOPP 3 or MOPP IV during site set-

up. Modification of the MOPP level based on temperature and expected workload during set-up can be accomplished as described in FM 3-11.4 MultiService Tactics, Techniques, and Procedures for NBC Protection, Chapter IV. If the site must be set up in the vapor hazard area, it is critical that the selected site be free of liquid contamination. As long as the team sent to the selected site remains completely outside the predicted liquid hazard area, and optimally outside the stand-off distance, a point chemical survey should take no longer than a few minutes using M8 chemical detector paper.

Site Preparation Phase

Site preparation will require time for shuffle pit preparation, dirty dump preparation, and removal of any ground obstacles. If the medical platoon has the luxury of time to accomplish any of this labor-intensive work prior to activating a patient decontamination site, it will greatly increase the accomplishment of the decontamination mission. If preparation prior to actual use cannot be done, at the very least a ground recon must take place prior to site activation. All vehicle movement routes must be marked, points along the route requiring direction indicators identified, and any ground obstacles identified for removal. The arrival/triage area must be surveyed to ensure it can handle the evacuation vehicles moving into and out of the

area, plus the activities of the triage officer and the litter teams. Both the litter decon and ambulatory decon areas must be surveyed to ensure ease of movement by augmentees, medical personnel, and ambulatory patients. The ambulatory decon area must be evaluated for direction indicators that might facilitate easy movement of ambulatory patients through the various steps and likewise for any obstacle that might impede foot traffic. The site must also be evaluated for night operations.

When preparing the site, 2 to 3 shuffle pits need to be prepared, each requiring at least 2 50-lb drums of Super Tropical Bleach (STB) each. These pits, depending on the amount of use they get, must be refreshed with the STB once every hour or after 10 personnel have shuffled through them. To refresh a shuffle pit, mix half the original ratio of two shovels of STB and three shovels of dirt back into the pit. For example, if a shuffle pit originally took 30 shovels of STB and 45 shovels of earth to construct, 15 shovels of STB and 22 shovels of earth (the 22.5 was rounded down for safety) would be needed to refresh the pit.

NOTE: If Reactive Skin Decontamination Lotion (RSDL) is used for patient decontamination, it must not be stored near the STB powder as it will cause the full strength, highly reactive STB powder to ignite. RSDL can

be applied to a casualty on a litter stand that is above the shuffle pit, as it will not cause a violent reaction with the diluted shuffle pit mixture.

The preparation of the dirty dump is the most labor-intensive effort in the preparation phase. If engineer support is not available (in combat, engineers will have more important missions than digging a hole in the ground at patient decontamination sites), then dedicated engineering tools must be available to assist in digging the dirty dump. Pick axes and long-handled shovels are more appropriate than individual entrenching tools. The use of heavy equipment, if available, will expedite the set-up.

When setting up in a forest location, it may become necessary to clear low hanging branches, brush, or other ground obstacles. Saws, axes, pry bars, and long-handled shovels should be dedicated for this work.

Also, a site for supplies should be made near the treatment area for rapid replacement. The supplies could be covered to prevent contamination and allow for reprocessing.

NOTE: The dedicated tools mentioned in this section must be obtained prior to deployment and used exclusively by the medical treatment squad for site preparation. This will

ensure that tools are available at the critical time.

After site preparation is complete, all tools must be kept on the "clean" side of the Hot Line.

NOTE: Ideally, tentage should be set up over the decontamination and decontamination check areas of the decontamination line to shield unclothed patients against the elements.

Suggested Equipment Minimums

During the site set-up, the saying "Do more with less!" should be followed. Only the minimum amount of equipment needed to support patient decon should be set up on the soon to be dirty side of the Hot Line. Additionally, only the minimum amount of medical supplies needed to support the contaminated emergency treatment point should be set out. During the conduct of decon operations, any resupply items should be obtained from the clean side of the Hot Line on as needed basis. By keeping equipment and supplies to the barest minimum required, the site OIC/NCOIC will ensure that only minimal items must be dealt with during disestablishment of the decontamination site. The decon and treatment sets will be opened prior to the arrival of the first casualty.

A suggested minimum list of equipment needed to set up a litter decon area and ambulatory decon area is provided below. Most of this equipment is provided in the MES Chemical Agent Patient Decontamination.

- **Arrival/Triage Area**

- 1 bk - Field Medical Card (carried by triage officer)
- 2 ea - M291 SDK (carried by triage officer)
- 4 ea - Litters (decontaminable or canvas litters with sacrificial coverings)
- 2 pr - TACTILE chemical protective gloves (1 worn and 1 carried by the triage officer)
- 11 bk - M8 chemical detection paper (1 booklet carried by one member of each litter team and 1 carried by the triage officer)

If organic ambulances are used to transport casualties from collection points that are inside the attack area or hazard area to the patient decontamination site, it is highly unlikely that these same ambulances, which may require decontamination, would be used to evacuate clean casualties to the next level of HSS. In this situation, remove from each ambulance the four patient protective wraps (PPW) authorized per vehicle and hold them on the clean side of the Hot Line for use in transporting decontaminated,

nude casualties in designated “dirty” evacuation assets, or through possible areas of contamination, to the next level of care.

• **Emergency Treatment Areas**
(CLEAN/DIRTY)

- 1 bx - M291 SDK
- 6 ea - MARK I, Nerve Agent Antidote Kits
- 6 ea - Atropine autoinjectors
- 4 ea - Convulsant Antidote for Nerve Agent
- 5 ea - 50 ml syringes
- 1 ea - Stethoscope, Adult
- 1 ea - Flashlight
- 2 ea - Field I.V. poles
- 4 ea - I.V. bags
- 6 ea - I.V. sets
- 10 ea - Catheter/needle units
- 1 pg - Providine iodine pads
- 10 ea - Constricting band (one patient use only; impossible to ensure that decon between each patient is complete)
- 2 ro - Adhesive tape (to secure the IV)
- 10 ea - Field dressings
- 4 ea - First-aid dressing, 11-3/4"
- 4 ea - 7.25" angled bandage scissors
- 2 ea - Cricothyroidotomy cannula kits
- 2 ea - Airway pharyngeal, LARGE
- 2 ea - Airway pharyngeal, SMALL
- 1 ea - Resuscitator, hand-operated

The resuscitation device, individual chemical (RDIC) would be the best hand-operated resuscitator for use on the dirty side of the Hot Line. The RDIC can be found in each ground ambulance and in the MES Chemical Agent Patient Treatment.

Litter Patient Decontamination

Dirty Dump

The dirty dump is located a minimum of 75 meters downwind from the triage and emergency medical treatment areas. Prepare the dump ahead of time; this will be a manual, labor-intensive job if you have no engineering support. The dirty dump initially is a hole 5 feet deep, by 4 feet wide, by 4 feet long. After closing the decontamination site and backfilling the dirty dump, the location must be reported to higher headquarters as a contaminated site with an 8 or 10-digit grid coordinate. The report format used to transmit the dirty dump's location is the NBC-4 report. All personnel working in and around the dirty dump will be at MOPP IV once casualties begin to arrive at the site.

Triage Point/ Collection Point

Field ambulances approach the triage point from a downwind direction. Patients are off-

loaded from the ambulances and taken to the triage point. Once casualties are inbound, personnel working in the triage area are at MOPP IV. The patients are triaged and visibly marked with prepared tags or adhesive tapes using the following colors to denote triage casualties:

Immediate - Red
Delayed - Yellow
Minimal - Green
Expectant - Black

The use of these colors can extend into night operations with the use of "chemlights" in the colors mentioned above, with the exception that the "expectant" casualty would be marked with a blue chemlight. Unless the casualty is in respiratory distress, requiring intubation on the dirty side, or has wounds that prohibit masking, **unmasked patients must be masked immediately at this point.** After the arrival of casualties, the entire decontamination site on the downwind side of the Hot Line must be considered a liquid/vapor hazard area.

Both litter and ambulatory casualties remove, or have removed for them, all military gear (protective mask carrier, Kevlar vest and helmet, LBE, weapon, and all types of armament. A pat down search of the casualty's body, especially the chest and all pockets, is

important to locate any ordinance carried by the Soldier or possible explosive devices carried by disguised terrorists. After triage, the casualty will be directed to either the ambulatory decontamination line, litter casualty decontamination line, or the dirty side EMT station. The mask is kept on the patient unless removal is clinically indicated.

Emergency Medical Treatment (EMT)

Treatment at the EMT station is limited to the administration of MARK I Kits and diazepam, application of pressure dressings, establishing a patient airway, and starting an IV infusion. If immediate clearing of the airway must be done at this point to save a life, the airway is cleared and the mask replaced, or the patient is intubated. After this lifesaving procedure, it may or may not be necessary to change the triage category of the patient to reflect the increased burden of the exposure or the improved condition of the casualty.

The EMT station should be established upwind from the triage point and to the side of the decontamination site perpendicular to the prevailing wind direction. The EMT station should be positioned as far to the side of the decontamination site as is practical. This set-up will allow the EMT station to be away from the heaviest concentration of vapor resulting from

the evaporation of liquid chemical agents concentrated at the triage point. It should also be an area that is expandable, depending on the influx of patients that need to be treated and stabilized. All personnel rendering EMT assistance will be at MOPP Level IV.

Litter Casualty Decontamination

Personnel working in the litter casualty decontamination areas will be at MOPP Level IV. Only the Soldiers performing litter patient decontamination should wear the Toxicological Agent Protective (TAP) apron over their IPE to keep it dry. Any additional gear (i.e., helmets and body armor, LBE, protective mask carrier, and weapons) should be kept on the clean side of the Hot Line. Each worker should carry in the cargo pockets of the JSLIST/BDO trousers three MARK I Kits, one Diazepam Auto-injector (CANA), one M291 SDK, and one booklet of M8 detection paper.

NOTE: Two people (not including litter team) will work with each patient, tracking the patient from Step 1 to hand-over at the Hot Line.

The step-by-step procedure outlined below is the prescribed doctrine for decontaminating a litter patient, but it is by no means the only method. Knowing this method, however,

ensures that correct and essential steps are not omitted, and when they are, other measures are taken to preclude a hazardous outcome.

The M291 Skin Decontamination Kit, soap and water, or 0.5% bleach solution with a water rinse is used to remove chemical contamination on the skin. A 0.5% hypochlorite solution is useful if water is limited and other alternatives are not available. A bleach solution greater than 0.5% should never be used on skin. A 5% bleach (hypochlorite) solution will irritate and burn the skin, which will allow agents to enter the skin more rapidly.

NOTE: RSDL is expected to replace the M291 Kit and can be used on skin, when fielded, where the M291 is noted.

Two different concentrations of bleach solution are used in the patient decontamination procedure. A 5% bleach solution is used to decontaminate the casualty's protective mask and quick doff hood (if attached), scissors and other cutting devices, TAP aprons, and the gloves of personnel working in patient decontamination area plus litters. Approximately 10 quarts of the bleach solution are placed in 12-quart stainless steel buckets for use in this area. The buckets should be distinctly marked to distinguish the 5% solution from either the 0.5% bleach solution or soap and water.

Preparation of these solutions is covered in Appendix C. Bleach evaporates quickly at high temperatures and loses its oxidation ability over time, so the solutions should be prepared shortly before they are needed.

Litter Patient Decontamination Area Supplies

- 4 pr - Litter support stands
- 8 ea - 12 qt utility pails (4 for the clothing removal points and 4 for the skin decontamination points)
- 4 ea - Sponges or rags per 12 qt utility pail
- 4 ea - 7.25" angled bandage scissors
- 4 ea - J-Knife/long-handled seatbelt cutter
- 1 pr - Chemical protective glove set per augmentee (16)
- 2 pr - TACTILE chemical protective gloves for medics (1 pair is worn, and 1 pair is carried)
- 1 ea - Butyl rubber apron worn by each augmentee working with the litter patients (16)
- 24 ea - "Zip-lock" bags for FMC and personal items from each patient
- 12 ea - Plastic garbage bags
- 2 ea - M8 chemical detection paper booklets
- 1 ea - IICAM (if available) to survey suspected contamination or verify completeness

of decon; the IICAM is kept in the skin decon area)

Step 1. Clothing Removal (Litter Patient)

1. Decontaminate mask and hood.

a. Wipe/sponge down the voicemitter, eyelets, and outserts with the M291 or 5% bleach solution. While wiping around the filter, cover the inlet of the C2A1 filter canister with a hand or gauze momentarily to keep liquid out of the inside of the canister where it could wet the charcoal, reduce filter efficiency, and clog the filter.

b. To decon the hood (quick doff hood or integrated hood/hooded overgarment), wipe down the hood using M291 SDK or 5% bleach solution (starting at the top of the head and wiping down towards the litter and shoulders).

NOTE: After every complete segmental cut, the cutting tools are decontaminated, along with the gloved hands of the Soldier doing the cutting. Do this by dipping gloved hands and cutting tools in a bucket of 5% bleach, or if ample supplies of the M295 or, M291 are available, and water is limited, these can be used to scrub the cutting tools.

2. Remove hood.

NOTE: To cut the hood and JSLIST/BDO, use scissors or a long-handled seat belt cutter. You must replace the cutting tools once they no longer make a smooth cut.

a. Remove the quick doff hood of the M40 mask.

(1) Dip the cutting device in a bucket of 5% bleach solution or decon/scrub-cutting tool with the M295 or M291.

(2) Cut the hood shoulder straps.

(3) Cut the neck cord, hood straps and drawstring.

(4) Cut the quick-doff hood from the front bottom center to the chin through the elastic band under the chin.

(5) Cut the hood straps that connect the hood to the mask.

(6) Finally, cut from the center of the forehead, over the top of the head toward the litter, so that the hood will lay flat on the litter.

b. Remove the hood of the JSLIST.

(1) Dip the cutting device in a bucket of 5% bleach solution or decon/scrub-cutting tool with the M295 or M291.

(2) Cut the hood starting at the front center and continue cutting across the top of the head toward the litter.

(3) Fold the left and right sides of the hood away from the head on the litter.

NOTE: Use soap and water, M291, or 0.5% bleach solution on skin or equipment items that will contact skin.

3. Decontaminate head.

a. Use soap and water, M291, or 0.5% bleach solution.

b. Patient wears mask. Cover inlet port of filter canister to prevent wetting or congesting.

c. Wipe any exposed areas of patient's face that were not protected by the hood.

(1) Chin

(2) Neck

(3) Back of ears

4. Remove the Field Medical Card (FMC)

a. The medic at the litter patient decontamination station should view the FMC prior to removal.

b. Cut FMC tie wire.

c. Allow the FMC to fall into a "zip-lock" plastic bag.

d. Seal the plastic bag and decontaminate the outside of the bag.

e. Place the plastic bag under the back of the patient's mask head harness straps.

5. Remove personal articles from pockets of BDO/JSLIST.

- a. Place in "zip-lock" bags.
- b. Mark the bags with the patient's name and identifying number and retain for inclusion of other items from inside pockets later in the process.
- c. Decontamination team must decontaminate their gloves before and after handling the bag.

NOTE: The patient's identification tags stay around the patient's neck throughout the decontamination process. They are decontaminated with soap and water, M291, or 0.5% bleach.

6. Remove casualty's BDO/JSLIST.

- a. Cut overgarment around tourniquets, bandages, and splints. Two people will be cutting the IPE at the same time.

NOTE: Dip cutting device in a bucket of 5% bleach solution after each complete line of cut to avoid contaminating inner parts of the clothing or exposed skin. If bleach solution

is not available, then cutting tools must be scrubbed using the M295 or M291.

b. Remove BDO/JSLIST jacket by cutting.
(1) Unfasten/cut Velcro closure at the wrist.

(2) Make two cuts, one up each sleeve from the wrist to the shoulder, and then to the collar. Keep the cuts close to the inside of the arms so that most of the sleeve material is folded outward.

(3) Cut the jacket drawstring at the bottom of the jacket and unfasten Velcro closures, moving from waist to neck, and then unzip the jacket.

(4) If the casualty is able, instruct him to hold his arms up and away from his body, and drape the left and right chest sections of the jacket over the outside of the litter.

(5) Instruct the patient to keep his hands to his sides, away from the areas where the BDO/JSLIST have been removed.

(6) If the casualty is unable to lift his arms, one augmentee will hold the casualty's gloved hand and perform this action. Another augmentee folds the chest sections over the outside of the litter. The patient's arms are then lowered to the sides, keeping the gloves away from the area where the jacket has been removed.

b. Remove the BDO/JSLIST trousers by cutting.

- (1) Cut the suspenders.
- (2) Cut the leg closure cord at the ankle cuff.
- (3) Unzip the zipper.
- (4) Cut from the ankle along the inseam of the left trouser leg until the crotch area is reached, then cut across into the zipper.
- (5) Cut along the inseam of the right trouser leg until the crotch area is reached, then go sideways into the first cut.
- (6) Allow trouser halves to drape over the side of the litter.
- (7) Tuck the remaining cloth between the legs by rolling it, while ensuring that only the black lining is showing.

7. Remove outer gloves. Do not remove the inner gloves.

- a. Decontaminate your own gloves with the M295, M291, or 5% bleach solution.
- b. Decontaminate the casualty's gloves with the M295, M291, or 5% bleach solution.
- c. Instruct the casualty to hold his arms away from the litter and upper body or, if he cannot comply with instructions, hold his gloves by the fingers.

NOTE: Always remove the gloves over the sides of the litter.

- d. Grasp the cuff of the glove, turning the glove inside out and remove it.
- e. Carefully lower the patient's arm(s) across his chest as each glove is removed. Avoid touching the patient's cloth glove liner or arm with your rubber glove.

CAUTION: Do not allow the arms to contact the exterior (ICAMouflage) side of the overgarment.

- f. Dispose of the contaminated gloves by placing them in a trash bag.
- g. Decontaminate your own gloves with the M295, M291, or 5% bleach solution.

8. Remove black vinyl overboots (BVO) or Multi-purpose overboot (MULO).

- a. Unfasten the overboots.
- b. Gently pull the overboot by the heel until it is removed.
- c. If the overboot will not come off, cut the boot from top to bottom along the centerline of the boot or along the inside of the boot. Fold the overboot down and gently pull the heel until it is removed.

9. Remove personal effects from BDU/JSLIST.

NOTE: Remember to decontaminate your gloves first.

- a. Place personal effects in "zip lock" plastic bag.
- b. Remove the bag to the contaminated holding area.

10. Remove combat boots without touching body surfaces.

- a. Cut the boot laces along the tongue.
- b. Pull the boots downward and toward you until removed.
- c. Place the boots in the plastic bag containing the chemical overboots and gloves.

11. Remove inner clothing.

- a. Cut or unbuckle belt.
- b. Cut the BDU pants following the same procedures as for the overgarment trousers.
- c. Cut the BDU jacket following the same procedures as for the overgarment jacket.

12. Remove undergarments

- a. **Remove the patient's T-shirt.**

(1) Decon/scrub gloves and scissors with the M295 or M291, or immerse cutting device in a bucket of 5% bleach solution between each cut.

(2) Cut up the front of the patient's T-shirt from the waist up to the collar.

(3) Cut both sleeves from the inside, starting at the elbow, up to the shoulder, and then to the collar.

(4) Cut around bandages or splints, leaving them in place.

(5) Next, gently peel the T-shirt away from the body to avoid spreading contamination if present on undergarment.

b. Remove the patient's brassiere.

(1) Decontaminate gloves and scissors.

(2) Cut brassiere between the cups.

(3) Cut both shoulder straps where they attach to the cups and remove the brassiere.

c. Remove the patient's under-shorts/panties.

(1) Decontaminate gloves and scissors.

(2) Cut from the lower side of the hip to the waist on both sides.

(3) Place the undergarments into the plastic garbage bag containing the other contaminated items.

14. Remove socks. Place in the plastic garbage bag.

15. Remove inner gloves. Place in the plastic garbage bag.

NOTE: Workers must decontaminate each other's TAP aprons, gloves, and lower portion of protective hood with the M291 or 0.5% solution between each patient and before any litter transfers. The team members should wash each other, with each member being decontaminated standing with his arms spread out to the sides, allowing the team member performing the decontamination to get into all the folds of the TAP apron front and sleeves.

Step 2. Litter Transfer and Decontamination

1. After decontaminating one another's TAP aprons, augmentees will now use a patient-lift to move the nude patient to a clean litter where skin decontamination will occur.
2. Decontamination team members position themselves with one member on one side of the litter and three on the other.
3. The lone augmentee rolls the patient toward him.
4. The three augmentees lifting the patient slide their clean arms under the patient in forklift fashion supporting the casualty's neck, torso/lower back, and distal legs. The medic, if present, will provide supervision and can assist in neck stabilization.

5. The patient is then rolled back onto the three augmentees' forearms.
6. The medic, or individual at the patient's head, gives the command "prepare to lift." If ready to lift, the other members reply "ready." The medic then commands "lift."
7. Augmentees keep their backs as straight as possible and perpendicular to the ground, and lift using their legs and arms to ensure a safe lift.
8. The patient is lifted up and rolled slightly inward against the lifters' chests to make holding the casualty up less of an effort and to better support the patient. Before and during the lift, the leader explains to the casualty exactly what is going to happen.
9. The dirty litter and its contaminated clothing are removed from the litter stands, and a clean, decontaminable litter is placed under the patient. If decontaminable litters are not available, use a plastic covered canvas litter.
10. The medic then gives the command "prepare to lower." If ready, the other augmentees respond "ready." The command "lower" is then given and the patient is slowly lowered onto the clean litter.
11. The cut BDO, BDU, and undergarments are now placed in the plastic garbage bag with the other waste from the casualty.
12. The dirty litter is decontaminated with an M295, M291, or a 5% bleach solution with a water rinse. It remains on the dirty side for the transfer of casualties from the triage area to the

litter patient decontamination point.

NOTE: Contaminated material from two litter patients can be placed into one 35-gallon trash bag. The remaining 5% bleach solution and soapy water (if used) can be poured into the bags. The bag must be tied shut and transported to the dirty dump.

Step 3. Skin and Wound Decontamination

1. The casualty is now decontaminated with soap and water, the M291, or 0.5% bleach solution.
2. If the patient was wearing a CPO, the best method is to decontaminate only those skin areas where there was a break in the IPE (e.g., around wounds, areas where the underlying uniform is wet with agent, or where there is a tear in the BDO/JSLIST).
3. If the patient is not wearing IPE or had significant uniform tears or damaged underlying uniform, an alternate method is to decontaminate the entire skin surface by wiping the skin with a sponge and soapy water or 0.5 % bleach solution with a water rinse. Wash the casualty from the midline outward, constantly washing from clean to dirty and not placing a dirty sponge back on a clean area without first rinsing the sponge. The complete topside of the

casualty is washed in this manner, paying particular attention to hairy areas of the body (groin and axillary regions) and sweaty areas (belt-line, just above the boots, the crease of the buttocks, and wrists). After log-rolling the patient onto their side, wash the backside of the casualty. Then wash the casualty's back from the shoulders to over halfway down the backside, taking care not to miss any areas. The upper side of the litter is deconned prior to rolling the patient to their back again. Wash the opposite side of the casualty in exactly the same manner and decontaminate the litter with soap and water, 0.5% bleach, or M291 before rolling the patient onto their back again.

4. After the casualty is deconned, the medic removes dressings and replaces them only if needed.

a. Superficial wounds (**not** body cavities, eyes, or nervous tissue) are deconned with the M291, flushed with soapy water, or 0.5% bleach solution, and new dressings are applied if needed.

b. Larger wounds are irrigated, if contaminated, with sterile water or IV saline to remove contaminants. Then cover the wounds with a large dressing and plastic if there is a fear of additional contamination getting into the wound.

c. Tourniquets that are contaminated are replaced by the medic. The new tourniquets are placed 0.5 to 1 inch proximal to the original tourniquet. The old, contaminated tourniquet is removed and put in the waste bag.

d. Splints are not removed by augmentees, but are deconned with the M291 or saturated to the skin with 0.5% hypochlorite solution and rinsed thoroughly with soapy water. If the splint cannot be saturated (air splint or canvas splint), it must be removed sufficiently or be replaced by the medic to enable everything under it to be decontaminated.

Step 4. Monitor for Completeness of Decontamination

1. An area is established between the decontamination area and the Hot Line to check for thoroughness of patient decontamination before the patient crosses the Hot Line.

2. Use the IICAM or M8 paper in this area to check for chemical agent contamination and other appropriate monitoring instruments to check radiological contamination.

3. If contamination is detected, use appropriate decontaminants (M291, soap and water, or 0.5% bleach) to spot decon suspected area(s).

4. Once the casualty is confirmed clean of any NBC contamination, the decontamination team again helps one another to ensure that their TAP aprons and gloves are decontaminated and then takes the litter patient to the Hot Line.

NOTE: As the dirty team prepares to bring the casualty to the Hot Line, the clean team opens a blanket or other covering appropriate for the environmental conditions

Step 5. The Hot Line and Clean Side Actions for Litter Patient

Straddling the Hot Line is the casualty pass-over point, which is in a shuffle pit. The shuffle pit is composed of two parts Super Tropical Bleach (STB) and three parts earth (by volume). The shuffle pit should be deep enough to cover the bottom of the protective overboots and large enough that the dirty team, two litter stands supporting a clean litter, and the clean team can occupy it at one time. It must be recharged after 10 casualties.

1. The dirty team brings the decontaminated casualty to the Hot Line on the litter and places the litter on the stands.
2. In the shuffle pit, the patient's field medical card is transcribed by the medic on a new/clean FMC, and the dirty one is taken back to the dirty side by the decon team.

3. Three dirty team members logroll the casualty up and off the litter. A fourth dirty team member removes the litter. The clean team replaces the litter. The dirty team lowers the casualty onto the clean litter and moves away.
4. After the dirty team moves away, the blanket is folded over the casualty, and the casualty is moved from the pass-over point to a holding area 30 to 50 meters upwind.
5. In the **clean treatment area**, the patient can now be retriaged, treated, and evacuated. In a hot climate, the patient will probably be significantly dehydrated. The rehydration process must begin immediately. Overhead cover should be provided for casualties in the holding area. It is here that the mask may be removed for treatment unless circumstances dictate that the casualty remain closer to the Hot Line.

Ambulatory Casualty Decontamination

Decontamination of ambulatory casualties closely follows the methods described in FM 4-02.7 Health Service Support in an NBC Environment and FM 3-5, NBC Decontamination.

The step-by-step procedure outlined below is the prescribed doctrine for decontaminating an ambulatory patient, but it is by no means the only method. Knowing this method, however,

ensures that correct and essential steps are not omitted, and when they are, other measures are taken to preclude a hazardous outcome.

The M291 Skin Decontamination Kit or a soap solution and water are used for chemical contamination on the skin. [The least desired alternative for skin decontamination is bleach (hypochlorite solution)]. A 0.5 % hypochlorite solution with water rinse is useful if water is limited and the M291 kits are not available. Only a 0.5% hypochlorite solution is used for skin decontamination; higher concentrations will irritate and burn the skin, allowing agents to enter the skin more rapidly.

The M295 Individual Equipment Decontamination Kit is used to remove obvious contamination from the patient and help to control the spread of contamination on IPE (MOPP ensemble) and other equipment. If it is not available, then either soap solution or a field-expedient adsorbent material, such as clean, dry earth or flour, can be substituted.

Step 1. Clothing Removal (Ambulatory Patient)

1. Decontaminate the mask and hood.

a. Wipe/sponge down the voicemitter, eyelets, and outserts with the M291 or 5%

bleach solution. While wiping around the filter, cover the inlet of the C2A1 canister with a hand or gauze momentarily to keep liquid out of the inside of the canister where it could wet the charcoal, reduce filter efficiency, and clog the filter.

b. Hoods are of two types: those that are part of the overgarment and those attached to the mask.

(1) For integral hoods that are part of the overgarment, such as the JSLIST, no decontamination of this hood is necessary.

(2) For quick doff hoods attached to the mask, first wipe down the hood using 5% bleach solution, wiping the mask and then the hood (starting at the top of the head wiping down towards the shoulders).

NOTE: When the M295 or M291 are not available or are in limited supply, use the 5% bleach solution on equipment.

2. Remove hood.

a. Remove the quick doff hood of the M40 mask.

(1) Dip the cutting device in a bucket of 5% bleach solution or decon/scrub-cutting tool with the M295 or M291.

(2) Cut the hood shoulder straps.

(3) Cut the neck cord, hood straps, and drawstring.

b. Remove the hood of the JSLIST.

(1) Dip the cutting device in a bucket of 5% bleach solution or decon/scrub-cutting tool with the M295 or M291.

(2) Cut the hood starting at the front center, and continue cutting across the top of the head toward the back.

(3) Fold the left and right sides of the hood away from the head and place on the shoulders.

NOTE: After every complete segmental cut, decontaminate the scissors and seat belt cutter along with the gloved hands of the Soldier doing the cutting. This is done by dipping gloved hands and cutting tools in a bucket of 5% bleach. If ample supplies are available and water is limited, the M295 or M291 can be used.

2. Decontaminate head.

a. Use soap and water, M291, or 0.5% bleach solution.

b. Cover inlet port of filter canister to prevent wetting or congesting it. The patient continues to wear their mask until they cross the VCL.

c. Wipe any exposed areas of patient's face that were not protected by the hood.

- (1) Chin
- (2) Neck
- (3) Back of ears

NOTE: After completing the hood removal, instruct the casualty to move to the next station for the following steps. This station should be 10 to 20 meters upwind from the hood removal station.

3. Remove the Field Medical Card (FMC).

- a. The medic at the litter patient decontamination station should view the FMC prior to removal.
- b. Cut FMC tie wire.
- c. Allow the FMC to fall into a "zip-lock" plastic bag.
- d. Seal the plastic bag and decontaminate the outside of the bag.
- e. Place the plastic bag under the back of the patient's mask head harness straps.

4. Remove personal articles from pockets of BDO/JSLIST.

- a. Have the casualty remove all items from the BDO/JSLIST jacket and trousers and place them in a "zip-lock" bag.
- b. Mark the bag with a name and identifying number and then move with the patient to the next step in the ambulatory decontamination line.

c. The patient must decontaminate their gloves before and after handling the bag.

NOTE: The patient's identification tags stay around the patient's neck throughout the decontamination process. They are decontaminated with soap and water, M291, M295, or 0.5% bleach.

5. Remove casualty's BDO/JSLIST.

a. Cut overgarment around tourniquets, bandages, and splints. One augmentee medic, or an augmentee, will supervise the patients to cut off one another's overgarments if there are not adequate numbers of augmentees to assist.

NOTE: Dip cutting device in a bucket of 5% bleach solution after each complete line of cut to avoid contaminating inner parts of the clothing or exposed skin. If bleach solution is not available, then cutting tools must be scrubbed using the M295 or M291.

b. Remove BDO/JSLIST jacket by cutting.

(1) The casualty is standing and can hold on to a support, such as a chair or litter stand.

(2) The individual with a cutting tool (scissors or long-handled seat belt cutter) stands

in front of the casualty and cuts the patient's IPE.

(3) First, cut around all bandages and tourniquets.

(4) Cut the Velcro wrist closures.

(5) Cut the BDO jacket drawstring or the JSLIST draw cord at the jacket bottom. On the BDO, unzip the 3 snaps that connect the back of the BDO jacket and pants.

(5) Cut the BDO/JSLIST jacket starting at the waist and cut toward the collar in a line parallel to the zipper. Alternate ways are: unfasten the Velcro and unzip the zipper. Instead of cutting the front, cut from the collar down the back of the BDO, or with the JSLIST, continue the cut from the hood down the back, center of the jacket. This is best done using a seatbelt cutter.

(6) To remove the jacket: if the jacket is cut at the front or unzipped, move to the rear of the casualty. If the jacket is cut along the back, move to the front of the casualty.

(7) Instruct the casualty to clench his fists; stand with arms held down and extended backward at about a 30° angle if the jacket was unzipped or cut in the front. If the jacket was cut along the rear, have the patient extend the arms forward at about a 30° angle.

(8) The patient positions their feet shoulder width apart.

(9) Grasp the jacket collar at the sides of the neck.

(10) Peel jacket off the shoulders in a down and away motion, smoothly pulling the jacket inside out over the casualty's fists.

(11) Place the BDO jacket in a plastic trash bag.

NOTE: The jacket may need to be cut along the sleeve if bandages are in the way and sleeves cannot be rolled over the bandaged area.

c. **Remove the BDO/JSLIST trousers by cutting.**

(1) One augmentee should stand behind the casualty and, if available, another at the front of the casualty. The casualty should have an object to help steady them in standing, such as a chair or litter stand.

NOTE: Do not cut the trouser suspenders until the end of the process so that the trousers do not fall during cutting and get in the way of the cutter.

(2) The easiest way to cut the trousers is from the front. Keep the pants zipped. Unfasten Velcro ankle fasteners and begin cutting at the ankle. Cut along the inseam, moving up toward the waist of the trousers. After cutting both trouser legs from ankle to waist, cut each suspender and allow the trousers to fall to the ground. Take the trousers and lay them on the ground, black side up, next to the patient. Later

the patient will step onto this as they remove their overboots.

(3) An alternate method is to cut the trousers from the rear. In this case, first unfasten the Velcro waist tabs. Start the cut at the ankle and move to the waist. Once the cuts on both legs are complete from ankle to waist, cut the suspenders below the suspender cross points and then above the cross points, allowing the trousers to fall to the ground. Lay the trousers on the ground, black side up, next to the patient.

NOTE: After each long cut, dip the cutting device in a bucket of 5% bleach solution or decon/scrub-cutting tool with the M295 or M291.

6. Remove the overboots.

- a. Unfasten all boot closures.
- b. Step on the heel of the boot and have the patient step out of the overboot and onto the black side of the cut trousers that are lying on the ground. Repeat this process for both boots. These overboots can be decontaminated and issued to other individuals.
- c. If the overboot will not come off, cut the boot from top to bottom along the centerline of the boot until the boot is loose enough to step out of.

7. Remove outer gloves. Do not remove the inner glove liners.

a. Decontaminate your own gloves with the M295, M291, or 5% bleach solution.

b. Decontaminate the casualty's gloves with the M295, M291, or 5% bleach solution.

c. Instruct the casualty to hold his arms up, if possible, and away from his upper body. If the patient cannot do this, then hold his gloves at the fingers.

d. Grasp the cuff of the glove.

e. Pull the cuff over the fingers, turning the glove inside out.

f. Dispose of the contaminated gloves by placing them in a trash bag.

g. Decontaminate your own gloves again with the M295, M291, or 5% bleach solution.

8. Remove inner gloves.

a. The patient should remove the liners to reduce the possibility of spreading contamination. The augmentee instructs the casualty to remove the white glove inner liner using the following guidance:

b. Grasp heel of glove liner without touching exposed skin.

c. Peel liner downward and off.

d. Drop it into the plastic trash bag.

e. Remove the remaining liner in the same manner.

f. Drop it into the plastic trash bag.

g. The patient then moves to the monitoring station.

NOTE: Waste material from two ambulatory patients, including the cut trousers, are placed into one 35-gallon trash bag along with the used 5% bleach and soapy water used on the two patients. Tie the bag shut and transport it to the dirty dump.

Step 2. Monitor BDU

1. Monitor with IICAM or M8 detection paper.
2. Check all areas of the casualty's clothing and combat boots. Pay particular attention to:
 - a. Combat boots
 - b. The protective mask
 - c. Hair and neck area
 - d. Discolored areas
 - e. Damp spots
 - f. Wrist closure area
 - g. Areas under tears in BDO
 - h. Areas around dressings and splints
3. If clean, send the casualty to the Hot Line.
4. If contaminated areas are found, decontaminate the areas using the M291, M295, or soap and water. If the BDOs are contaminated, they must be removed (see following). After decontamination or BDO removal, recheck the area again with the IICAM or the M8 detection paper.

Step 3. Remove the BDU

1. Remove personal effects from BDU.

- a. Have the casualty remove all items from his BDU and deposit them into a "zip-lock" bag.
- b. Check for contamination. If not contaminated, they remain with the patient. If contaminated, they are moved to a contaminated item holding area.

2. Remove inner clothing (if contaminated).

- a. Cut or unbuckle belt.
- b. Cut the BDU pants following the same procedures as for the overgarment trousers.
- c. Cut the BDU jacket following the same procedures as for the overgarment jacket.

3. Remove undergarments (if contaminated)

- a. Remove the patient's T-shirt.
 - (1) Dip cutting devices in 5% bleach solution or scrub them with the M295 or the M291 between each cut.
 - (2) Cut around bandages or splints, leaving them in place.
 - (3) Cut up the front of the patient's T-shirt from the waist up to the collar.
 - (4) Cut both sleeves from the elbow to the shoulder and then to the collar.

(5) Next, peel the T-shirt away from the body to avoid spreading contamination.

b. Remove the patient's brassiere.

(1) Cut it between the cups.

(2) Cut both shoulder straps where they attach to the cups and remove the brassiere.

c. Remove the patient's underpants/panties.

(1) Cut from the lower side of the hip to the waist on both sides.

(2) Place the undergarments into the plastic garbage bag containing the other contaminated items.

4. Check Patient for Contamination.

a. After the patient's BDU and underwear have been removed, check the skin, hair, and boots for contamination by using M8 detector paper or the IICAM.

b. Carefully survey all areas of the patient's skin, paying particular attention to areas around the neck, wrist, ears, dressings, and splints.

5. Final Decontamination. Use the M291, soap and water, or a 0.5% hypochlorite solution, followed by a water rinse, at the contamination check area for any places on the patient that still indicate contamination.

6. Remove any contaminated bandages and tourniquets (the medic does this procedure).

- a. Place new tourniquets 1/2 to 1 inch above the old tourniquets.
- b. Remove old tourniquets.
- c. Decontaminate the exposed skin area.
- d. Cut away bandages.
- e. Decontaminate the exposed skin area.
- f. Replace bandages only to control bleeding.
- g. Decontaminate exposed skin.

7. Conduct final check for completeness of decontamination with the IICAM or M8 detection paper.

8. Move to the Hot Line. The augmentee instructs the patient to move 10 to 30 meters to the shuffle pit/Hot Line.

**Step 4. The Hot-Line and Clean Side
Actions for the Ambulatory Patient**

NOTE: Straddling the Hot Line is the casualty pass-over point, which is in a shuffle pit. The shuffle pit is composed of two parts super tropical bleach (STB) and three parts earth (by volume). The ambulatory patient shuffle pit should be wide enough for the

ambulatory patient and two assistants.

1. At the shuffle pit, an augmentee from the clean side meets the patient and opens a blanket or other covering for the patient appropriate for the environmental conditions.
2. The patient shuffles through the shuffle pit wearing combat boots.
3. Once across the vapor control line, the ambulatory patient can remove their mask.
4. In the **clean treatment area**, the patient is now retriaged, treated, and evacuated.
 - a. In a hot climate, the patient will probably be significantly dehydrated. The rehydration process must begin immediately.
 - b. Overhead cover should be provided for casualties in the holding area. It is here that the mask may be removed for treatment unless circumstances dictate that the casualty remain closer to the Hot Line.
 - c. Personnel on the “clean” side, past the VCL, are in MOPP 2 or less.

Logistical Support Point

Of equal importance to the casualty decontamination effort is the logistical support of the ongoing operation. A logistics support point is established upwind within 30 to 50 meters of

the Hot Line. At this point, the soapy water and hypochlorite (bleach) solutions are prepared. All the Soldiers manning the site also stockpile 1 or 2 quart canteens for use by decontamination team members. The logistics support point should have one 400-gallon water buffalo, or initially 20 5-gallon water cans. Medical supplies, chemical casualty treatment, and decontamination medical equipment sets (MESs) can be located in this area along with additional decontamination supplies.

Dirty Side Rest/Rehydration Point

An area should be established 50 meters perpendicular to the litter casualty decontamination line and approximately 5 meters from the Hot Line for workers to use as a rest and rehydration point. Prior to using this point, workers must decontaminate the TAP aprons they are wearing using a 5% bleach solution and doff the apron near the decontamination line. Mask quick doff hoods, if worn, should also be decontaminated. Before removing the apron, gloves must be decontaminated with either M295, M291, or 5% bleach solution. The aprons should be hung up so they can air out and be worn again. Next, they must decontaminate their chemical protective boots by using an M295 or move through a shuffle pit dug for this area. After completion of this decontamination process, the

Soldiers move to the rest/rehydration point. The IICAM must be used to monitor the hood, gloves, lower sleeve area of the BDO, lower leg area of the BDO/JSLIST, and boots. If all indications are that these areas are vapor free, the Soldiers conduct an unmasking exercise and begin to rehydrate. If it is not safe to remove the mask, Soldiers can rehydrate using their mask drink tubes. The Soldiers should not group together, but should maintain three meters distance from one another. If possible, this rest point should have overhead cover for shade.

Disestablish the Patient Decontamination Station

The closure of the patient decontamination site will pose as difficult a mission as the actual decontamination effort itself, due in large part to the physical condition of the medical personnel and the non-medical augmentees. Accomplish the disestablishment of the site carefully to prevent heat casualties among the augmentees and medical personnel. Fatigue will cause site personnel to move slower and make mistakes. Regardless of the number of times command drinking was accomplished, most of the site personnel will be dehydrated. Dehydration will lower performance and stamina, while increasing the likelihood of heat injuries. Prolonged encapsulation in the MOPP gear may distort tempers, attitudes, and motivation. Any

plans made to disestablish the decon site must be simple and quick; personnel will not be able to sustain an involved and detailed process.

The three areas of concern during closure are equipment recovery, site closure, and personnel recovery. A prioritization of effort is established to optimize the recovery of essential equipment versus expendable equipment, to deny threat forces tactical intelligence, and ensure that site personnel complete required work and get out of total encapsulation as quickly and safely as possible.

Equipment Recovery/Site Closure

A list of recommended equipment needed for recovery is provided below. These items can be recovered by decontamination with a slurry mix of STB or a 5% bleach solution.

To prepare the STB slurry mix, use two parts STB mixed into three parts water (by weight). For example, 6 parts of water weighs 42 lbs (1 gallon = 7 pounds), and mixed with 28 pounds of STB, gives you the required slurry mixture. The slurry mixture or 5% bleach solution must be scrubbed onto the items requiring decontamination and allowed to remain on the surface for 30 minutes. After this contact time, the items must be flushed with clean water.

- Decontaminable litters
- Litter support stands
- 12-quart steel utility pails
- Butyl rubber aprons
- Field IV poles
- Flashlights
- Resuscitation Device Individual Chemical (RDIC)
- Chemical Agent Monitor (IICAM) (if available)

Decontamination and monitoring of the equipment can take place adjacent to the Hot Line and 50 meters to the left or right of the litter/ambulatory decontamination area. After the 30-minute contact time has elapsed and all items have been flushed with clean water, each item must be monitored with the IICAM before it is passed over the Hot Line. When monitoring with the IICAM, ensure that cracks, joints/seams, bolts, porous materials, and any openings are monitored, in addition to surface areas of the equipment items.

While waiting for the 30-minute contact time to elapse, all other items on the dirty side of the Hot Line can be placed in a plastic garbage bag and put in the dirty dump. The dump is covered with earth, marked with hazard signs, and is marked on a map with coordinates relayed to higher headquarters. Several personnel must

conduct a police call of the litter decon area, ambulatory decon area, and arrival/triage area.

Personnel Recovery

Upon completion of equipment recovery/site closure, all personnel except for two will conduct MOPP gear exchange. The site NCOIC/OIC will select a position adjacent to the Hot Line and 50 meters opposite the side used to decontaminate equipment. All personnel will perform MOPP gear exchange with the unit supplying required support. After completing MOPP gear exchange, the two remaining personnel will put all discarded MOPP gear into plastic bags and place them in the dirty dump. Additionally, they will backfill the dirty dump, ICAMouflage it as much as possible, and mark the contaminated area with the NATO NBC marking set. They will then move back to the Hot Line and perform MOPP gear exchange. The remaining two sets of discarded MOPP gear are left in place and ICAMouflaged.

NOTE: It is strongly suggested that two personnel from the clean side of the Hot Line are detailed to complete the actions outlined above as those who have been on the dirty side will be very fatigued.

INDIVIDUAL PROTECTIVE EQUIPMENT

This overview is divided into four sections:

- Individual Protection
- Individual Decontamination
- Detection and Alarms
- Patient Protective Equipment

INDIVIDUAL PROTECTION

This section includes standard "A" Individual Protective Equipment (IPE) issued to each Soldier depending on their MOS and consisting of the following:

- M40 Series Field Protective Mask
- M42A2 Combat Vehicle Protective Mask
- M45 Air Crew/Land Warrior Chem-Bio Mask System
- MCU-2A/P Protective Mask
- Battle Dress Overgarment
- Joint Service Lightweight Integrated Suit Technology
- Suit Contamination Avoidance and Liquid Protective
- Chemical Protective Gloves and Overboots

- Skin Exposure Reduction Paste Against Chemical Warfare Agents (SERPACWA)

Chemical-Biological Mask: Field M40/M42A2/M45

TM - 3-4240-346-10

TM - 3-4240-348-10

This section focus on three variations of protective masks--the M40A1, M42A2, and the M45. These masks share many of the same design characteristics, capabilities, and features. Each mask has been designed for very specific mission requirements, such as aircraft or combat vehicle operation. This section is not designed to highlight specific mask operational capabilities; it is intended to provide technical information pertaining to overall mask operations.

Protective masks provide users with respiratory, eye, and face protection against CB agents and radioactive fallout partials. If a mask is properly fitted and worn correctly, it provides a gas-tight face seal, which prevents contaminated air from reaching the wearer's respiratory, ocular, and dermal systems.

Masks described in this section have not been designed for use in TIC environments and are known to be ineffective against chemicals, such as ammonia and carbon monoxide. The

masks are also not suitable for confined spaces where oxygen is insufficient to support life.

Each mask is constructed of silicone rubber with an in-turned sealing surface so it can form a comfortable seal on the wearer's face, an external second skin for additional protection. Binocular eye lens system is used for improved vision, and clear and tinted outserts to provide eye protection against laser and low speed fragmentation. Optical inserts may be inserted if the user requires corrective lenses. An elastic head harness secures the mask to the user's face. Other common features include front and side voicemitters to allow for face-to-face and phone communications.

Each of the masks is furnished with drinking tubes to allow for hydration. A key design feature of each of the discussed protective masks is the use of a standard C2/C2A1 NATO threaded filter canister. The C2 filter canister contains Chromium VI. Damaged or unusable canisters are considered hazardous waste and are known to be carcinogenic if inhaled or swallowed. The C2A1 canister is Chromium free but must be disposed of in accordance with State and local environmental laws. Both canisters are qualified to withstand and protect against a maximum of 15 nerve, choking, and blister agent attacks. The canister is externally mounted and may be mounted on the left or

right side of the user's face, depending on the preference of the user. Additionally, a quick-doff hood is used to provide protection to the user's head and neck.

MCU-2A/P Protective Mask

Air Force Technical Order 14P4-15-1

The MCU-2A/P Series Mask is designed to protect the face, eyes, and respiratory tract of the user from tactical concentrations of chemical and biological agents, toxins, and radioactive fallout particles. The mask has a unimolded, silicone rubber face piece and a single flexible lens bonded onto the face piece. The large lens gives the user a wide field of vision. It has a single filter and two voicemitters, one on the front of the mask for speaking directly into a telephone or radio handset and one at the side to allow personnel nearby to hear. A nose cup with two inlet valves fits over the nose and mouth. It directs incoming air across the inside of the lens to reduce fogging. The mask has a drinking tube that connects to a canteen with an M1 cap. The mask is not authorized for use during TIC spills, and the mask is not effective against chemicals such as ammonia, chlorine, or even carbon monoxide fumes. The mask is not effective in confined spaces where oxygen levels are insufficient to sustain life.

Battle Dress Overgarment (BDO)

TM 10-8415-209-10

The Battle Dress Overgarment will hereafter be referred to as the BDO. The BDO chemical protective overgarment is a two-piece overgarment consisting of a coat and separate trousers.

The BDO is available in a factory sealed, vacuum packaged vapor barrier (VB) bag. The VB bag assists in protecting the BDO from environmental impacts associated with storage. Each VB bag contains a jacket and trousers. The suit is composed of an outer layer constructed of 50/50 nylon cotton tightly woven material that has been treated with water resistant sealant. The liner or inner layer is constructed of charcoal impregnated polyurethane foam nylon tricot laminate. BDOs are available in various ICAMouflage patterns with sizes ranging from extra extra small (XXXS) to double extra large (XXL). Once the BDO has been removed from the vacuum-sealed packaging, the suit offers 22 days of wear. With slight increase in risk, commanders may increase wear time to 30 days. Wear time for the BDO begins when the seal is broken on the VB bag. To properly maintain the BDO when not in use, it should be sealed in the original VB bag or other similar material bag. To seal the bag, close with duct tape, 100 mile per hour tape, or other

suitable tape. Donning the BDO, regardless of the amount of time within a 24-hour period, constitutes a day of use. The BDO is currently qualified to offer 24 hours of protection against CB agents in solid, liquid, or vapor form. The suit also protects against alpha and beta radioactive particles.

Joint Service Lightweight Integrated Suit Technology (JSLIST)

TM 10-8415-220-10

The Joint Service Lightweight Integrated Suit Technology (JSLIST) will hereafter be referred to as the Chemical Protective Overgarment CPO or JSLIST. The JSLIST CPO has been designed to replace its predecessor, the battle dress overgarment (BDO). The JSLIST CPO is a two-piece overgarment consisting of a coat with an integrated hood and separate trousers. The CPO has been designed to be lighter weight, more flexible, and have the ability to be laundered up to six times. Additionally, the system has been designed to reduce the stresses of protective gear. The JSLIST CPO is available in four-color woodland and three-color desert ICAMouflage patterns. The JSLIST suit is composed of an outer layer of 50/50 nylon/cotton poplin rip stop material with ICAMouflage pattern facing outward. The liner, or inner layer, is polyester knit coated with activated carbon spherical absorbers covered by

a nonwoven laminate that is bonded to a tricot knit back. Unlike the BDO, JSLIST suits are not packaged as sets. JSLIST suits consist of a coat and trousers. Each component is separately packaged in a factory sealed, vacuum bag containing the ensemble item and a resealable bag. JSLIST suits are available in seven sizes, ranging from short extra small (SXS) to large long (LL). The JSLIST overgarment is currently qualified to offer 24 hours of protection against CB agents in solid, liquid, or vapor form. The suit will also protect against alpha and beta radioactive particles.

Once the CPO has been removed from the vacuum-sealed packaging, the suit offers 45 days of wear and 120 days of service life. To properly maintain and store the JSLIST CPO when not in use, it should be placed in the resealable bag that is furnished with each component of the ensemble.

Both the BDO/JSLIST ensemble will be worn in all environments when under threat of an imminent nuclear, biological, or chemical attack or after chemical operations have been initiated. Once the suit has been contaminated, the Soldier must replace the suit by using the MOPP gear exchange procedure described in STP 21-1-SMCT, Soldier's Manual of Common Tasks, October 2003, Task #031-503-1023, Exchange MOPP Gear. The BDO/JSLIST adds

weight to the Soldier's workload. In addition, the BDO/JSLIST prevents heat exchange with the environment and may add, depending on the Soldier's level of exertion, 10-15°F to his ambient temperature and heat burden. When wearing the BDO/JSLIST at MOPP 1 or MOPP 2 and complete encapsulation is not required, certain modifications to the uniform are authorized:

- The trouser leg closures may be unzipped.
- The waist tabs may be loosened.
- The jacket may be unzipped.
- The sleeve Velcro closures may be opened.

This overall loosening of the BDO/JSLIST will allow heat to escape as walking and other movements induce a bellows action of the suit against underlying clothing and skin.

Suit, Contamination Avoidance and Liquid Protective (SCALP)

TM 10-8415-209-10

The SCALP is an impermeable, lightweight, inexpensive, disposable ensemble. The suit provides supplemental liquid protection. The SCALP is a four-piece ensemble that consists of a jacket, trousers, and two footwear covers. It is designed to be worn over the BDO or JSLIST with protective overboots. The footwear covers

are constructed with 12 mil embossed polyethylene soles. The SCALP ensemble provides protection from gross liquid contamination for up to one hour. Operationally the SCALP is used to protect personnel who are conducting decontamination procedures from becoming soaked during decon operations.

Chemical Protective Gloves and Overboots

- Green/Black Vinyl Overboots (GVO)/ (BVO)
- Multipurpose Overboot (MULO)
- Gloves, 0.025-inch thickness
- Gloves, 0.014-inch thickness
- Gloves, 0.007-inch thickness

Green or Black Vinyl Overboots (GVO) (BVO)

The overboots have been designed to be worn over combat boots to protect the user's feet and are available in sizes 3 to 14. The GVO/BVO is constructed of vinyl making it impervious to all known chemical, biological agents, alpha and beta radiological particles. They also protect against environmental effects, such as rain, mud, and snow. Both boots are similar except for the color and enlarged elastic pull tab fasteners on the BVO. The GVO/BVO is qualified to offer 60 days of protection. If the GVO/BVO becomes contaminated, it provides 24 hours of protection. Following contamination,

use a 5% HTH and water solution or a 5% household bleach and water solution to decontaminate the GVO/BVO. Ensure boots are serviceable and no signs of deterioration are present after the decontamination process. If boots are deemed to be unserviceable, replace them.

The Multipurpose Overboot (MULO)

The Multipurpose Rain/Snow/CB Overboot (MULO) replaces the older black vinyl overboot/green vinyl overboot (BVO/GVO). The MULO is made by injection molding an elastomer blend, compounded to provide the characteristic chemical and environmental protection required. It incorporates two quick-release side buckles and is designed to be worn over the standard issue combat boot, jungle boot, and intermediate cold/wet boot. The MULO provides 60 days of durability and 24 hours of protection against liquid chemical agents. The MULO is capable of being decontaminated to an operationally safe level using standard field decontaminates. Environmental protection is provided against water, snow and mud, in addition to petroleum, oil, and lubricant (POL) and flame resistance.

Chemical Protective Glove Set

Chemical protective glove sets are qualified to offer protection against chemical and biological agents, and alpha and beta radiological particles. The chemical protective glove set consists of an outer glove for protection and an inner glove for absorption of perspiration. The outer gloves are made from black butyl rubber and are impermeable to chemical agents. The inner gloves are made of thin, white cotton.

Glove sets are available in three thicknesses, 7-mil to 25-mil and in sizes ranging from extra small (XS) to extra large (XL).

25-mil gloves offer the most durable protection and may be utilized to perform close combat tasks or other types of heavy labor.

14-mil gloves are less durable and are used in an environment where much less physical demand is placed on the glove. Such users could include vehicle mechanics, aviators, or weapons crews.

If either glove becomes contaminated, decontaminate or replace it within 24 hours after exposure. Contaminated gloves may be decontaminated with a 5% chlorine solution or a 5% HTH and water solution.

7-mil gloves offer the most dexterity and are used by individuals who require extreme sensitivity to accomplish tasks without subjecting the glove to harsh treatment. If the 7-mil glove becomes contaminated, replace or decontaminate it after 6 hours of exposure. Contaminated gloves may be decontaminated with a 5% chlorine solution or a 5% HTH and water solution.

Skin Exposure Reduction Paste Against Chemical Warfare Agents (SERPACWA)

NSN: 6505-01-483-7162

SERPACWA is used by service members in conjunction with MOPP gear to enhance protection against chemical warfare agents. Approved by the FDA for military use only, it is a cream containing chemically inert perfluorinated polymers. It is applied to susceptible areas of the skin before donning MOPP gear. Not intended for use by itself, SERPACWA will provide additional protection at those locations where the MOPP is susceptible to leakage or separation, including, the waist, groin, armpits, wrists, ankles and neck. In conjunction with personal decontaminating materials, the use of SERPACWA will prevent or reduce the toxicity resulting from exposure to chemical warfare agents. When used as directed, SERPACWA

will provide between 5 and 8 hours of protection.

For further information on these items, see *Multiservice Tactics, Techniques, and Procedure for Nuclear, Biological, and Chemical (NBC) Protection FM 3-11.4 June 2003, Chapters VI, Appendix A.*

INDIVIDUAL DECONTAMINATION

The preceding section provided an overview of the primary items of IPE which, when used correctly, will prevent contact with agent in typical battlefield concentrations. The problem of decontamination arises when some Soldiers, because of bad training, bad discipline, or bad luck, become exposed to liquid agent despite the availability of protective masks and clothing.

This section addresses two decontamination kits currently in the inventory. The M291 Decontaminating Kit, and M295 Decontamination Kit Individual Equipment. The kits are fairly simple in design and function, and instructions for their use are straightforward and easily committed to memory. Because of the potency of liquid nerve agents and the rapidly occurring tissue damage caused by vesicants, every Soldier must be able to conduct an effective decontamination of all exposed skin

without referring to the instructions printed on the kits.

Decontaminating Kit, Skin: M291

NSN 4230-01-276-1905

TM 3-4230-229-10

The M291 Decontamination Kit consists of a wallet like carrying pouch containing six individually sealed decontamination applicator pads. Each pad is filled with FDA approved Ambergard XE-555 decontaminating resin. Each kit allows personnel to decontaminate their skin of liquid nerve and vesicant agents through physical removal, absorption, and neutralization of chemical agents. The M291 kit is nontoxic and has been designed for external use. It may be slightly irritating to the eyes or skin. Decontamination powder should be kept out of eyes, cuts, and wounds. Inhalation of the powder should be avoided as it can irritate the lungs.

Each of the individual decontamination pads is capable of providing decontamination coverage to the face and hands or an equivalent area of skin from exposure to chemical agents. Effective decontamination will result in blacking of decontaminated skin areas.

**Decontamination Kit, Individual Equipment:
M295 (DKIE)**

NSN 4230-01-357-8456

TM 3-4230-235-10

The M295 Decontamination Kit Individual Equipment consists of a pouch containing four individually sealed, wipe-down mitts. Each wipe-down mitt is comprised of a sorbent decontaminating powder containing Alumina and Silica. Each kit allows personnel to decontaminate their individual equipment through sorption of contamination by both the pad and the decontaminating powder. Decontamination is effective against liquid nerve and vesicant chemical agents. Kits are worn over protective ensembles and are capable of decontaminating approximately 1,200 square feet. M291 kits may be used to decontaminate such items as the following: CB mask and hood, gloves, footwear, weapons, helmet, and load-bearing vest (LBV).

M295 kits are issues in boxes of 20 kits. The kits should be stored at the squad level in a box capable of being decontaminated.

DETECTION AND ALARMS

This section will describe the equipment issued for detection and identification of chemical agent liquid and vapor in the

environment. For both the individual Soldier and the unit, these items of equipment (listed below) are the primary means of identifying the presence and type of chemicals on the battlefield and determining when a safe condition exists.

- Paper, CM Agent Detector: M9
- Paper, CM Agent Detector: M8
- Chemical Agent Detector Kit: M256A1
- Improved Chemical Agent Monitor (IICAM)
- Automatic Chemical Agent Alarm: M8A1
- Water Test Kit, Chemical Agents: M272
- M22 Automatic Chemical Agent Alarm (ACADA)

Paper, CM Agent Detector: M9

NSN- 6665-01-049-8982

TM- 3-6665-311-10

M9 detector paper is placed on personnel and equipment to detect and identify the presence of liquid nerve or blister agents in exposures as small as 100 microns in diameters. The paper contains an indicator chemical dye that will turn pink, red, reddish brown, or red purple when exposed to liquid agents. The paper is capable of detecting but cannot identify specific agents. M9 paper is manufactured in 30 feet x 2 inch adhesive backed rolls of dull, off-white, cream-colored paper. The rolls are packaged with a reusable, plastic storage bag in

a vacuum-sealed vapor barrier package. The detector paper dye may be a potential carcinogen; chemical protective gloves should be worn when handling M9 detector paper. Placement of M9 is dictated by the dominant hand of the user if the user is right-handed. M9 detector paper should be placed around the right upper arm, left wrist, and right ankle. If the user is left-handed, M9 detector paper should be placed around the left upper arm, right wrist, and left ankle. If a color change is indicated, proper masking, decontamination, and MOPP procedures must be followed.

NOTE: *M9 Chemical Agent Detector Paper will not detect cyanide.

Many substances are known to cause false positive responses on M9 paper. The following are common false positive indicators: antifreeze, liquid insecticide, or petroleum products. Attention to possible interfering substances on the battlefield can help in the later interpretation of a color change on the M9 paper in the absence of confirmation tests for agents. This does not relieve the service member of the obligation to mask and take other appropriate measures.

Paper, CM Agent Detector: M8

NSN -6665-00-050-8529

M8 Chemical Agent Detector Paper is used to detect the presence of liquid V type nerve, G type nerve, and H type blister agents. M8 paper is issued in booklets containing 25 tan-colored sheets of chemically treated dye impregnated paper. Each page is perforated and staple bound for easy removal. The reverse side of the front cover contains a color comparison bar chart for color comparison agent recognition.

If M8 paper is exposed to chemical agents, the dye-impregnated paper will convert from tan to an agent specific color, depending on the agent. The following agents will cause the dye to change to one of three colors.

- G: Nonpersistent Nerve: Yellow
- H: Blister: Red
- V: Persistent Nerve: Olive Green or Black

NOTE: *M8 Chemical Agent Detector Paper will not detect cyanide.

If indicated by M9 chemical agent detector paper or encountering a liquid suspected of being a chemical agent, service members must follow proper masking, decontamination, and MOPP procedures. To prepare M8 paper to conduct agent identification, tear one half sheet from the booklet and affix the sheet to a stick or

other object. Use the stick as a handle, blot the paper onto the unknown liquid, and wait 30 seconds. Once 30 seconds has elapsed, compare the tested M8 paper to the color comparison bar chart located on the inside cover of the booklet.

The following are common false positive indicators: antifreeze, liquid insecticide, or petroleum products. Attention to possible interfering substances on the battlefield can help in the later interpretation of a color change on the M8 paper.

Improved Chemical Agent Detector Kit:

M256A1

NSN - 6665-01-133-4964

TM # 3-6665-307-10

The M256A1 Chemical Agent Detection Kit is designed to detect and identify chemical agents in liquid or vapor and consists of the following:

- A booklet of M8 paper (previously described) to detect agents in liquid form, and
- 12 foil-wrapped detector tickets containing eel enzymes as reagents to detect very low concentrations of chemical vapors.

Instructions for the use of the detector tickets appear on the outside of each of the foil packets and in a separate instruction booklet in

the kit. The following chart shows the agents detected by the M256A1 Kit:

Agent Detected	Symbol	Class
Hydrogen Cyanide	AC	"Blood" (cyanide)
Cyanogen Chloride	CK	"Blood" (cyanide)
Mustard	H	Blister
Nitrogen Mustard	HN	Blister
Distilled Mustard	HD	Blister
Phosgene Oxime	CX	Blister
Lewisite	L	Blister
Nerve Agents	V and G Series	Nerve

By following the directions on the foil packets or in the instruction booklet, service members can conduct a complete test with the liquid-sensitive M8 paper and the vapor-sensitive detector ticket in approximately 20 minutes. During the test, the sampler must be kept out of direct sunlight, which speeds evaporation of the reagents. Waving the detector sampler in the air also accelerates

evaporation, so the sampler should be held stationary during all parts of the test.

**Simulator, Detector Tickets,
Chemical Agents: Training, M256A1**

NSN 6665-01-112-1644

TM 3-6665-320-10

The M256 trainer simulator was developed to provide realistic training while avoiding unnecessary exposure to potentially carcinogenic reagents in the M256A1 detector kit. The M256 trainer contains 36 pre-engineered detector tickets and an instruction booklet. The pre-engineered detector tickets show color changes comparable to those seen when the M256A1 detector kit is used in clean or contaminated environments.

Improved Chemical Agent Monitor (IICAM)

NSN 6665-01-199-4153

TM 3-6665-331-12&P

The IICAM, which is used to detect nerve and blister agents as vapors only, uses a 10-mCi nickel-63 (Ni^{63}) beta-particle radiation source to ionize airborne agent molecules that have been drawn into the unit by a pump. The resulting ion clusters vary in mass and charge and thus also travel at different rates in an applied electrical field. Comparison of the mobilities of the different ionic species to electronically stored standards

allows an on-board microcomputer to determine the type of agent and its relative concentration. A liquid crystal display (LCD) presents these data as a series of concentration-dependent bars in a G mode for G agents and VX, and in an H mode for blister agents.

The IICAM detects agent vapor in that volume of air drawn by the pump into the sampling chamber of the instrument. It follows that the inlet port must not come into contact with a suspected area of evaporating agent on a surface but must nevertheless approach within a few inches of the site of suspected contamination. Because of the variation in agent concentration from one spot to another, depending upon wind velocity and other environmental factors, numerical displays of agent concentration in typical units would be impractical and unreliable. Accordingly, the display warns of a low vapor hazard (1 to 3 bars visible), a high vapor hazard (4 to 6 bars visible), or a very high vapor hazard (7 to 8 bars visible).

M22 Automatic Chemical Agent Alarm (ACADA)

NSN 6665-01-438-6963

TM 3-6665-321-12&P

The M22 is an automatic agent alarm system capable of detecting and identifying standard blister and nerve agents. The

system is man-portable, operates independently after system start-up, and provides an audible and visual alarm. The M22 system also provides communications interface for automatic battlefield warning. The system consists of the M88 detector, as many as five M42 alarm units, a confidence sample, protective caps, square inlet, rain caps, a carrying case, and various power supplies.

The M22 ACADA samples the air for the presence of nerve agent vapors (GA, GB, GD, VX) and blister agent vapors (HD, L), and provides simultaneous detection and warning of these agents. It operates in cold and hot climates (-30°F to +125°F). The M88 detectors normally are placed facing into the wind no more than 150 meters outside of the unit perimeter, with no more than 300 meters between detectors. They are connected to the alarm units with WD-1/TT telephone wire; whenever possible, the distance between the detector units and the alarm units should not exceed 400 meters.

The following items can interfere with the normal operation of the M22 ACADA and will sound a false alarm:

- CS Tear Gas
- JP8 Fuel

- Brake Fluid
- Aqueous Fire Fighting Foam (AFFF)
- M18 Marking Grenade (Red and Violet)

Water Testing Kit, Chemical Agents: M272

NSN 6665-01-134-0885

TM 3-6665-319-10

The M272 water test kit was designed and fielded to answer the need for a test to detect water contamination by nerve agent, blister agent, cyanide ("blood" agent), or Lewisite. The kit will operate between 32°F and 125°F. An enclosed instruction card enables the Soldier to conduct all the tests required to identify the threat agents. The kit will detect the chemical agents at the concentrations indicated on the following chart.

Chemical Agent	Symbol(s)	Concentration (mg/l)-*
Cyanide	AC	20.0 as CN ⁻
Mustard	HD	2.0 --
Lewisite	L	2.0 as As+++
Nerve	G/V	0.02 --

*Concentration reliably detected by kit tests. Water containing agents in lesser concentrations is permissible for short-term use (up to 7 days) in both cold and warm regions as long as the daily consumption per person does not exceed 5 quarts. Each kit contains enough reagents for tests on 25 separate water samples. The operator can easily conduct the full range of tests in 20 minutes when the temperature is between 50°F and 105°F; at lower temperatures, the water samples and the nerve agent ticket should both be warmed for 10 minutes before beginning testing. Water that is too hot may cause foaming in the detector tubes for Lewisite, mustard, and cyanide; therefore, water at temperatures between 105°F and 125°F should be cooled for at least 5 minutes to reduce its temperature to 105° or cooler.

PATIENT PROTECTIVE EQUIPMENT

In this section, the following three items that have been fielded will be discussed:

- Patient Protective Wrap
- Decontaminable Litter
- Resuscitation Device Individual Chemical (RDIC)

Patient Protective Wrap

Wrap, Patient, Chemical Protective

(NSN 6530-01-383-6260)

Blower, Lightweight

(NSN 4240-01-442-8415)

Hose Assembly

(NSN 4240-01-442-2314)

Many protective garments have been developed for military personnel; however, protection for patients who are unable to wear standard chemical protective garments was lacking. The Chemical Warfare Patient Protective Wrap was developed to satisfy this requirement. The addition of the blower unit serves as a modification for the improvement of the performance of the Patient Wrap by increasing airflow to the patient. The Wrap resembles a lightweight sleeping bag. It is 107cm wide x 249cm long and weighs 2.7kg. It is constructed of a permeable sheet of carbon-impregnated fabric and an impermeable bottom sheet. The top sheet has an impermeable, transparent window to permit observation of the patient during transit. A port to provide a protective entryway for the insertion of IV tubing is located at each side of the window. The blower unit is a small, lightweight unit providing a continuous flow of clean, filtered air for breathing. The benefit of the addition of this item is a considerable reduction in the danger of heat stress on the casualty, and an increase in

the operational effectiveness of the wrap while in hot climates.

The system consists of the following:

- Wrap, Patient, Chemical Protective (NSN 6530-01-383-6260)
- Blower, Lightweight (NSN 4240-01-442-8415)
- Hose Assembly (NSN 4240-01-442-2314)

NOTE: Patients should not be left in the wrap longer than six hours.

Decontaminable Litter

NSN 6530-01-290-9964

Contaminated casualties arriving at a medical treatment location will in most cases require decontamination prior to definitive treatment. This decontamination process will require the use of the limited supplies of equipment organic to the treatment unit. Ideally, equipment in limited supply should be capable of complete decontamination using field-available methods. However, in tests conducted by the U.S. Army Soldier and Biological Chemical Command, canvas litters exposed to liquid blister agents and then decontaminated still desorbed vapors for 72 hours after all surface contaminants were removed.

The decontaminable litter was developed to replace the canvas litters. The new litter is made from a monofilament polypropylene that has high tensile strength and low elasticity. The fabric does not absorb liquid chemical agents and is not degraded by decontaminating solutions. The fabric is flame retardant, highly rip resistant, and treated to withstand exposure to weather and sunlight. The fabric has a honeycomb weave, which results in a rough, non-slip surface, and liquids easily pass through the 40% of surface area that is open. The carrying handles retract into the metal pole frame for a closed total length of 83.5 inches (212.1 cm) to allow for loading the litter onto the UH-60 helicopter. The handles have TWO open positions, 90.0 inches (228.1 cm) and 91.6 inches (232.7 cm). The first position is a NATO standard, and litter bearers provided the second position to allow increased gripping comfort. The aluminum poles have been designed to provide direct gripping surfaces for litter stanchions. All metal parts have been painted with Chemical Agent Resistant Coating (CARC) paint.

Resuscitation Device, Individual Chemical
NSN 6515-01-338-6602

The Resuscitation Device, Individual Chemical (RDIC) is a ventilatory system consisting of a compressible butyl rubber bag, a NATO standard C2 canister filter, a non-

rebreathing valve, a cricothyroid cannula adapter, and a flexible hose connected to an oropharyngeal mask. The mask is removable from the distal end of the flexible hose for connection of the hose to the cannula adapter. The butyl rubber bag resists the penetration of liquid chemical agent that may be on the chemical protective gloves of operator and is easily decontaminated. The elasticity of the outer cover limits airway pressure to a maximal value of 70 cm H₂O (70 mbar). The device will deliver up to 600 ml of filtered air per cycle at a rate of 30 cycles per minute.

APPENDIX A

Shown on the foldout is a summary of the chemical agents, the effects they cause, and the first-aid therapy.

APPENDIX B

Equipment List

MCU-2A/P Protective Mask

Item	Size	NSN
MCU-2A/P Protective Mask	S	4240-01-327-4148
MCU-2A/P Protective Mask	M	4240-01-327-4149
MCU-2A/P Protective Mask	L	4240-01-327-4150

M40-A1 Protective Mask

Item	Size	NSN
M40-A1, Protective Mask	S	4240-01-258-0061
M40-A1, Protective Mask	M	4240-01-258-0062
M40-A1, Protective Mask	L	4240-01-258-0063

M42-A2 Protective Mask

Item	Size	NSN
M42-A2, Protective Mask	S	4240-01-413-4100
M42-A2, Protective Mask	M	4240-01-413-4101
M42-A2, Protective Mask	L	4240-01-413-4102

M45 Protective Mask

Item	Size	NSN
M45 Protective Mask	XS	4240-01-414-4034
M45 Protective Mask	S	4240-01-414-4035
M45 Protective Mask	M	4240-01-414-4051
M45 Protective Mask	L	4240-01-414-4052

Desert JSLIST Coat

Item	Size	NSN
JSLIST COAT DESERT	XLL	8415-01-505-1616
JSLIST COAT DESERT	XLR	8415-01-509-8314
JSLIST COAT DESERT	2XLL	8415-01-505-1622
JSLIST COAT DESERT	3XLL	8415-01-506-7710
JSLIST COAT DESERT	LL	8415-01-444-6131
JSLIST COAT DESERT	LR	8415-01-444-6138
JSLIST COAT DESERT	ML	8415-01-444-6131
JSLIST COAT DESERT	MR	8415-01-444-5926
JSLIST COAT DESERT	MS	8415-01-444-5913
JSLIST COAT DESERT	SS	8415-01-444-5905
JSLIST COAT DESERT	SXS	8415-01-444-5902

Desert JSLIST Trousers

Item	Size	NSN
JSLIST TROUSERS DESERT	XLL	8415-01-505-1567
JSLIST TROUSERS DESERT	XLR	8415-01-509-8269
JSLIST TROUSERS DESERT	2XLL	8415-01-505-1591
JSLIST TROUSERS DESERT	3XLL	8415-01-506-7713
JSLIST TROUSERS DESERT	LL	8415-01-444-5900
JSLIST TROUSERS DESERT	LR	8415-01-444-5898
JSLIST TROUSERS DESERT	ML	8415-01-444-5892
JSLIST	MR	8415-01-444-5893

TROUSERS DESERT		
JSLIST TROUSERS DESERT	MS	8415-01-444-5506
JSLIST TROUSERS DESERT	SS	8415-01-444-5504
JSLIST TROUSERS DESERT	SXS	8415-01-444-5417

Woodland JSLIST Coat

Item	Size	NSN
JSLIST COAT WOODLAND	XLL	8415-01-444-1241
JSLIST COAT WOODLAND	XLR	8415-01-509-8296
JSLIST COAT WOODLAND	2XLL	8415-01-505-1591
JSLIST COAT WOODLAND	3XLL	8415-01-506-7546
JSLIST COAT WOODLAND	LL	8415-01-444-1270

JSLIST COAT WOODLAND	LR	8415-01-444-1265
JSLIST COAT WOODLAND	ML	8415-01-444-1249
JSLIST COAT WOODLAND	MR	8415-01-444-1238
JSLIST COAT WOODLAND	MS	8415-01-444-1200
JSLIST COAT WOODLAND	SS	8415-01-444-1169
JSLIST COAT WOODLAND	SXS	8415-01-444-1163

Woodland JSLIST Trousers

Item	Size	NSN
JSLIST TROUSERS WOODLAND	XLL	8415-01-505-1274
JSLIST TROUSERS WOODLAND	XLR	8415-01-509-8265
JSLIST TROUSERS WOODLAND	2XLL	8415-01-505-1591

JSLIST TROUSERS WOODLAND	3XLL	8415-01-506-7698
JSLIST TROUSERS WOODLAND	LL	8415-01-444-2338
JSLIST TROUSERS WOODLAND	LR	8415-01-444-2325
JSLIST TROUSERS WOODLAND	ML	8415-01-444-2308
JSLIST TROUSERS WOODLAND	MR	8415-01-444-2310
JSLIST TROUSERS WOODLAND	MS	8415-01-444-1613
JSLIST TROUSERS WOODLAND	SS	8415-01-444-1439
JSLIST TROUSERS WOODLAND	SXS	8415-01-444-1435

BDO (Four-Color Woodland ICAMouflage Pattern)

Item	Size	NSN
BDO	XXL	8415-01-137-1707
BDO	XL	8415-01-137-1706
BDO	LR	8415-01-137-1705
BDO	MD	8415-01-137-1704
BDO	SM	8415-01-137-1703
BDO	XS	8415-01-137-1702
BDO	XXS	8415-01-137-1701
BDO	XXXS	8415-01-137-1700

DBDO (Three-Color Desert ICAMouflage Pattern)

Item	Size	NSN
DBDO	XXL	8415-01-327-5353
DBDO	XL	8415-01-327-5352
DBDO	LR	8415-01-327-5351
DBDO	MD	8415-01-327-5350

DBDO	SM	8415-01-327-5349
DBDO	XS	8415-01-327-5348
DBDO	XXS	8415-01-327-5347
DBDO	XXXS	8415-01-327-5346

Suit Contamination Avoidance and Liquid Protective (SCALP)

Item	Size	NSN
Footwear Covers, Liquid Contamination	SM	8430-01-364-3458
Footwear Covers, Liquid Contamination	M/L	8430-01-364-3459
Footwear Covers, Liquid Contamination	XL/ XXL	8430-01-364-3460
Clothing Outfit, Liquid Contamination, Trousers, Poncho Attached Hood (Green)	SM	8415-01-364-3320
Clothing Outfit, Liquid Contamination,	M/L	8415-01-364-3321

Trousers, Poncho Attached Hood (Green)		
Clothing Outfit, Liquid Contamination, Trousers, Poncho Attached Hood (Green)	XL/XXL	8415-01-364-3322
Clothing Outfit, Liquid Contamination, Trousers, Poncho Attached Hood (Tan)	SM	8415-01-333-0987
Clothing Outfit, Liquid Contamination, Trousers, Poncho Attached Hood (Tan)	M/L	8415-01-333-0988
Clothing Outfit, Liquid Contamination, Trousers, Poncho Attached Hood (Tan)	XL/ XXL	8415-01-333-0989

Chemical Protective Glove Sets

Item	Size	NSN
25-Mil Gloves with liners Butyl	XS	8415-01-144-1862
25-Mil Gloves with liners Butyl	SM	8415-01-033-3517
25-Mil Gloves with liners Butyl	MD	8415-01-033-3518
25-Mil Gloves with liners Butyl	LG	8415-01-033-3519
25-Mil Gloves with liners Butyl	XL	8415-01-033-3520
14-Mil Gloves with liners Butyl	SM	8415-01-138-2497
14-Mil Gloves with liners Butyl	MD	8415-01-138-2498
14-Mil Gloves with liners Butyl	LG	8415-01-138-2499
14-Mil Gloves with liners Butyl	XL	8415-01-138-2500

7-Mil Gloves with liners Butyl	SM	8415-01-138-2501
7-Mil Gloves with liners Butyl	MD	8415-01-138-2502
7-Mil Gloves with liners Butyl	LG	8415-01-138-2503
7-Mil Gloves with liners Butyl	XL	8415-01-138-2504

Chemical Protective Overboots (MULO)

Item	Size	NSN
Overboot (Black) Multipurpose	3	8430-01-464-9453
Overboot (Black) Multipurpose	4	8430-01-464-9458
Overboot (Black) Multipurpose	5	8430-01-464-9459
Overboot (Black) Multipurpose	6	8430-01-464-9461

Overboot (Black) Multipurpose	7	8430-01-464-9462
Overboot (Black) Multipurpose	8	8430-01-464-9464
Overboot (Black) Multipurpose	9	8430-01-464-9474
Overboot (Black) Multipurpose	10	8430-01-464-9475
Overboot (Black) Multipurpose	11	8430-01-464-9477
Overboot (Black) Multipurpose	12	8430-01-464-9480
Overboot (Black) Multipurpose	13	8430-01-464-9479
Overboot (Black) Multipurpose	14	8430-01-464-9484

Chemical Protective Overboots (BVO)

Item	Size	NSN
Overboot (BVO)	3	8430-01-317-3374

Overboot (BVO)	4	8430-01-317-3375
Overboot (BVO)	5	8430-01-317-3376
Overboot (BVO)	6	8430-01-317-3377
Overboot (BVO)	7	8430-01-317-3378
Overboot (BVO)	8	8430-01-317-3379
Overboot (BVO)	9	8430-01-317-3380
Overboot (BVO)	10	8430-01-317-3381
Overboot (BVO)	11	8430-01-317-3382
Overboot (BVO)	12	8430-01-317-3383
Overboot (BVO)	13	8430-01-317-3384
Overboot (BVO)	14	8430-01-317-3385

Chemical Protective Overboots (GVO)

Item	Size	NSN
Overboot (GVO)	3	8430-01-084-6305
Overboot (GVO)	4	8430-01-084-6306
Overboot (GVO)	5	8430-01-049-0878
Overboot (GVO)	6	8430-01-049-0879
Overboot (GVO)	7	8430-01-049-0880
Overboot (GVO)	8	8430-01-049-0881
Overboot (GVO)	9	8430-01-049-0882
Overboot (GVO)	10	8430-01-049-0883
Overboot (GVO)	11	8430-01-049-0884
Overboot (GVO)	12	8430-01-049-0885
Overboot (GVO)	13	8430-01-049-0886
Overboot (GVO)	14	8430-01-049-0887

¹Removing BDOs, BDUs, hoods, protective boots, and combat boots by cutting will ruin one pair of bandage scissors for every two casualties.

²Replace sponge when CI solution is replaced. CI solution should be replaced after being used on two casualties.

³Replace sponge and water solution after two casualties.

APPENDIX C

PREPARATION OF PATIENT DECONTAMINATION SOLUTIONS

(0.5 & 5.0% Hypochlorite)

Preparation of the 0.5% and 5% hypochlorite solutions will require mixing the solutions in a container that can be closed after completion. By closing the container, the solution will remain at the required strength far longer than if allowed to stand in an open container. The recommended mixing container is a 5-gallon water can. The hypochlorite granules must be completely dissolved in the water. The most effective method for mixing is to agitate the granules as they are poured into the water, and then allow the solution to sit for 20 minutes to ensure the granules dissolve.

0.5% Hypochlorite Solution

Use 6-ounce bottles of calcium hypochlorite granules found in the Chemical Agent Patient Decon MES, and mix one 6-ounce bottle into 5 gallons of water.

When using a bulk package of calcium hypochlorite, retain one empty 6-ounce bottle from the Chemical Agent Patient Decon MES to measure the correct amount of dry calcium hypochlorite granules and mix as described above.

If you must use household bleach (i.e., Clorox or Purex), use the following procedure. The bleach should be packaged in 1-quart bottles or 1-gallon jugs when received from supply. Only 4.5 gallons of water will be used. Mix 2 quarts of bleach into 4.5 gallons of water, and store the solution in a closed container until ready to use.

5.0% Hypochlorite Solution

Use 6-ounce bottles of calcium hypochlorite granules found in the Chemical Agent Patient Decon MES, and mix 8 of the 6-ounce bottles of calcium hypochlorite into 5 gallons of water.

If using calcium hypochlorite from a bulk package, retain one empty 6-ounce bottle from the Chemical Agent Patient Decon MES to measure the correct amount of dry calcium hypochlorite granules.

If you must use household bleach, use the bleach straight from the bottle; do not mix in water.

APPENDIX D

**MEDICAL EQUIPMENT SET
CHEMICAL AGENT PATIENT TREATMENT
(30 patients)
6545-01-5187565, MES CHEM AG TRMT-2003**

Nomenclature/NSN		Amount	
4240014422314	HOSE ASSEMBLY, AIR B	EA	12
4240014428415	BLOWER, LIGHT WEIGHT	EA	12
4720014061637	HOSE METALLIC	EA	12
6130015009675	BATTERY CHARGER 4POSI	EA	1
6140015009672	RECHARGEABLE BATTERY	EA	24
6505009269083	ATROPINE INJ 0.7ML	EA	500
6505011253248	PRALIDOXIM CHL INJ2ML	EA	50
6505013321281	ATROPINE SULF INHAL6S	PG	1
6505014542525	ATROPINE SULFATE OPHT	TU	12
6505014578901	ANTIDOTE	EA	5

	TREATMENT		
6505015053476	DIAZEPAM INJ 2ML 10S	PG	10
6515006878052	AIRWAY PHARY 100MM10S	PG	1
6515007540412	SYRINGE HYPODERMI100S	PG	1
6515007542834	NEEDLE HYPO 18GA 100S	PG	2
6515009582232	AIRWAY PHARYN 80MM10S	PG	1
6515013386602	RESUSCITATOR HAND OPR	EA	4
6515014123099	SYRINGE HYPODERMIC20S	PG	1
6515014355350	SUCTION APPAR OROPHAR	EA	2
6515015195876	ADMINISTRATION SET60S	PG	1
6530013836260	WRAP AND LITTER PAT	EA	12
6530015196886	BAG STERILIZATION 10S	PG	1
6545009143490	CHEST NO4 30X18X12 EM	EA	3
6640015007717	CARTRIDGE	EA	48

	RESPIRATOR		
6640015007721	INDICATOR AIRFLOW	EA	1
7520009357135	PEN BALL-POINT BLACK	DZ	1
8415011382503	GLOVES CHEM PROT LG	PR	4

**MEDICAL EQUIPMENT SET
CHEMICAL AGENT DECONTAMINATION
(60 patients)
6564-01-15187568, CHEM AGT PA-2003**

Nomenclature/NSN		Amount	
6515009357138	SCISSORS BANDAGE7.25"	EA	15
6515011688108	SYRINGE HYPO 10ML100S	PG	1
6515014123099	SYRINGE HYPODERMIC20S	PG	1
6530006600034	SUPPORT LITTER FOLDNG	PR	8
6530013807309	LITTER FOLDING 91.60"	EA	4
6545009143490	CHEST NO4 30X18X12 EM	EA	3

6545009143510	CHEST MED INS SUP NO6	EA	1
6665000508529	PAPER CHEM AGENT 25S	BK	6
6665012265589	PAPER CHEMICAL AGEN	RO	1
6840002550471	DISINFECTANT CALC 6OZ	BT	49
6850012761905	DECONTAMINATING KIT	BX	2
7240002461097	PAIL UTILITY PLAS3GAL	EA	10
7520009357135	PEN BALL-POINT BLACK	DZ	1
7540014608995	FORM PRINTED	BK	1
7920008841115	SPONGE CELLULOSE RECT	EA	60
8105001913902	BAG PLASTIC	RO	2
8135006181783	PLASTIC SHEET RO POLY	RO	1
8415002817813	APRON TAP SMALL	EA	2
8415002817814	APRON TAP MEDIUM	EA	4
8415002817815	APRON TAP LARGE	EA	2
8415010333517	GLOVE SET CHEM PROTEC	SE	2

8415010333518	GLOVE SET CHEM PROTEC	SE	4
8415010333519	GLOVE SET CHEM PROTEC	SE	4
8415011382494	GLOVE INSERTS CHEM SM	PR	25
8415011382495	GLOVE INSERTS MEDIUM	PR	25

APPENDIX E

Shown in the foldout is a casualty receiving area for contaminated casualties. This area must be the receiving area for any medical treatment area that receives contaminated casualties.

APPENDIX F

GLOSSARY OF MEDICAL TERMS

Acetylcholine (ACh). A chemical released by certain nerves that stimulates a muscle, gland, or another nerve. This is one of a number of neurotransmitters in the body that carry “messages” from nerves to other organs.

Acetylcholinesterase). An enzyme (a protein produced in the cells) that stops the action of acetylcholine by destroying it. This action occurs as soon as acetylcholine has produced a muscle contraction or stimulated a gland or nerve. Nerve agents combine with acetylcholinesterase to prevent it from destroying acetylcholine; acetylcholine accumulates in excess and continues to stimulate the muscle, gland, or nerve.

Acid. A substance with a pH less than 7.

Aerosol. A gaseous suspension of fine solid or liquid particles.

Alkali. A substance with a pH greater than 7. A base.

Alveoli. Microscopic air sac in the lungs where oxygen and carbon dioxide diffusion (movement) takes place through the alveolar walls.

Anesthetic. Any agent that causes unconsciousness or an insensitivity to pain.

Anorexia. Loss of appetite.

Anoxemia. Inadequate oxygenation of the blood.

Anoxia. Lack of oxygen.

Antibiotic. A natural or synthetic substance that inhibits the growth of or destroys microorganisms. Used extensively in the treatment of infectious diseases in plants, animals, and humans.

Anticholinergic. An agent or chemical that blocks or impedes the action of acetylcholine, such as the antidote atropine.

Anticholinesterase. A substance that blocks the action of cholinesterase (acetylcholinesterase), such as nerve agents.

Aphonia. Inability to phonate or produce speech sounds.

Aplasia. Failure of production of cellular products from an organ or tissue, such as blood cells from the bone marrow, after a toxic dose of mustard.

Apnea. Absence or cessation of breathing

Asphyxiation. Unconsciousness or death caused by lack of oxygen.

Ataxia (ataxic). A staggering or unsteady gait; inability to walk a straight line.

Atelectasis. Collapse of the alveoli of the lungs secondary to mucous plugs, foreign bodies, and secretions. Frequently associated with pneumonia, best treated by vigorous coughing and breathing exercises, as well as Positive Pressure Breathing with PEEP.

Bradycardia. A slow heart rate (less than 60 beats per minute).

Blepharospasm. A twitching or spasmodic contraction of muscles around the eye; if severe, can lead to closure of the eyes.

Bronchi. The finer, smaller divisions of the wind pipe into the lungs.

Bronchoconstriction/Bronchospasm.

Constriction of the bronchial tubes making it difficult to move air in and out of the lungs.

Bronchopneumonia. Inflammation of the terminal bronchioles and alveoli, causing edema and consolidation of alveoli.

Capillaries. Small blood vessels.

Carfentanil. A drug used by veterinarians to anesthetize large animals.

Central airway. The main airway that transports air from the nose and mouth to the lungs.

Cilia. Hair-like cells in the respiratory and GI Tract that assist with mucous mobilization.

Ciliary. Pertaining to certain structures in the eye, such as the ciliary muscles.

Conjunctiva. The delicate membrane that lines the eyelids and covers the exposed surface of the sclera.

Conjunctival. Pertaining to conjunctiva.

Conjunctivitis. Inflammation of the conjunctiva.

Cornea, corneal. The clear, transparent, anterior portion of the eye comprising about one-sixth of its surface through which light passes to transmit images to the retina. It is continuous at

its periphery with the sclera and composed of five layers.

Cyanosis. Slightly bluish, grayish, slate-like, or dark purple discoloration of the skin due to oxygen in the blood.

Cyclitis. Inflammation of the ciliary body of the eye.

Dermis. The deeper layer of the skin under the epidermis. It contains the hair follicles, sweat glands, and sebaceous glands.

Dermatitis. An inflammation or infection of the skin.

Dyspnea. Labored breathing resulting from an increased need for oxygen or inadequate air exchange in the lungs.

Edema. Swelling of the tissues because of fluid.

Emphysema. Process of trapping air in the alveoli, associated with loss of elasticity of the lung tissues and resulting in inability to completely exhale.

Epidermis. The outer layer of the skin.

Epithelium. The inner layer of tissue in hollow organs.

Erythema. Red area of skin caused by heat or cold injury, trauma, or inflammation. May be localized or generalized.

Fasciculation. Localized contraction of muscle fibers, usually visible through the skin.

Fentanyl. An anesthetic commonly used in a liquid form for injection under controlled conditions in an operating room.

Fibrosis. Scar tissue; replacement by fibrous tissue.

Flaccid paralysis. Loss of muscle tone and capability to function; limp. Nerve agents cause this condition.

GI. Gastrointestinal; gut.

Granulocytopenia. Decrease in white cells of the granulocyte series in the bloodstream.

Halothane. A gaseous anesthetic used for surgery. that could be used to help aerosolize Fentanil.

Hematopoietic. Pertaining to production and development of blood cells.

Hemoconcentration. A relative increase in the number of red blood cells, usually resulting from a decrease in the volume of plasma.

Hyperemia. Redness of the skin.

Hypertension. High blood pressure.

Hypotension. Low blood pressure; if blood pressure is too low, shock and death may occur.

Hypovolemic shock. Insufficient blood volume to maintain adequate tissue oxygenation and aerobic metabolism.

Hypoxemia (hypoxia). Insufficient oxygen in the circulatory system to adequately supply tissue cells. May be caused by lack of oxygen, inadequate hemoglobin to carry oxygen, or interference with transfer of oxygen to the cells.

Intubation. The process of enhancing respiration by providing an artificial airway.

Iritis. Inflammation of the iris with accompanying pain, photophobia, lacrimation,

and diminution with transfer of oxygen to the cells.

Laryngospasm. Spasmodic closure of the larynx (voice box at the top of the trachea/wind pipe).

Larynx. Voice box and vocal cords.

Leukocytosis. Above normal increase of white blood cells.

Leukopenia. Less than normal number of white blood cells.

Lymphadenitis. Inflammation of lymph nodes, usually caused by a focus of infection distal to the node.

Malaise. A feeling of illness or depression.

Miosis. Small, "pinpoint" pupils.

Mydriasis. Large or dilated pupils.

Naloxone/naltrexone. An opioid antagonist that rapidly reverses the effects of opioids. Given routinely in emergency rooms for heroin overdose.

Nasopharynx. The area of the nose and upper airway.

Necrosis. Death of tissue.

Necrotic. Pertaining to necrosis, end result of necrosis, dead.

Opioid. A class of narcotic compounds that affect the brain and cause sedation and reduce pain sensation; includes morphine, and Fentanil derivatives.

Oropharynx. The mouth and upper airway.

Physostigmine. A carbamate that reverses the

effects of anticholinergic glycolate compounds like BZ and atropine.

Pruritis. Itching.

Pulmonary edema. Fluid in the lungs; associated with an outpouring of fluids from the capillaries into the pulmonary spaces (air sacs or alveoli) producing severe shortness of breath. In later stages, produces expectoration of frothy, pink, serous fluid and cyanosis.

Resin. A semi-solid substance, sometimes sticky, that is produced by plants.

Rhinitis. Inflammation of nasal mucosa.

Rhinorrhea. Thin watery discharge from the nose; runny nose.

Tachycardia. A rapid heart rate (over 100 beats per minute).

Thrombocytopenia. An absolute decrease in the circulating platelets in the blood.

Trachea. Wind pipe.

Urticant. Something that causes itching or stinging and a raised area on the skin (wheal).

Vacuolation. Formation of a space.

Vapor. Fumes given off by a liquid.

Vascularization. Development of new blood vessels in a structure.

Vasoconstriction. Diminution of interior size of a blood vessel with resultant decrease in blood flow.

Vertigo. Dizziness where space seems to move around.

Vesicant. Something that causes a vesicle (blister). Many things will do this, such as

poison ivy and certain animal stings. Some chemical agents (mustard and Lewisite) are vesicants.

Vesication. Blistering.

Zoonosis. A disease of animals that may be transmitted to man under natural conditions.

Zoonotic. Transmissible from animals to man under natural conditions; pertaining to or constituting a zoonosis.

APPENDIX G

Glossary of Military Terms

- ACAA.** Automatic Chemical Agent Alarm
- ACADA.** Automatic Chemical Agent Detector Alarm
- AMEDD.** Army Medical Department
- BDO.** Battle Dress Overgarment
- BDU** Battle Dress Uniform
- BIDS.** Biological Integrated Detection System
- BW.** Biological warfare.
- BZ.** An anticholinergic incapacitating agent 3-quinuclidinyl benzilate.
- C2A1 filter canister.** The standard filter used on the military mask.
- ICAM.** Chemical Agent Monitor
- CANA.** Convulsive Antidote, Nerve Agent
- CARC.** Chemical Agent Resistant Coating
- C/B.** Chemical/Biological
- CBPS.** Chemically Biologically Protected Shelter
- CDC.** Chemical Decontamination Center
- CG.** Phosgene
- CN.** Riot control agent 1-chloroacetophenone
- CPS.** Collective Protection Shelter
- CS.** Riot control agent o-chlorobenzylidene malononitrile
- CR.** Riot control agent dibenz (b,f)-1:4-oxazepine
- DBDO.** Desert Battle Dress Overgarment

DKIE. Decontamination Kit, Individual Equipment

DM. Riot control agent diphenylaminearsine, a vomiting agent.

DTD. Detailed Troop Decontamination

ECP. Entry Control Point

FMC. Field Medical Card

GA. Tabun

GB. Sarin

GD. Soman

GREGG. Graves Registration

HC smoke. Military tactical smoke

HD. Mustard

HTH. High Test Hypochlorite

HSS. Health Service Support

KPH. Kilometers Per Hour

LBE. Load Bearing Equipment

LCL. Liquid Control Line

MES. Medical Equipment Set

MOPP. Mission Oriented Protective Posture

MTF. Medical Treatment Facility

MTO&E. Modified Table of Organization and Equipment

NAAK. Nerve Agent Antidote Kit

NATO. North Atlantic Treaty Organization

NCO. Noncommissioned Officer

NCOIC. Noncommissioned Officer-in-Charge

NOx. Toxic smoke, which can cause pulmonary edema; produces by exploding munitions, industrial smoke, and in grain silos as a product of grain fermentation.

OC. Oleoresin of capsicum.

OIC. Officer-in-Charge

PFIB. Perfluoroisotutylene; toxic smoke produced by Teflon® burning at more than 700°F

SDK. Skin Decontamination Kit

SERPACWA. Skin Exposure Reduction Paste Against Chemical Warfare Agents

TAP. Toxicological Agent Protective (e.g., TAP Apron)

TC. Training Circular

TIC. Toxic Industrial Chemical

VCL. Vapor Control Line

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NERVE AGENTS

GA, GB, GD, GF, VX

SUMMARY

Signs and Symptoms:

Vapor

Small exposure—small pupils, runny nose, mild difficulty breathing.

Large exposure—sudden loss of consciousness, convulsions, no breathing, flaccid paralysis, copious secretions from nose, mouth and lungs, small pupils.

Liquid on skin:

Small to moderate amount—localized sweating, nausea, vomiting, feeling of weakness.

Large amount—sudden loss of consciousness, convulsions, no breathing, flaccid paralysis, copious secretions from nose, mouth, and lungs.

Detection: M256A1; Improved Chemical Agent Monitor (ICAM); M8 paper; M9 paper; M22 (ACADA).

Decontamination: M291; large amounts of water and soap; RSDL, 0.5% hypochlorite bleach, M295. [Note: Never use full-strength or 5% bleach on skin!]

Immediate management: administration of MARK I kits or ATNAA; diazepam (Convulsive Antidote Nerve Agent-CANA). In addition, if casualty's symptoms are severe, ventilation and suction of airways for respiratory distress.

MUSTARD

H, HD, L, HL

SUMMARY

Signs and Symptoms: asymptomatic latent period (hours). Erythema and blisters on the **skin**; irritation, conjunctivitis and corneal opacity and damage in the **eyes**; mild upper **respiratory** signs to marked **airway** damage; also gastrointestinal effects and bone marrow stem cell suppression. Fever is not typically associated with the agents.

Detection: M256A1; ICAM; M8 paper; M9 paper.

Decontamination: M291; water/soap in large amounts. M295 for equipment.

Management: Decontamination immediately after exposure is the only way to prevent damage. Symptomatic management of lesions.

LEWISITE

L

SUMMARY

Signs and Symptoms: Lewisite causes immediate pain or irritation of skin and mucous membranes. Erythema and blisters on the skin and eye and airway damage similar to those seen after mustard exposures develop later.

Detection: M256A1, M272 water testing kit, and ICAM.

Decontamination: M291, 0.5% hypochlorite, water in large amounts.

Management: immediate decontamination; symptomatic management of lesions the same as for mustard lesions; a specific antidote (BAL) will decrease systemic effects.

CYANIDE

AC, CK

SUMMARY

Signs and Symptoms: few. After exposure to high Ct, seizures, respiratory and cardiac arrest.

Detection: M256A1 Detector Kit.

Decontamination: Skin decontamination is usually not necessary because the agents evaporate rapidly. Wet, contaminated clothing should be removed and the underlying skin decontaminated with water or other standard decontaminants.

Management: **Antidote:** intravenous **Sodium Nitrite** and **Sodium Thiosulfate**. **Supportive:** oxygen; correct acidosis.

LUNG-DAMAGING AGENTS AND TOXIC INDUSTRIAL CHEMICALS

Ammonia, CG, Cl, HC Smoke, NOx

SUMMARY

Signs and Symptoms: sudden laryngospasm and collapse. **Central airway:** breathing difficulty, wheezing; sneezing, coughing, hoarseness when talking. **Peripheral airway:** breathing difficulty, chest tightness.

Detection: Odor of newly mown hay or freshly cut grass or green corn. There are no specific military field detection devices for these compounds; however, the ACADA can detect battlefield agent vapors when deployed as an area surveillance tool.

Decontamination: Vapor - fresh air; liquid - copious water irrigation.

Management: termination of exposure, ABCs of resuscitation, enforced rest and observation, oxygen with or without positive airway pressure for signs of respiratory distress, other supportive therapy as needed.

RIOT CONTROL AGENTS

CN, CS, CR, OC, and DM

SUMMARY

Signs and Symptoms: CN, CS, CR, and OC: tingling and pain on exposed skin and mucous membranes, burning in the nostrils and tearing of the eyes. With severe exposure: laryngospasm. **CN, CS, CR:** with severe exposure: respiratory discomfort and skin burning, blistering. **DM:** delayed skin irritation, vomiting, and malaise.

Detection: no detector.

Decontamination: CN, CS, CR, and DM: eyes: thoroughly flush with water, saline, or similar substance. Skin: flush with copious amounts of water, soap is beneficial. Generally, decontamination is not needed if the wind is brisk. **OC:** Pain may increase if water used for decontamination of OC. This is best decontaminated using baby shampoo, milk, or vegetable oil.

Management: Usually none is needed; effects are self-limiting.

TOXINS

Botulinum Toxin, Ricin, SEB, etc.

SUMMARY

Signs and Symptoms: These depend upon the specific toxins. Botulinum toxins cause descending weakness and paralysis (including respiratory-muscle paralysis) along with dry mouth and dilated pupils. Ricin and SEB cause different presentations depending upon the route of exposure.

Detection: **No field detectors** commonly available. Detection of exposure is mainly by a high index of suspicion and by clinical recognition of signs and symptoms.

Decontamination: Clothing removal and skin cleansing using water (with or without soap) is generally sufficient.

Management: For almost all toxins, treatment is supportive only. This includes the potential necessity of ventilatory support for weeks following exposure to botulinum toxins, although a botulinum toxoid is effective if given before signs and symptoms appear. Active immunization with botulinum toxoid is available only as a pre-exposure measure for those at demonstrated high risk.

PHOSGENE OXIME CX

SUMMARY

Signs and Symptoms: immediate burning and irritation followed by wheal-like skin lesions and eye and airway damage.

Detection: M256A1, M18A2, M90, M93 Fox, and the ICAM M256A1.

Decontamination: water in large amounts, 0.5% hypochlorite, M291.

Management: immediate decontamination, symptomatic management of lesions.

Introduction

Nerve Agents

Vesicants

Cyanide

Lung-Damaging Agents and TICs

Riot Control Agents

Incapacitating Agents

Biological Agents

Toxins

Field Management of Casualties

Patient Decontamination

Chemical Defense Equipment

Appendices